thermoscientific

Thermo

FAIMS Pro and FAIMS Pro Duo

User Guide

For the high-field asymmetric waveform ion mobility spectrometry (FAIMS) interfaces

Thermo Fisher
SCIENTIFIC

Release history: Revision A, September 2021

Software versions: (Thermo) Foundation 3.4 and later, Xcalibur 4.4 and later, and TSQ Tune 3.4, Orbitrap Exploris Tune 3.1, and Orbitrap Tribrid Tune 3.5

General Laboratory Equipment. Not intended for use in diagnostic procedures.

thermoscientific

Regulatory Compliance

Thermo Fisher Scientific performs complete testing and evaluation of its products to ensure full compliance with applicable North American and European regulations. Your system meets the applicable requirements in the electromagnetic compatibility (EMC) and product safety standards described in this section.

Unauthorized changes that you make to your system will void regulatory compliance and may defeat the built-in protections for your instrument. Some examples of unauthorized changes include using replacement parts or adding components, options, or peripherals that Thermo Fisher Scientific has not qualified and authorized. Unauthorized changes can also result in bodily injury and/or damage to your system and laboratory.

Ensure continued compliance with regulatory standards:
*   Follow all installation instructions provided in the documentation that comes with your system.
*   Order replacement parts (as specified in the instrument manual) and additional components, options, and peripherals directly from Thermo Fisher Scientific or an authorized representative.

Low Voltage Directive 2014/35/EU	
This device complies with Low Voltage Directive 2014/35/EU and the following safety standards:	
EN 61010 1:2010+A1:2019	EN 61010 2 010:2020
UL 61010-1:2012 Ed. 3+R:19Jul2019	UL 61010-2-010:2019 Ed.4
CAN/CSA 61010-1-12 Ed.3+U1;U2;A1	CAN/CSA C22.2 No. 61010-2-010:2019 Ed.4

EMC Directive 2014/30/EU		
This device was tested by TÜV Rheinland of North America and complies with the following EMC standards:		
47 CFR 15, Subpart B, Class A: 2015	EN 55011:2009 + A1	EN 61000-4-4: 2012
CISPR11: 2009 + A1	IEC/EN 61326-1: 2013	EN 61000-4-5: 2014
ICES-003 Issue 6: 2016	IEC 61000-3-2: 2014	EN 61000-4-6: 2014
AS/NZS CISPR22: 2009	IEC/EN 61000-3-3: 2013	IEC/EN 61000-4-11: 2004 / ISH1:2010
AS/NZS CISPR32: 2015	IEC/EN 61000-4-2	
VCCI CISPR 32: 2015	IEC 61000-4-3: 2006 + A2	

FCC Compliance Statement

thermoscientific

Notice on Lifting and Handling of Thermo Scientific Instruments

For your safety, and in compliance with international regulations, the physical handling of this Thermo Fisher Scientific instrument *requires a team effort* to lift and/or move the instrument. This instrument is too heavy and/or bulky for one person alone to handle safely.

Notice on the Proper Use of Thermo Scientific Instruments

In compliance with international regulations: This instrument must be used in the manner specified by Thermo Fisher Scientific to ensure protections provided by the instrument are not impaired. Deviations from specified instructions on the proper use of the instrument include changes to the system and part replacement. Accordingly, order replacement parts from Thermo Fisher Scientific or one of its authorized representatives.

thermoscientific

thermoscientific

WEEE Directive
2012/19/EU

Thermo Fisher Scientific is registered with B2B Compliance (B2Bcompliance.org.uk) in the UK and with the European Recycling Platform (ERP-recycling.org) in all other countries of the European Union and in Norway.

If this product is located in Europe and you want to participate in the Thermo Fisher Scientific Business-to-Business (B2B) Recycling Program, send an email request to weee.recycle@thermofisher.com with the following information:

- WEEE product class

- Name of the manufacturer or distributor (where you purchased the product)

- Number of product pieces, and the estimated total weight and volume

- Pick-up address and contact person (include contact information)

- Appropriate pick-up time

- Declaration of decontamination, stating that all hazardous fluids or material have been removed from the product

For additional information about the Restriction on Hazardous Substances (RoHS) Directive for the European Union, search for RoHS on the Thermo Fisher Scientific European language websites.

> **IMPORTANT** This recycling program is **not** for biological hazard products or for products that have been medically contaminated. You must treat these types of products as biohazard waste and dispose of them in accordance with your local regulations.

Contents

Preface

This user guide describes how the Thermo Scientific FAIMS Pro and FAIMS Pro Duo interfaces work and how to do the following:

- Connect the FAIMS interface to a Thermo Scientific mass spectrometer (MS)

- Operate the FAIMS interface from the mass spectrometer's Tune window or Method Editor (to add the parameter settings for the FAIMS interface to an instrument method)

- Maintain the FAIMS interface for optimal performance

- Upgrade the low-flow FAIMS Pro interface to handle high-flow applications.

See the following topics:

- Accessing documentation

- Special notices, symbols, and cautions

- Safety precautions

- Contacting us

Accessing documentation

The FAIMS interface includes complete documentation.

- Viewing the product manuals

- Accessing the Help system

- Downloading online documentation

For the mass spectrometer (MS) requirements, refer to the release notes on the instrument control software DVD and "Supported FAIMS platforms" on page 17.

Viewing the product manuals

The Thermo Fisher Scientific™ service engineer installs the instrument control applications and the instrument manuals on the data system computer.

From the Microsoft™ Windows™10 taskbar, click the **Start** icon, ▦. Then, choose **Thermo Instruments >***Model x.x* and open the applicable PDF file.

From the Tune window, click the **Set Options or View Help** icon, ⚙▾, and choose Instrument Manuals from the dropdown menu.

Accessing the Help system

To access the Help from the Thermo Scientific™ Tune instrument-control software, click the **Set Options or View Help** icon, ⚙▾, and choose **Tune Help** from the dropdown menu.

To access the Help menu from the Method Editor for your MS, choose an option from the **Help** menu (or press the F1 key). You can access the Method Editor for your MS from these Thermo Scientific applications:

- Instrument Setup window of the Xcalibur™ data system

- Instrument Setup window of the TraceFinder™ application

- Chromeleon chromatography data system (CDS)

To access the Help for dialog boxes, pages, or panes in the Tune window, place the mouse cursor in the dialog box, page, or pane. Then, press the **F1** key (or the key reserved on your computer keyboard for Help).

Downloading online documentation

❖ **To download documentation as PDF files from the Thermo Fisher Scientific website**

1. Go to thermofisher.com.

2. Point to **Support**. Then, click **Manuals** under Product Documentation on the left.

3. In the Search box, type the product name. Then, click the search icon.

4. From the results list, click the title to open the document in your web browser.

5. Use the toolbar icons to save or print the document.

6. To return to the document list, click the browser **Back** button.

Special notices, symbols, and cautions

Make sure you understand the special notices, symbols, and caution labels in this guide. Most of the special notices and cautions appear in boxes; those pertaining to safety also have corresponding symbols. Some symbols are also marked on the instrument itself and can appear in color or in black and white. For complete definitions, see Table 1.

Table 1. Notices, symbols, labels, and their meanings (Sheet 1 of 2)

Notice, symbol, or label	Meaning
IMPORTANT	Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or might contain information that is critical for optimal performance of the product.
Note	Highlights information of general interest.
Tip	Highlights helpful information that can make a task easier.
	Caution: Read the cautionary information associated with this task.
	Chemical hazard: Observe safe laboratory practices and procedures when handling chemicals. Only work with volatile chemicals under a fume or exhaust hood. Wear gloves and other protective equipment, as appropriate, when handling toxic, carcinogenic, mutagenic, corrosive, or irritant chemicals. Use approved containers and proper procedures to dispose of waste oil and when handling wetted parts of the instrument.
	Hot surface: Allow any heated components to cool before touching them.
	Risk of electric shock: This instrument uses voltages that can cause electric shock and personal injury. Before servicing the instrument, shut it down and disconnect it from line power. While operating the instrument, keep covers on.
	Risk of eye injury: Eye injury can occur from splattered chemicals, airborne particles, or sharp objects. Wear safety glasses when handling chemicals or servicing the instrument.

Table 1. Notices, symbols, labels, and their meanings (Sheet 2 of 2)

Notice, symbol, or label	Meaning
	Sharp object: Avoid handling the tip of the syringe needle or the APCI corona discharge needle.
	Trip obstacle: Be aware of cords, hoses, or other objects located on the floor.

Safety precautions

Read and understand the following cautions that are specific to the shutdown of the MS system or to the removal of parts for cleaning.

CAUTION If you must turn off the MS in an emergency, turn off the main power switch located on the right-side power panel. This switch turns off all power to the MS, including the forepump, without harming components within the system. However, do not use this method as part of the standard shutdown procedure. Instead, see "Shut down the LC/MS/FAIMS system for storage" on page 161. To turn off the LC, the autosampler, and the data system computer in an emergency, use their respective on/off switch or button.

CAUTION To avoid an electrical shock, be sure to follow the instructions in "Shut down the LC/MS/FAIMS system for storage" on page 161.

CAUTION Do not turn the MS on if you suspect that it has incurred any kind of electrical damage. Instead, disconnect the power cord and contact Thermo Fisher Scientific technical support for a product evaluation. Do not attempt to use the MS until it has been evaluated. (Electrical damage might have occurred if the system shows visible signs of damage, or has been transported under severe stress.)

CAUTION The FAIMS interface must be connected to a certified Thermo Scientific MS, which supplies high voltage capable of delivering a maximum of 8 kV and 100 μA. If you connect the interface to another type of MS, you might impair the protection provided by the equipment.

CAUTION Do not place any objects (for example, containers with liquids) on top of the MS, unless instructed to in the documentation. Leaking liquids might contact the electronic components and cause an electrical short circuit.

CAUTION Do not perform any servicing other than that contained in this manual. To avoid personal injury or damage to the FAIMS interface, do not perform any servicing other than that contained in this manual or related manuals unless you are qualified to do so.

CAUTION Do not disconnect the power cords at the MS or MCB while the other ends are still plugged into the electrical outlet.

Risk of electric shock: The FAIMS Pro Interface system must be properly earthed through a supply outlet that has an earthing connection. If you are not sure, check with a qualified electrician.

CAUTION Allow heated components to cool to room temperature (approximately 20 minutes) before servicing them.

Contacting us

Contact	Email	Telephone	QR Code
U.S. Technical Support	us.techsupport.analyze@thermofisher.com	(U.S.) 1 (800) 532-4752	
U.S. Customer Service and Sales	us.customer-support.analyze@thermofisher.com	(U.S.) 1 (800) 532-4752	
Global Support	❖ **To find global contact information or customize your request** 1. Go to thermofisher.com. 2. Sign in to your account. 3. Choose **Support** from the menu bar at the top. Then, choose **Contact Us** from the Product Support menu. 4. In the Support—How Can We Help? list, select an option and follow the instructions that appear for this option. ❖ **To find product support, knowledge bases, and resources** Go to thermofisher.com/us/en/home/technical-resources. ❖ **To find product information** Go to thermofisher.com/us/en/home/brands/thermo-scientific.	

Introduction to the FAIMS interfaces

This chapter describes the FAIMS technology, the benefits of using the Thermo Scientific™ FAIMS Pro and FAIMS Pro Duo interfaces, and the platforms that support these interfaces.

Note The FAIMS Pro interface is compatible only with low flow rates from 100 to 1000 nL/min. The FAIMS Pro Duo interface with its upgraded solvent drainage system is compatible with a range of flow rates from 100 nL/min to 1 mL/min.

Tip If you currently own a FAIMS Pro interface and you want to use it with high-flow applications, you must upgrade its drainage system.

- For an LC/FAIMS/MS system with a TSQ Series II mass spectrometer, order the FAIMS Pro to High-Flow Kit.

- For an LC/FAIMS/MS system with a legacy FAIMS Pro/Orbitrap Fusion MS, Orbitrap Fusion Lumos MS, or Orbitrap Eclipse system, order the OptaMax NG ion source and the FAIMS Pro to High-Flow Kit.

See Appendix A, "Upgrade a FAIMS Pro interface for high-flow applications."

See the following topics:

- The FAIMS technology and the FAIMS interface

- Supported FAIMS platforms

The FAIMS technology and the FAIMS interface

FAIMS is an acronym for high-field asymmetric waveform ion mobility spectrometry. Using the FAIMS technology with Thermo Scientific™ mass spectrometers can provide the additional selectivity required in challenging LC/MS experiments.

The FAIMS interface that resides between the ion source and the inlet to the mass spectrometer uses the FAIMS technology to separate ions on the basis of their relative mobilities at low and high electric fields between two electrodes. The relative mobility of ions in an electric field is related to their mass, charge, and shape. Because the shape of an ion affects its mobility, the FAIMS technology can separate isobaric ions.

Using electric fields, the FAIMS interface lets only selected ions pass from the ion source to the mass spectrometer. This selectivity leads to improved detection limits (signal-to-noise ratio) for your analytes. It can also result in increased throughput if the increased selectivity lets you shorten the chromatographic run time for your separation method.

The cylindrical electrode setup, which is unique to the FAIMS Pro and FAIMS Pro Duo interfaces, reduces diffusion and focuses ions through the electrode assembly, resulting in better ion transmission into the MS compared to parallel planar electrodes. As the nitrogen carrier gas and the ions with stable trajectories move from the front to the back of the electrode assembly, the inner electrode blocks the line of sight between the entrance and exit orifices of the electrode set, eliminating neutral species. The mass spectrometer's vacuum system draws the carrier gas and the ions with stable trajectories into the ion transfer tube of the API source interface.

Figure 1. Simplified representation of the carrier gas flow path and the ion path
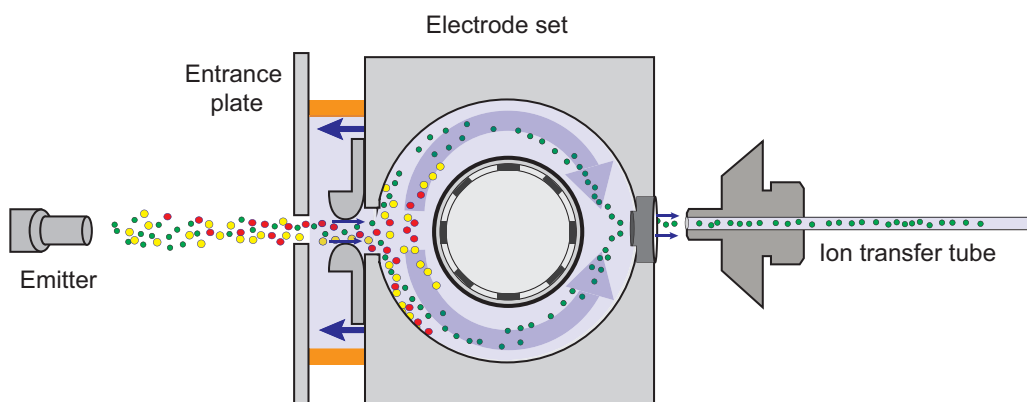
Supported FAIMS platforms

You can use the FAIMS interface with the Thermo Scientific™ mass spectrometers listed in Table 2 and ion sources listed in Table 3.

Table 2. Mass spectrometers that are compatible with the FAIMS interface

TSQ Series II	Orbitrap Exploris (hybrid)	Orbitrap Tribrid
TSQ Altis™	Orbitrap Exploris™ 120	Orbitrap Eclipse™ Tribrid
TSQ Quantis™	Orbitrap Exploris 240	Orbitrap ID-X™ Tribrid
TSQ Altis Plus	Orbitrap Exploris 480	Orbitrap IQ-X™ Tribrid
TSQ Quantis Plus		Orbitrap Fusion™ Tribrid
TSQ Endura		Orbitrap Fusion Lumos™ Tribrid
TSQ Quantiva		

Table 3. Compatible ion sources

Ion sources for nanoflow LC/MS methods
NanoSpray Flex™ series (See "Install the Nanospray Flex NG ion source on the FAIMS interface" on page 59.)
Easy-Spray™ series (See "Install the EASY-Spray NG ion source on the FAIMS interface" on page 58.)

Ion sources for high-flow LC/MS methods (LC flow rate up to 1 mL/minute)
OptaMax™ NG ion source (See "Install the OptaMax NG or the OptaMax Duet NG ion source on the FAIMS interface" on page 61.)
OptaMax™ Duet NG ion source The OptaMax Duet ion source is a separate option that you can purchase. It does not currently ship with any Thermo Scientific mass spectrometer. When used with the FAIMS interface, the OptaMax Duet ion source is compatible only with the TSQ Altis, TSQ Altis Plus, TSQ Quantis, TSQ Quantis Plus, and Orbitrap (Tribrid) Eclipse mass spectrometers. It is not compatible with any of the other mass spectrometers in the TSQ Series II product line or any of the other Orbitrap Tribrid mass spectrometers. In addition, it is not compatible with any of the Thermo Scientific Hybrid mass spectrometers.

Other ion sources
VeriSpray paper spray ion source (See "Install the VeriSpray ion source on the FAIMS interface.") Compatible only on the TSQ Endura MS, TSQ Quantiva MS, TSQ Altis, TSQ Altis Plus, TSQ Quantis, TSQ Quantis Plus mass spectrometers.

Table 4 lists the width and height of these mass spectrometers without the added accessories (without the external syringe pump and injection valve). The Orbitrap Exploris has a built-in syringe pump under its right side panel.

Table 4. Proportions of the benchtop mass spectrometers that support the FAIMS interface

MS model	Width (cm)	Height (cm)	Width (in.)	Height (in.)
TSQ Altis Plus	66	71	26.0	28.0
Orbitrap Eclipse	127	70.3	50.0	27.7
Orbitrap Exploris	53.4	70.3	21.0	27.7

The following figures (Figure 2, Figure 3, and Figure 4) show the FAIMS interface installed on a TSQ Altis Plus MS, an Orbitrap Tribrid MS, and an Orbitrap Exploris MS.

Figure 2. TSQ Altis Plus MS with the FAIMS Pro Duo interface and the OptaMax NG ion source
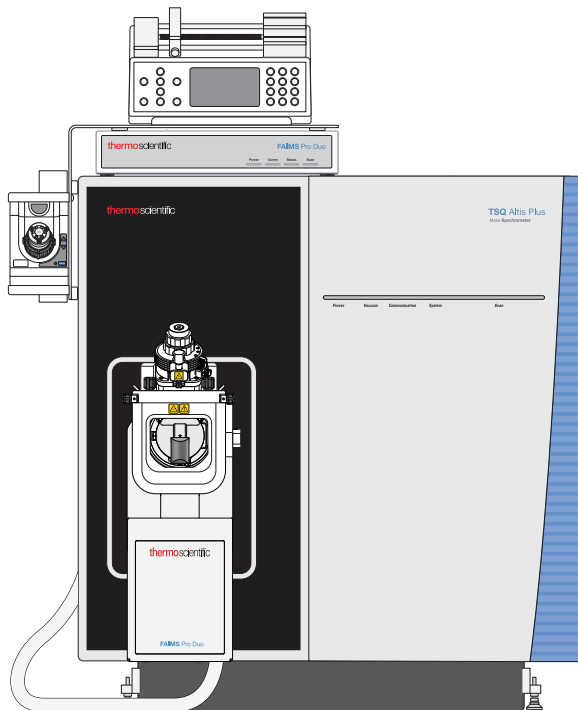
Figure 3. Orbitrap Tribrid MS with the FAIMS Pro Duo interface and the EASY-Spray ion source
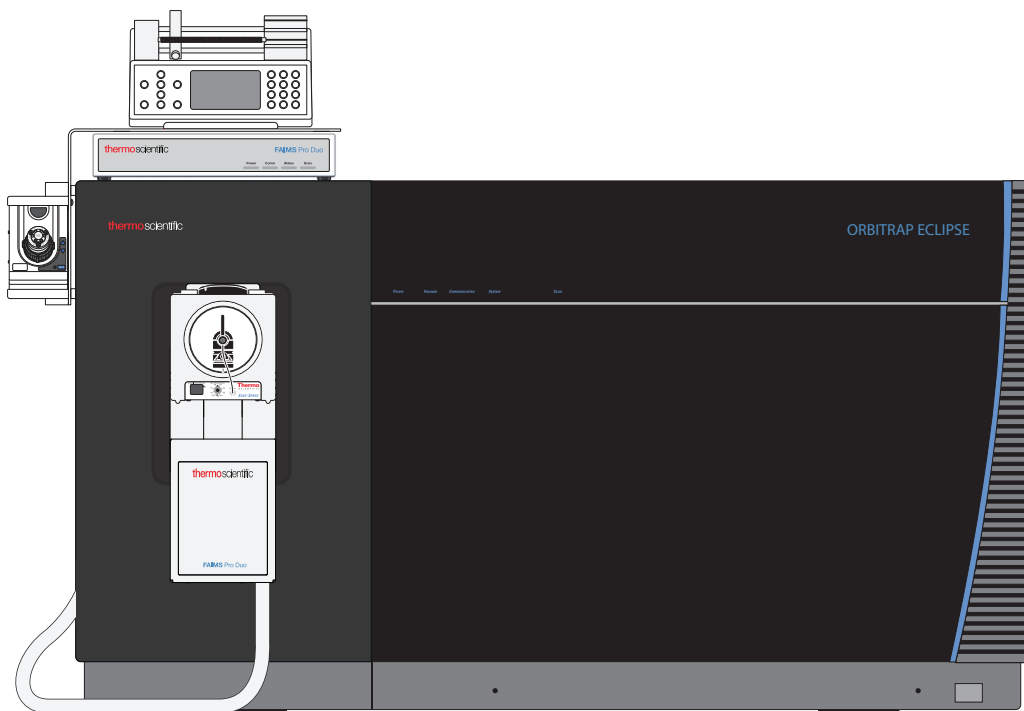
Figure 4.   Orbitrap Exploris MS with the FAIMS Pro Duo interface and the EASY-Spray ion source
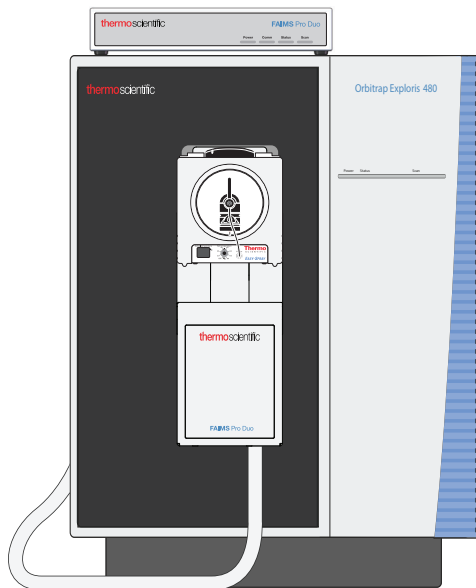
Ion selection by the FAIMS interface

The FAIMS interface uses the effect of electric field strength to select and focus ions before they enter the API source interface of the MS.

These topics describe the effect of electric field strength on the selection of specific ions and the effect of temperature on the electric field strength.

- The effect of the electric field strength
- The effect of temperature

The effect of the electric field strength

The FAIMS interface continuously selects and focuses ions at atmospheric pressure by using the changes that occur in ion behavior when ions are exposed to high electric fields.

At low field strengths, an ion's mobility is independent of the applied electric field. However, in high electric fields (for example, greater than 2.5 KV/cm) the mobility of an ion changes with electric field strength. This compound-dependent change in the mobility of ions in high electric fields relative to low electric fields provides the ion selectivity within the FAIMS interface.

The FAIMS interface applies alternating high and low electric fields to the electrode set by using a waveform generator that produces an asymmetric waveform. This asymmetric waveform applies a high electric field between the electrodes for a short period of time and then applies a lower electric field for a longer time. The amplitude of the waveform is called the dispersion voltage (DV). The dispersion voltage is not a user-defined parameter. It is preset to –5000V for positive ions and +5000V for negative ions.

The FAIMS interface introduces desolvated ions into the mass spectrometer by a flow of gas, called the carrier gas. As the mass spectrometer's vacuum system draws the carrier gas toward the mass spectrometer's entrance cone, the applied asymmetric waveform (DV) displaces the ions away from the center of the concentric gap between the inner and outer electrode walls. Because the ion mobility during the application of the dispersion voltage (DV) is different

from the ion mobility during the low-voltage portion of the waveform, ions begin to drift toward one of the two electrodes. During an ion's residence time, voltage switching repeats for tens of thousands of cycles, with each cycle causing greater dispersion. When an ion hits an electrode surface, the ion loses its charge and the interface discharges it to waste.

Figure 5. Ion displacement using a dispersion voltage (DV)
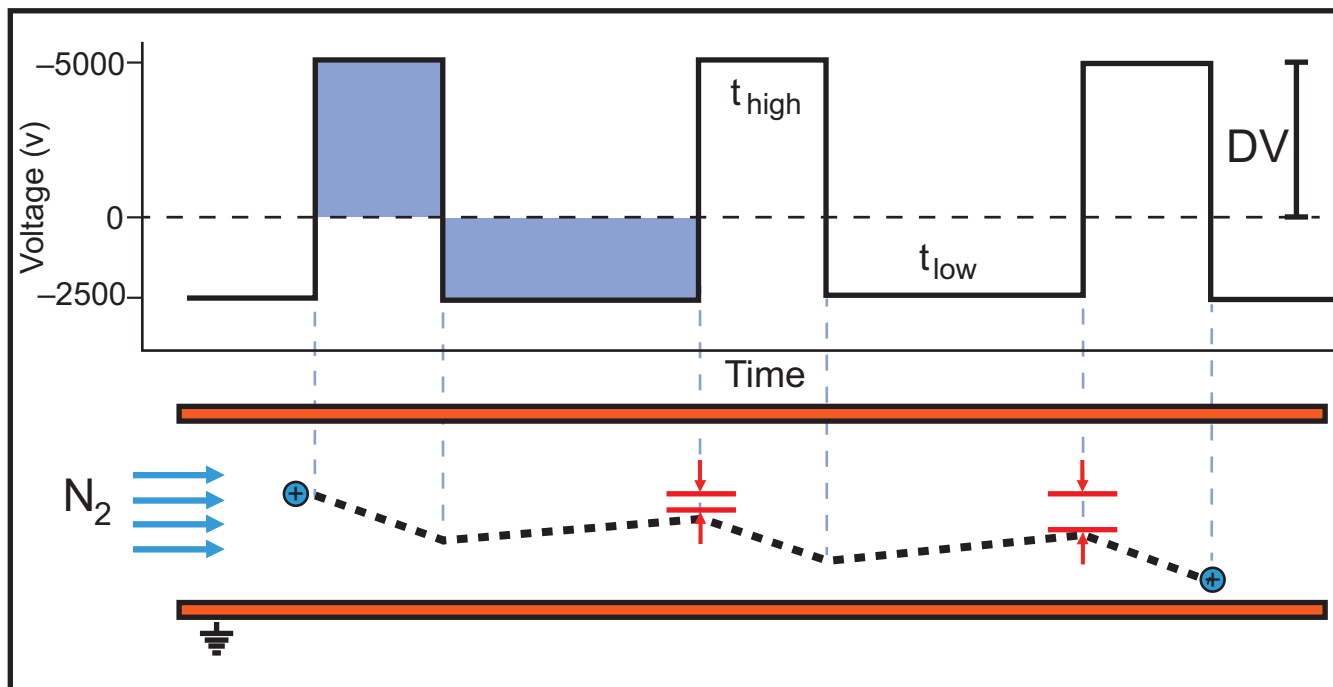
To prevent an ion from hitting an electrode surface and being discharged, the FAIMS interface applies a small DC potential— called the compensation voltage (CV)—to the inner electrode. The CV compensates for the ion drift that is the result of the applied asymmetric waveform. The CV required to compensate for drift is ion-dependent. Therefore, the CV is a selection parameter for transmitting a subset of ions to the MS.

The cylindrical geometry of the electrodes focuses the ions in flight along the radial axis between the inner and outer electrodes as the nitrogen gas carries them through the electrode assembly. As the ions with stable flight paths exit the back of the electrode assembly, the mass spectrometer's vacuum system draws them into the mass spectrometer's ion transfer tube.

Figure 6 shows the ion signal intensity versus the CV for a drug and its metabolite. The optimal CV for the drug is –7.2 V and the optimal CV for the metabolite is –18 V. At the optimal CV setting for the drug, the metabolite does not contribute any signal because the FAIMS interface neutralizes the metabolite ions and diverts them to waste before they reach the MS.

Figure 6. FAIMS-MS/MS selection of drug and metabolite
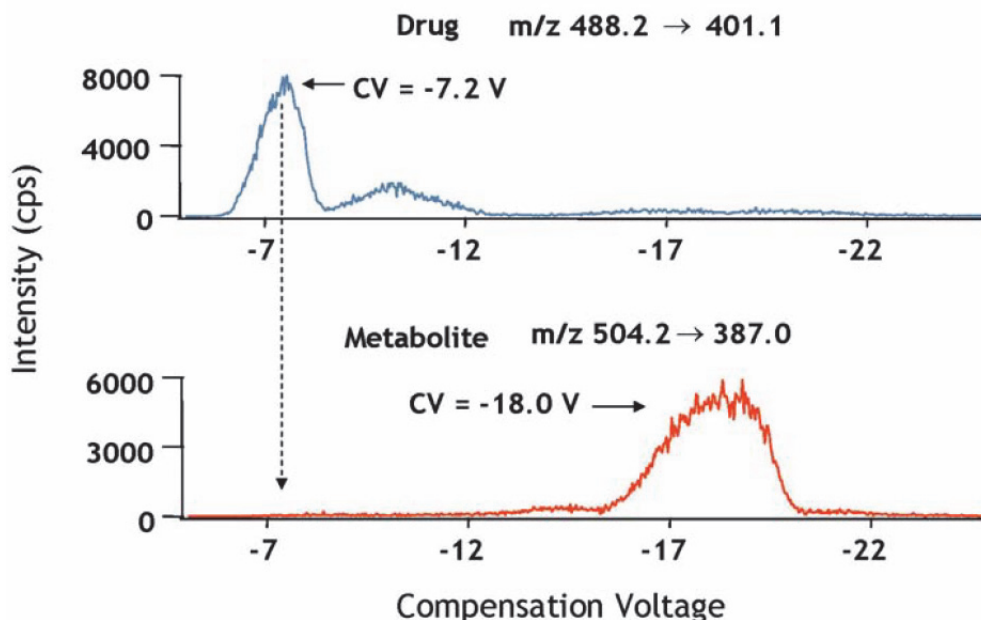
Figure 7 illustrates the combined effect of the DV and CV electric fields for a targeted analysis, where the optimal CV values for specific analytes are known, with the resulting separation of the blue, green, and pink ions within the space between the two cylindrical electrodes. The FAIMS interface transmits the blue, green, and pink ions at the following applied CV values: –16 V, –18 V, and –20 V.

Figure 7. Gas flow in the gap between the two cylindrical electrodes
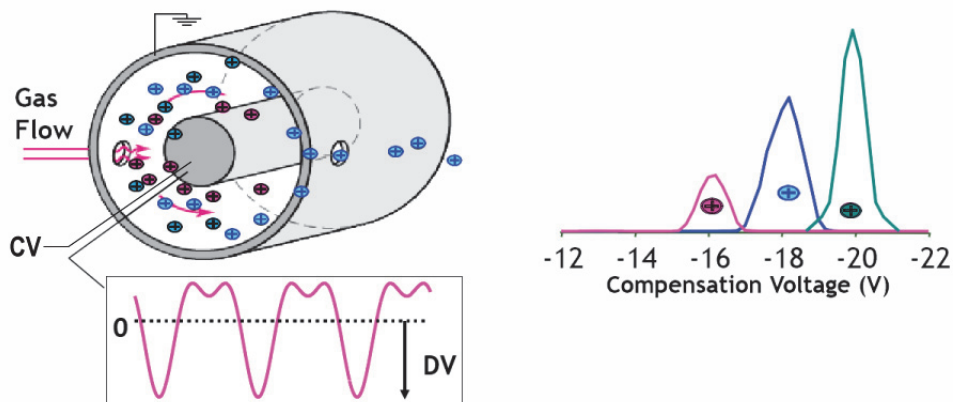
Selectively changing the CV can also aid in the separation of untargeted compounds—such as tryptic peptides in complex samples—as it can separate singly charged ions from multiply charged ions.

Figure 8 shows the separation of singly charged ions from multiply charged ions as the CV is changed from –100 V to –20 V.

Figure 8.   Untargeted CV fractionation of tryptic peptides
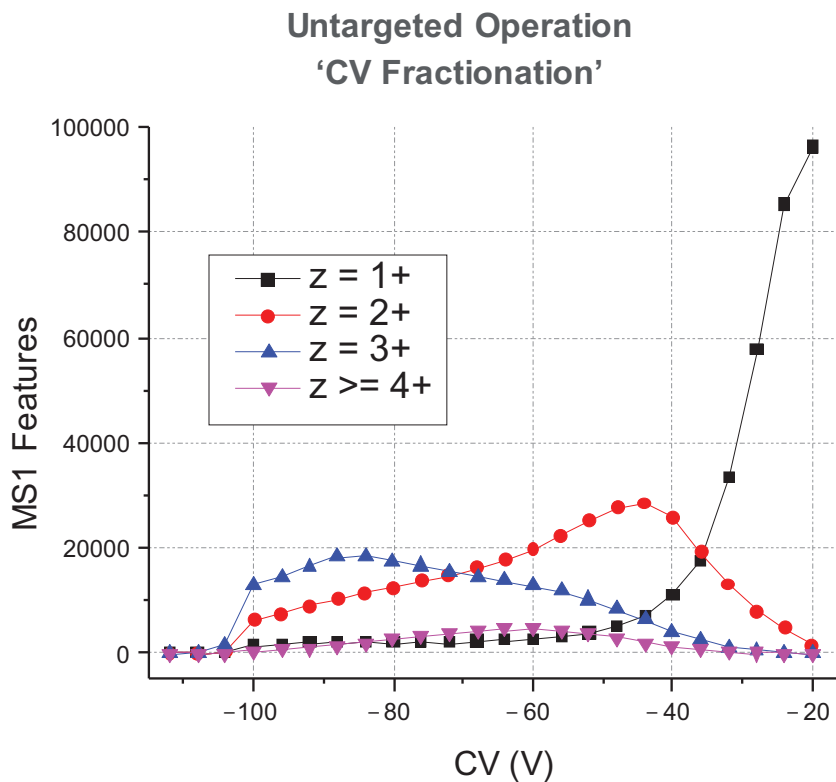
The effect of temperature

The temperatures of the inner and outer electrodes of the FAIMS interface play a significant role in determining the FAIMS field strength. The magnitude of the FAIMS field between the electrodes in a gas of a specific density, N, can be changed by altering the temperature of the inner and outer electrodes.

In the Method Editor and Tune windows, the electrode temperatures are determined by the FAIMS Mode that you select:

- Standard Resolution mode

- High Resolution mode

- User Defined mode

- Not Installed mode

Standard Resolution mode

The selection of Standard Resolution for the FAIMS Mode parameter automatically sets the temperatures of the inner and outer electrodes to 100 °C. The separation of ions in this mode results in a sensitivity improvement with wider CV peaks and larger relative peak intensities compared to High Resolution mode.

Compare Figure 9 to Figure 10.

Figure 9.   Standard Resolution mode example
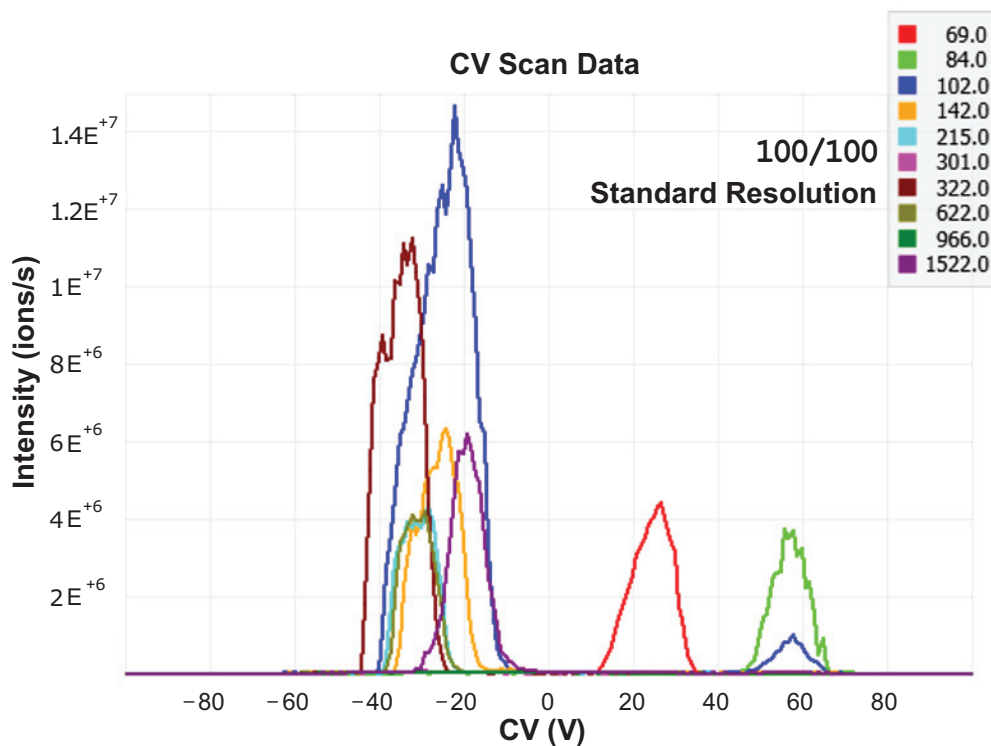
High Resolution mode

The selection of High Resolution for the FAIMS Mode parameter automatically sets the temperature of the inner electrode to 80 °C and the outer electrode to 100 °C. The separation of ions in this mode results in improved resolution with narrower CV peaks and lower relative peak intensities compared to Standard Resolution mode.

> **Note** In previous versions of the instrument control software, the temperature of the inner electrode was set to 70 °C and the temperature of the outer electrode was set to 100 °C.
>
> In the most recent versions of the instrument control software for the Exploris, Tribrid, and TSQ Series II mass spectrometers (Exploris 3.1, Tribrid 3.5, and TSQ 3.4, respectively), the temperature of the inner electrode has been increased to 80 °C.

Compare Figure 10 to Figure 9.

Figure 10. High Resolution mode example
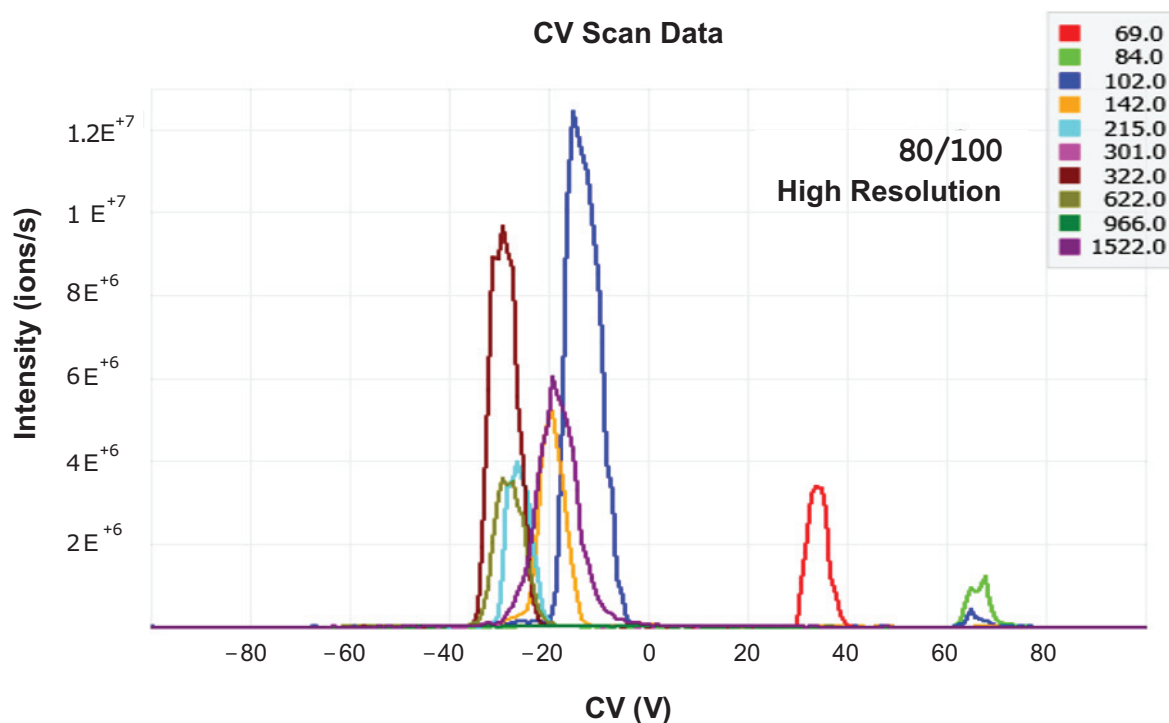
User Defined mode

The User Defined selection for the FAIMS Mode parameter lets you set the electrode temperatures individually.

The default temperature setting and the available temperature range is the same for both electrodes:

- Inner Electrode Temperature: Default: 90°C; range: 70 to 100°C

- Outer Electrode Temperature: Default: 90°C; range: 70 to 100°C

Not Installed mode

The Method Editor does not detect the presence of the FAIMS interface. On the Global Parameters page of the Method Editor, you can select Not Installed, Standard, High Resolution, or User Defined. The default selection for the FAIMS mode is Not Installed. To add control of the FAIMS interface to an instrument method, you must select Standard, High Resolution, or User Defined for the FAIMS Mode.

You can save instrument methods with the default setting of Not Installed for the FAIMS Mode parameter. However, when the FAIMS interface is installed on the MS, the data system does not accept Not Installed as a valid selection.

If you submit a sequence that includes instrument methods with the FAIMS mode set to Not Installed, the data system skips the sequence rows with these instrument methods and runs only the rows with valid instrument methods.

FAIMS interface components

This chapter describes the components of the FAIMS interface and the gas delivery system for the carrier and cooling gases (nitrogen).

See the following topics:

- Main controller box

- Housing adapter and RF transformer box assembly

- Electrode assembly

- Electrode set

- Additional drain system for high-flow applications

- Nitrogen gas supply lines

- Control of the FAIMS carrier gas and the FAIMS cooling gas

Main controller box

The main controller box (MCB) of the FAIMS interface provides power and control signals to the RF transformer box. The MCB interfaces with the MS for analysis of the ion stream and provides status information about the electrode temperatures and gas flow to the instrument control software on the data system computer.

See the following topics for details about the front panel LEDs and the back panel ports:

- MCB LEDs

- MCB back panel ports and fuse housing

MCB LEDs

Figure 11 shows the LED indicators on the front of the MCB, and Table 5 describes their function.

Figure 11. LEDs on the front of the main controller box (MCB)

Table 5. LED indicator states for the MCB

LED indicator	Color	Description
Power	Green	The power supply switch is in the On position and the FAIMS interface is receiving power.
	Not lit	The power supply switch is turned off.
Comm	Green	The FAIMS interface is communicating with the MS.
	Not lit	The MCB power is off.
	Amber	The FAIMS interface is not communicating with the MS.
Status	Green	Status is Ready (there are no errors).
	Not lit	Status is Not Ready.
Scan	Blue	The dispersion voltage is On.
	Not lit	The dispersion voltage is Off.

MCB back panel ports and fuse housing

Figure 12 and Figure 13 show the interconnect ports and the power switch and fuse box on the back panel of the main controller box (MCB), and Table 6 describes their function.

Note The nitrogen line for the cooling gas is 1/4 in. OD tubing for the FAIMS Pro Duo interface and 1/8 in. OD tubing for the FAIMS Pro interface. In addition, the positions of the COOL and FAIMS gas ports are reversed in these two interfaces.

Figure 12. Back panel of the FAIMS Pro Duo main controller box
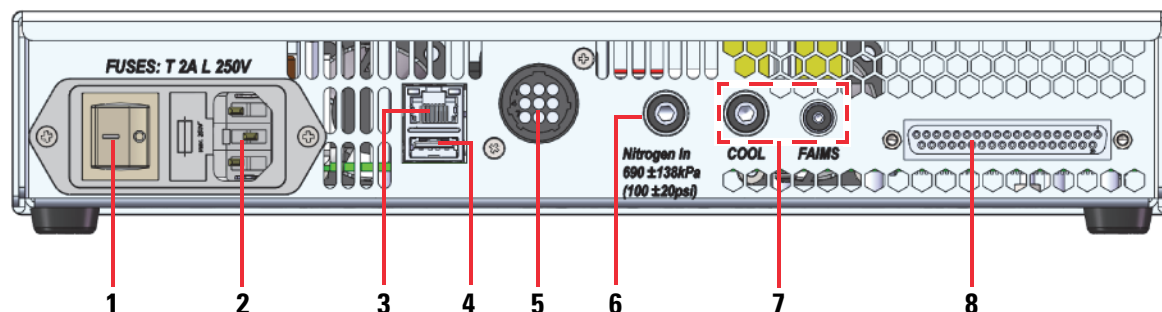
Figure 13. Back panel of the FAIMS Pro main controller box
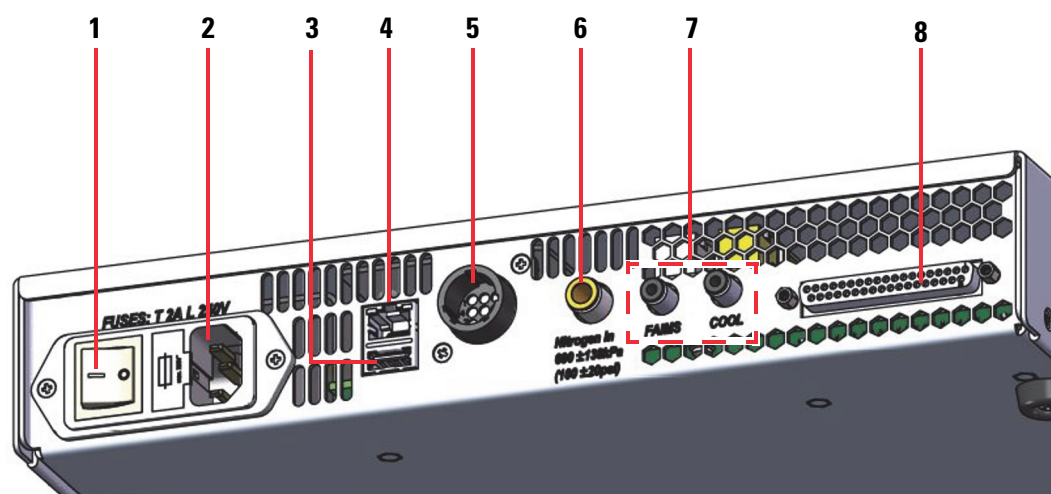
Table 6. Interconnect description

No.	Item	Direction	Description
1	Power switch	N/A	Turns the power on or off
2	Power receptacle	In	Line power 100–240VAC
3	Ethernet port	In/Out	Connection to the data acquisition computer
4	USB port	In/Out	Reserved for future use
5	High Voltage	Out	High voltage for the FAIMS interface
6	Nitrogen In	In	Nitrogen source for the carrier gas and the cooling gas
7	FAIMS	Out	Carrier gas for the FAIMS interface
	COOL	Out	Cooling gas for the FAIMS interface
8	Signal connector	In/Out	37-pin D receptacle for the cable that sends control signals to the FAIMS interface and feedback about the gas flows and electrode temperatures to the instrument control software

> **Note** For information about the MCB fuse, see Appendix C, "Specifications, laboratory requirements, and gas consumption."

> **Note** The USB port on the back panel of the MCB is reserved for future use.

Housing adapter and RF transformer box assembly

The housing adapter and radio frequency (RF) transformer box of the FAIMS interface ships as an assembly. When the electrode assembly is mounted on the housing adapter, the entire assembly is also known as the FAIMS source.

The housing adapter portion of the assembly includes the following features:

- Mounting holes for the mounting posts below the API source interface of the mass spectrometer

- A mount for the electrode assembly on the front with two heaters for the outer electrode

- A mount for the ion source on the front

- An exit slot for the interconnect cable from the RF transformer box

The RF transformer box of the assembly does the following:

- Provides RF sample feedback from the FAIMS housing adapter/electrodes to the MCB

- Delivers high voltage DC to the electrodes

- Creates the FAIMS waveform for the compensation voltage (CV) and the dispersion voltage (DV)

The following figures show various components of the FAIMS housing adapter and the FAIMS cable:

- Figure 14 shows the front and back of the housing adapter and the RF transformer box assembly.

- Figure 15 shows a closeup of the two heaters for the outer electrode.

- Figure 16 shows the tubing connections for the FAIMS gas, the cooling gas, and the drainage tubing. It also shows the gas channels for the FAIMS gas and the cooling gas. The FAIMS gas channel supplies the carrier gas to the air space between the back of the entrance plate and the sample inlet port of the outer electrode.

- Figure 17 shows a closeup of the Viton O-ring that provides a seal between the FAIMS interface and the entrance cone and the compression ring that makes contact with the entrance cone on the back side of the housing adapter.

- Figure 18 shows the free end of the FAIMS cable.

Figure 14. Adapter housing and RF transformer box (front and back with partial cable)

Front view   **Back view**
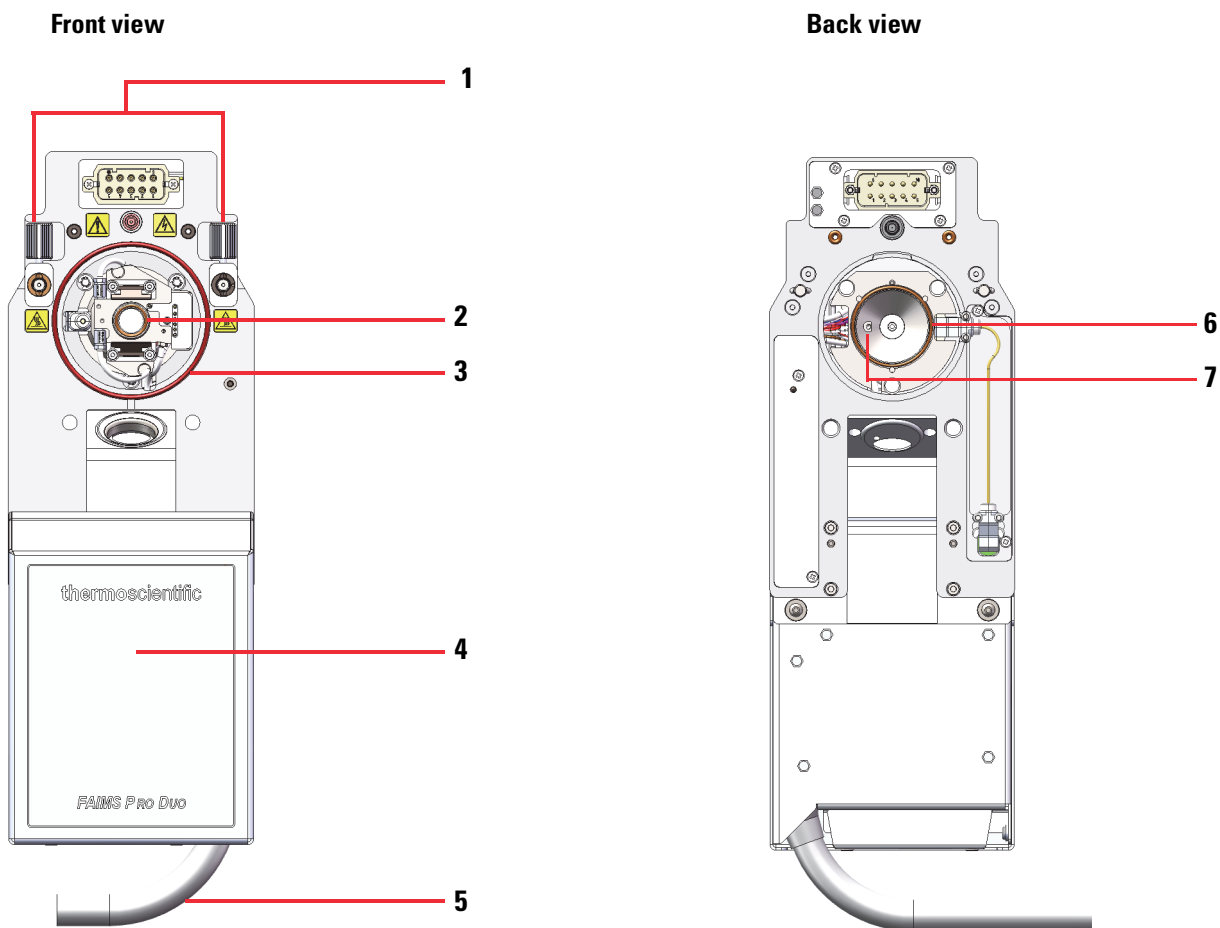
No.	Description	No.	Description
1	Locked latches on the adapter housing	5	Interconnect cable
2	O-ring, Viton, 15.61 mm ID, 1.78 mm W (0.614 in. ID, 0.07 in. W)	6	O-ring, Viton 1 5/8 in. ID, 1 3/4 in. OD, 1/16 in. W
3	O-ring, Viton, 82.22 mm ID, 0.61 mm W (3.237 in. ID, 0.103 in. W)	7	Compression spring that ensures contact between the FAIMS interface and the entrance cone of the MS (see Figure 17 on page 34)
4	RF transformer box		

Figure 15. Front of the housing adapter, showing the two heaters for the outer electrode
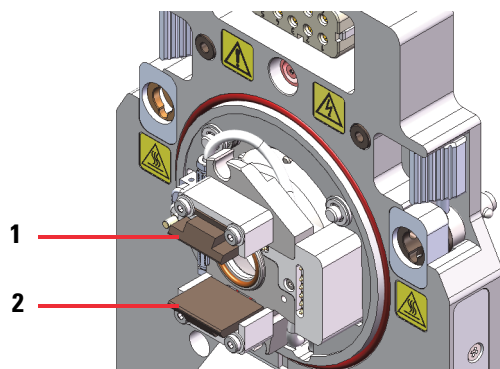
No.	Description	No.	Description
1	Heater block 1 for the outer electrode	2	Heater block 2 for the outer electrode

Figure 16. Front of the housing adapter, showing the gas and drain connections
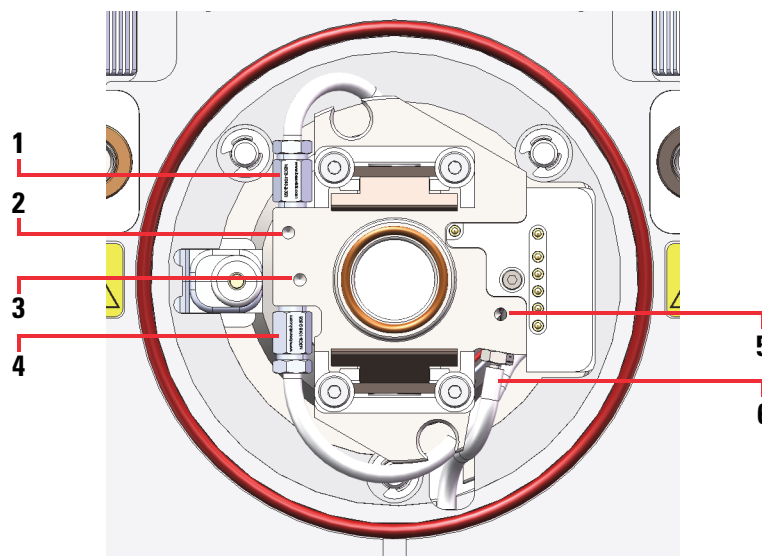
No.	Description	No.	Description
1	Connection for the FAIMS gas tubing	4	Connection for the cooling gas tubing
2	FAIMS gas channel that provides the carrier gas to the air space in front of the outer electrode's sample entry orifice	5	Drain channel
3	Cooling gas channel	6	Drain tubing

Figure 17. Back of the housing adapter, showing the compression spring and the Viton O-ring
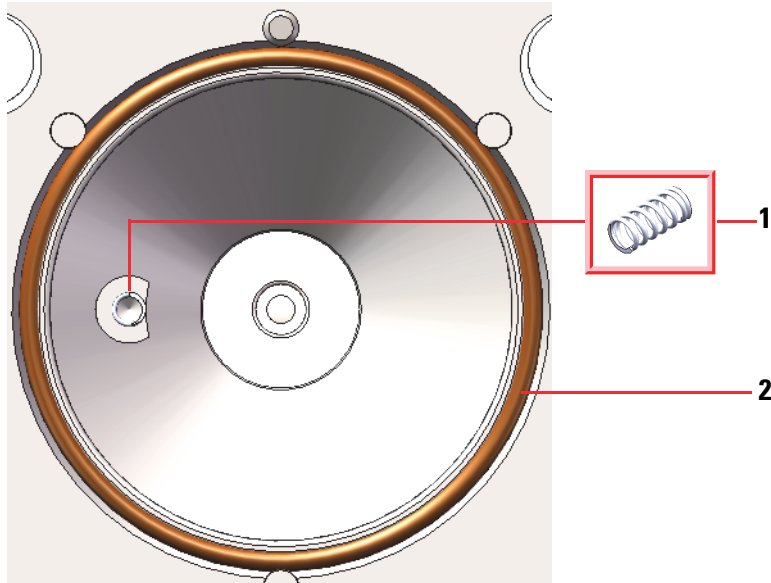
No.	Description	No.	Description
1	Compression spring	2	Viton O-ring

Figure 18. Free end of the FAIMS Pro interconnect cable (top) and the FAIMS Pro Duo interconnect cable (bottom)

FAIMS Pro cable
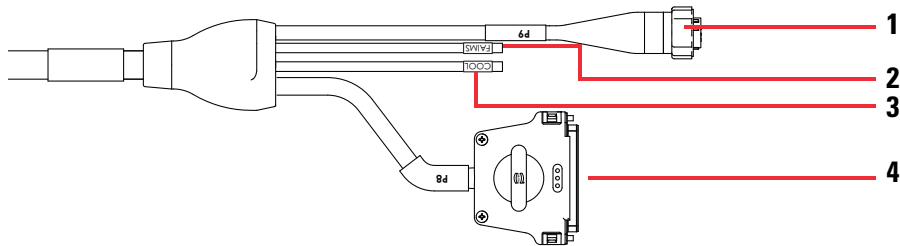
FAIMS Pro Duo cable
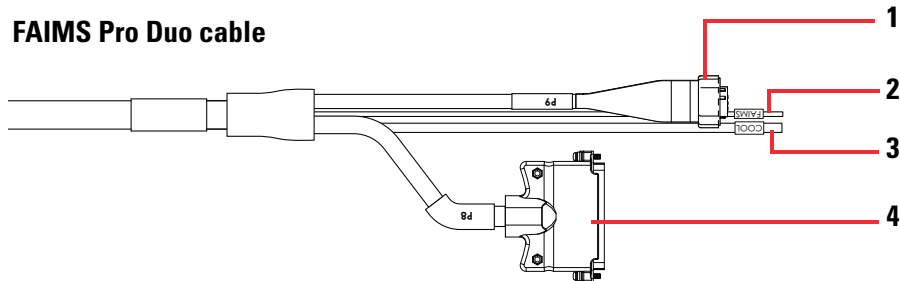
No.	Description	No.	Description
1	High voltage connector	3	Nitrogen line for the FAIMS cooling gas
2	Nitrogen line for the FAIMS carrier gas	4	37-pin communication connector

Electrode assembly

The FAIMS electrode assembly consists of an entrance plate and an electrode set. The entrance plate holds the electrode set and this electrode assembly fits onto the adapter housing. The assembly provides cooling and analytical gas paths and its O-rings provide a gas seal.

For details about the electrode set, see "Electrode set" on page 39.

The electrode assembly includes two sets of latches (see Figure 19):

- The electrode assembly latches that secure the electrode set to the entrance plate
- The entrance plate latches that secure the electrode assembly to the housing adapter.

Figure 19. Entrance plate latches and electrode set latches
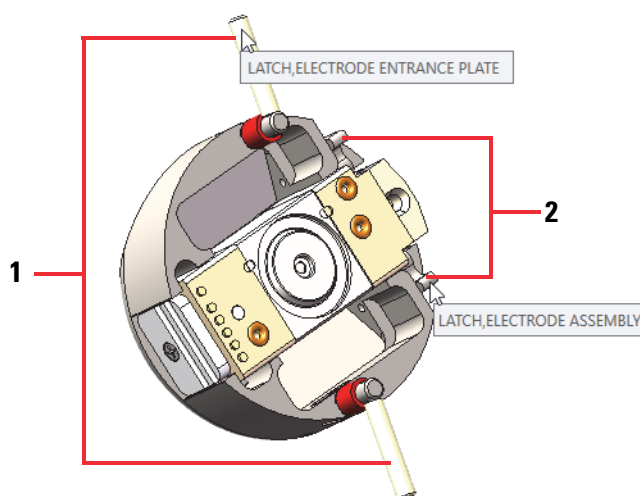
No.	Description
1	Entrance plate latches that secure the electrode assembly to the housing adapter
2	Electrode assembly latches that secure the electrode set to the entrance plate

Figure 20, Figure 21, and Figure 22 show the front, side, and back views of the electrode assembly. Figure 23 shows the electrode set removed from the entrance plate.

Figure 20. Electrode assembly with unlocked latches
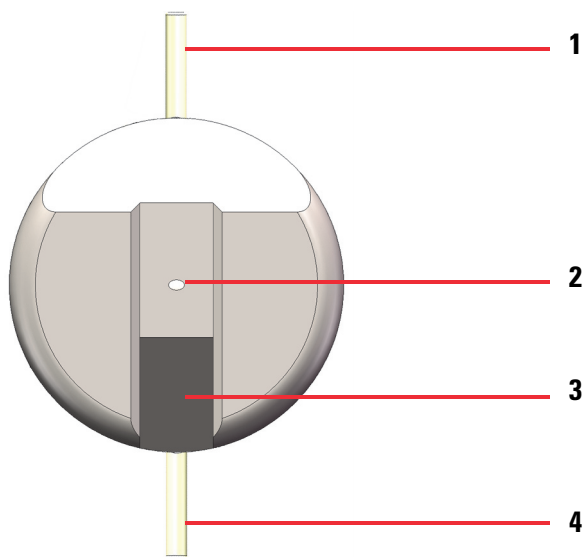
No.	Description	No.	Description
1	Top latch (secures the entrance plate assembly to the housing adapter)	3	Drain channel
2	Entrance plate orifice	4	Bottom latch (secures the entrance plate assembly to the housing adapter)

Figure 21. Electrode assembly (side view)
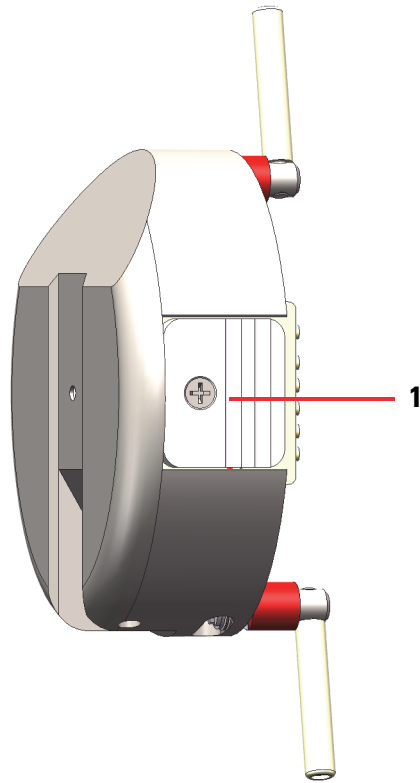
No.	Description
1	Heater endcap

Figure 22. Electrode assembly with latches locking the electrode set in place (back view)
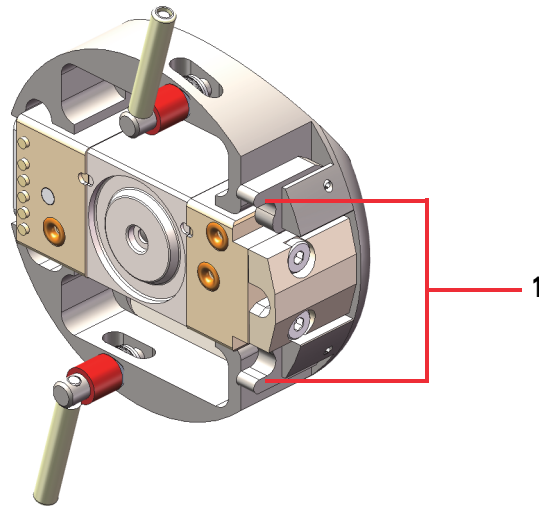
No.	Description
1	Electrode assembly latches in locked position

Figure 23. Entrance plate with the electrode set removed
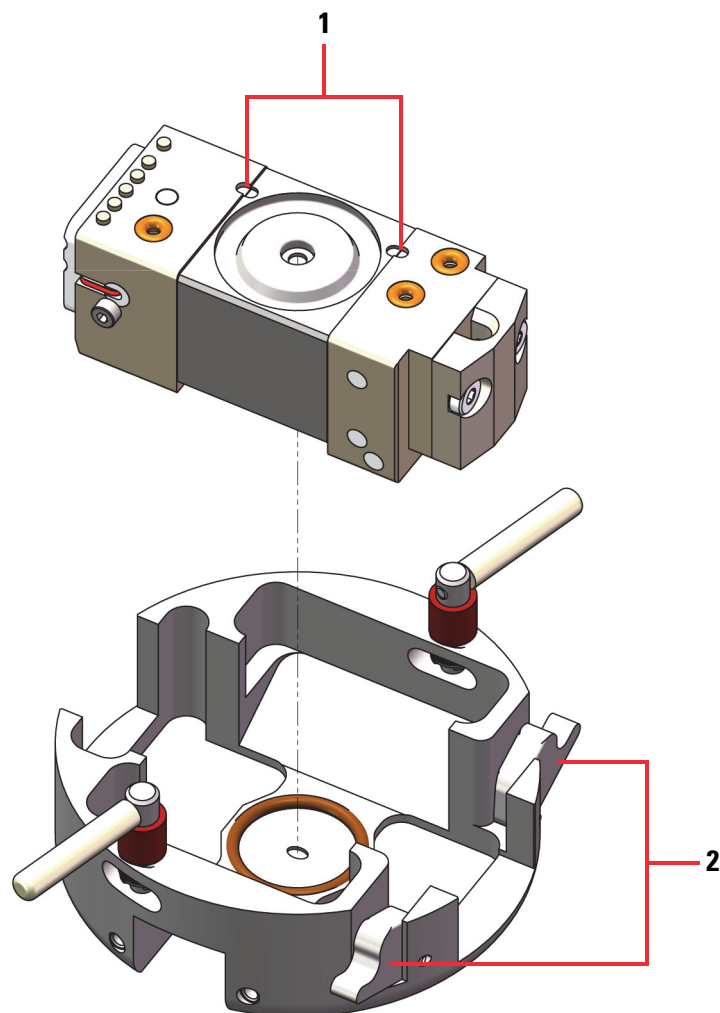
No.	Description
1	Alignment notches on the electrode set (Make sure to align these notches when you reassemble the electrode set.)
2	Electrode assembly latches unlocked and the electrode set removed (back side of the entrance plate)

Electrode set

The electrode set includes the following components:

- An RF endcap

- A heater endcap

- An inner electrode

- An outer electrode

- O-rings that provide a gas seal between the entrance plate and the electrode mount

- Two bushings that provide electrical insulation between the electrodes, set the inner electrode position, and maintain the gap between the electrodes.

Figure 24 shows the components of the electrode set.

> **IMPORTANT** The O-rings on the bushings must face the endcaps.

Figure 24. Electrode set (exploded view)
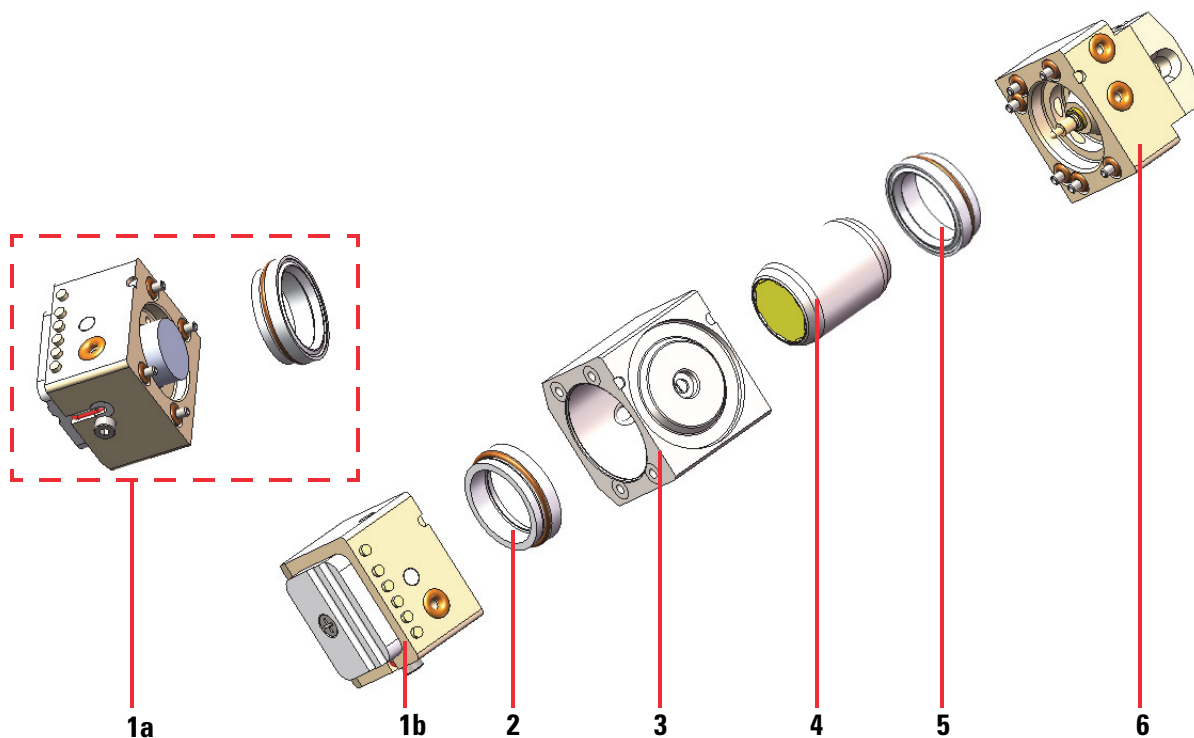
No.	Description	No.	Description
1a & 1b	Two views of the heater endcap, with 1a showing the heater	4	Inner electrode
2	Bushing with O-ring	5	Bushing with O-ring
3	Outer electrode	6	RF endcap

Additional drain system for high-flow applications

For high-flow applications, you must connect one drain to the electrode assembly and another drain to the bottom of the OptaMax NG ion source (or optional OptaMax Duet NG) source.

Figure 25 shows the top drain.

Figure 25. High-flow drain (top drain) for the electrode assembly
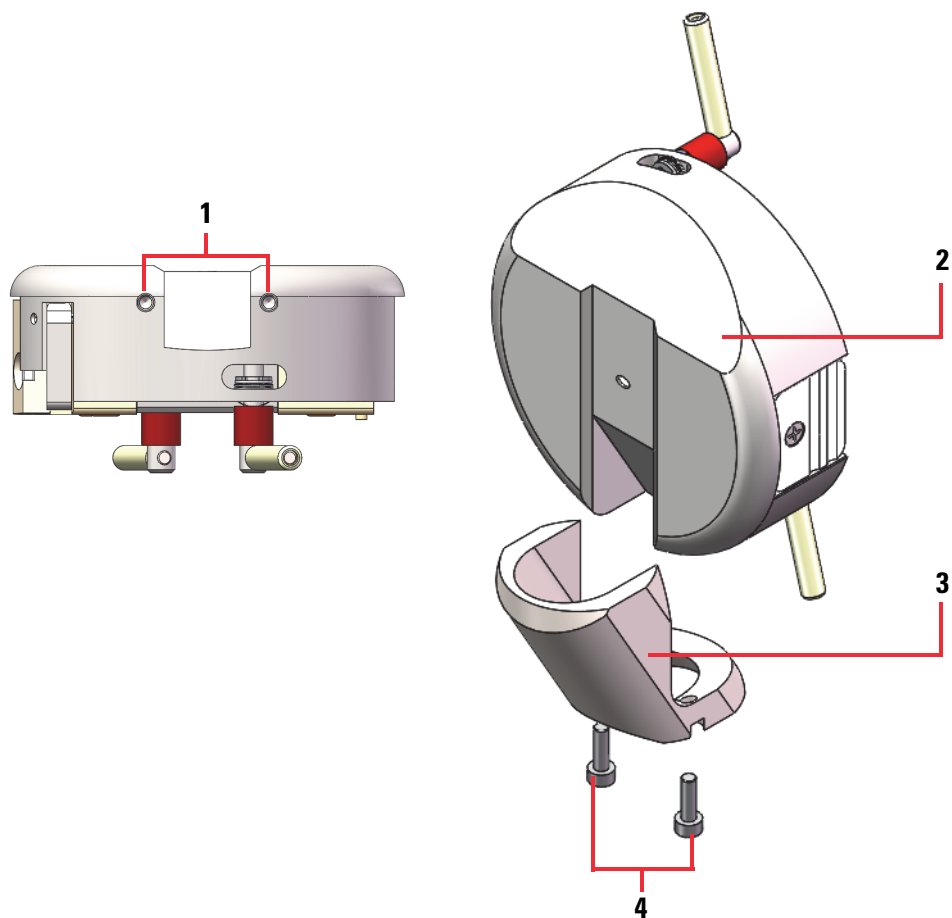
No.	Description	No.	Description
1	Receiving ports for the drain screws on the bottom of the electrode assembly's entrance plate	3	Top drain
2	Front face of the electrode assembly's entrance plate	4	Two screws that secure the drain to the electrode assembly

Figure 28 shows the bottom FAIMS drain that fits into the drain port at the bottom of the OptaMax NG ion source housing. The drain's pin aligns with the slot at the back of the ion source housing.

Figure 26. Bottom drain for the ion source housing and the bottom FAIMS drain
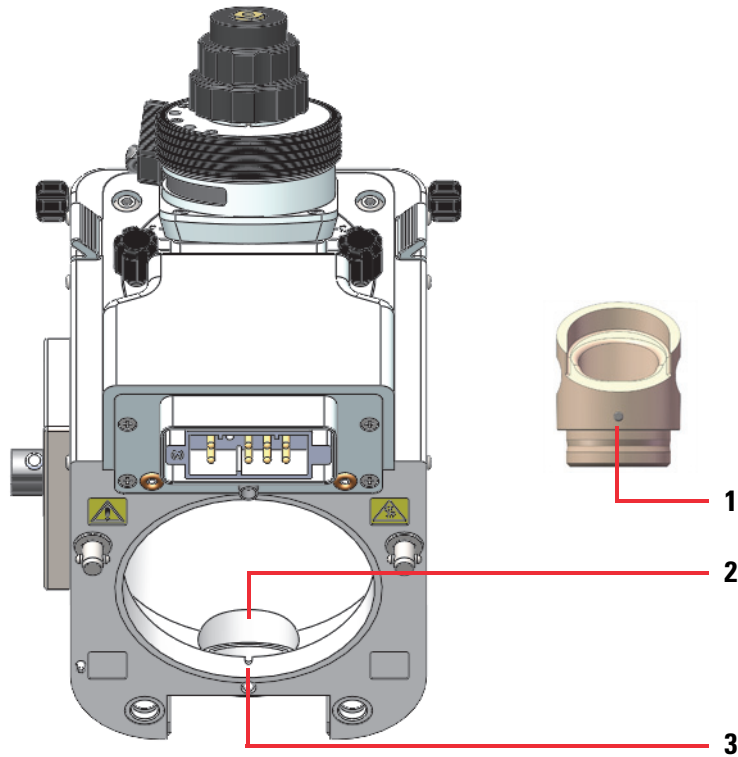
No.	Description	No.	Description
1	Alignment pin on the FAIMS bottom drain (insulator)	3	Alignment slot at the back of the ion source housing
2	Drain port at the bottom of the ion source housing		

Nitrogen gas supply lines

Figure 27 and Figure 28 show the delivery path for the nitrogen gas to the FAIMS electrodes and to the mass spectrometer.

> **Note** Thermo Fisher Scientific recommends a dedicated nitrogen supply for the FAIMS Pro Duo interface when it is installed on any compatible Thermo Scientific MS.
>
> An Exploris MS always requires its own dedicated nitrogen gas supply source because the specification for its input pressure and the outer diameter of its nitrogen supply line differ from those for the FAIMS interfaces.
>
> For a TSQ Series II MS with a nanospray ion source or a Tribrid MS with a nanospray ion source, you can use one nitrogen gas supply source for both the FAIMS Pro interface and the MS.

Figure 27. Schematic of the gas delivery lines to the FAIMS Pro Duo interface and the MS
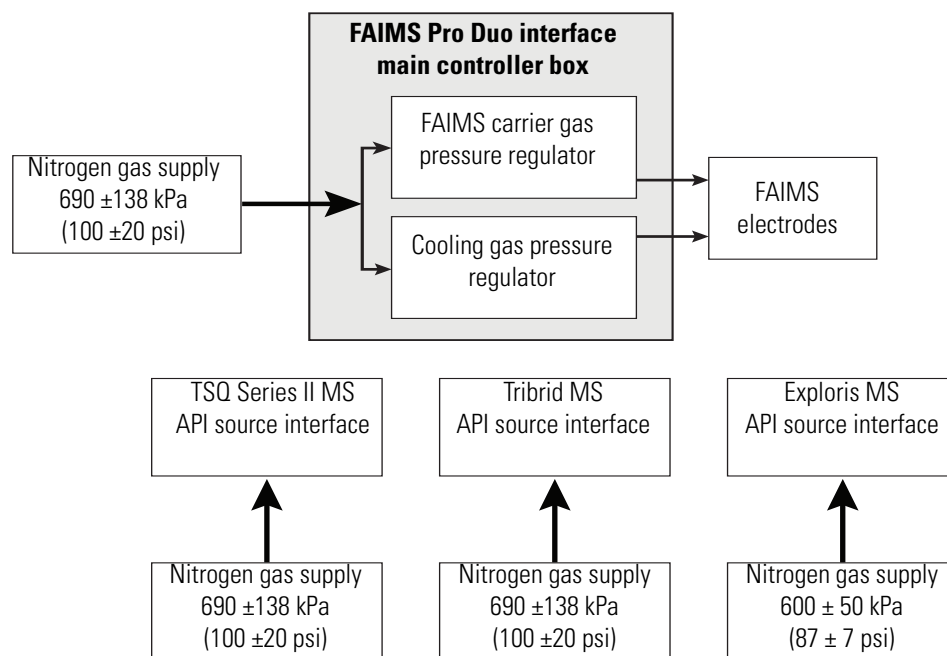
Figure 28. Schematic of the gas delivery lines to the FAIMS Pro interface and a TSQ Series II MS or a Tribrid MS
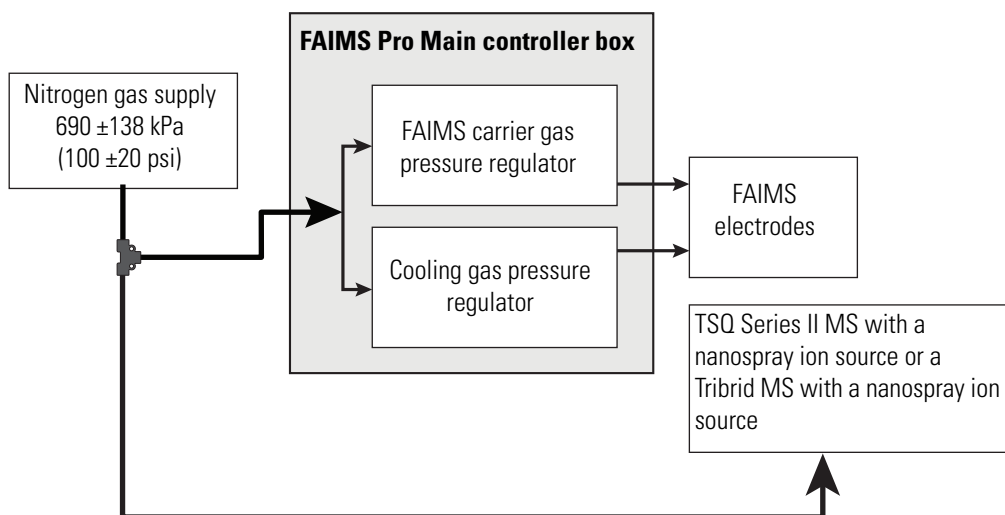
Control of the FAIMS carrier gas and the FAIMS cooling gas

The flow paths, flow rates, and control of the FAIMS carrier gas and the FAIMS cooling gas are completely independent of each other.

* Control of the FAIMS carrier gas

* Control of the cooling gas

Control of the FAIMS carrier gas

The FAIMS carrier gas facilitates ion transfer through the electrodes. The flow rate range for the carrier gas is based on the MS model (specifically the type of ion transfer tube that the MS uses) and is set by the instrument control software. You can adjust the carrier gas within the available range. For information about adjusting the flow rate of the FAIMS carrier gas, see "Total carrier gas flow rate" on page 93.

The FAIMS carrier gas is on when the FAIMS interface is installed on an MS and the interface is turned on (power switch on the back panel of the main controller box is in the On position), even when the MS is in standby or off mode. Turning off the FAIMS interface (toggling the power switch to the Off position) turns off the carrier gas flow at the main controller box.

Control of the cooling gas

The cooling gas helps regulate the inner and outer electrode temperatures. You cannot adjust the flow rate of the cooling gas. Its flow rate is dependent on the ion source in use and the vaporizer temperature (when applicable).

To keep the electrodes at the specified operating temperature, the cooling gas is always on when the FAIMS interface is turned on. However, as opposed to the carrier gas, the cooling gas is off when the MS is off.

Install the FAIMS interface

This chapter describes how to connect the FAIMS interface to a Thermo Scientific™ mass spectrometer and how to connect the ion source to the FAIMS interface.

> **Note** Keep the MS in standby mode while you install the FAIMS interface. Because you do not remove any of the API source interface components, except for the ion sweep cone while installing the interface, the installation procedure does not require venting.
>
> After you install the FAIMS interface, you must run the automated DV tune procedure.

To install the FAIMS interface, follow these steps in the order listed:

1. Remove the ion sweep cone from the MS

2. (Optional) Check the FAIMS electrode assembly for particulate matter

3. Connect the top FAIMS drain to the electrode assembly when using the OptaMax ion source

4. Install the electrode assembly on the FAIMS housing adapter

5. Install the FAIMS interface on the MS

6. Set up and connect the main controller box

7. Check for gas leaks between the FAIMS housing adapter and the MS

8. Install the ion source housing on the FAIMS interface

Remove the ion sweep cone from the MS

Before you install the FAIMS system, you must remove the ion sweep cone from the MS.

> **CAUTION Hot surface.** Allow the parts to cool to room temperature (approximately 20 minutes) before you touch them. The external surface of the spray insert, API source housing, MS ion sweep cone, and entrance cone of the ion transfer tube can be hot enough to burn your skin.

❖ **To remove the ion sweep cone**

1. Place the MS in Standby mode, ⏸ , and wait approximately 20 minutes for the external components to cool to room temperature.

2. After the ion source housing has cooled to room temperature, remove it as described in the ion source user guide.

> **Tip** The user guides for the ion sources that are compatible with your MS are available from the Tune window's Options menu. To open any of these user guides, click the **Options** icon, ⚙ ▾ . Then, choose **Instrument Manuals** from the dropdown menu.

> **IMPORTANT** To avoid contaminating the ion transfer tube, do not touch its exposed entrance cone after you remove the ion sweep cone from the MS.

3. Grasp the outer ridges of the ion sweep cone and pull it off the MS.

> **Tip** If you cannot remove the ion sweep cone by hand, use a small slotted screwdriver to loosen the screws on the ion sweep cone.
>
> The spray cone is directly behind the ion sweep cone.

Figure 29. Ion sweep cone removed from the mass spectrometer
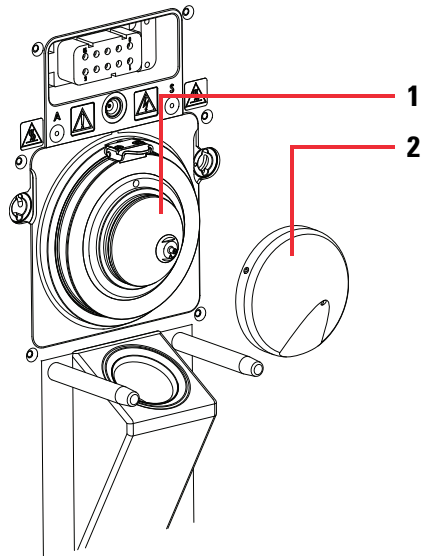
No.	Description	No.	Description
1	Spray cone	2	Ion sweep cone

(Optional) Check the FAIMS electrode assembly for particulate matter

If you did not cover the FAIMS electrode assembly during storage, check it for particulate matter.

❖ **To check the FAIMS electrode assembly for particulate matter**

1. Put on a pair of powder-free gloves to avoid contaminating the electrodes.

2. If the electrode assembly is connected to the FAIMS housing adapter, remove it as follows:

   a. Place the two locking latches in the unlocked position.
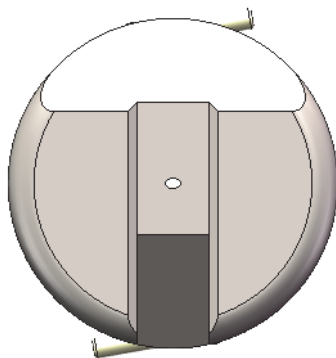
Locked position	Unlocked position
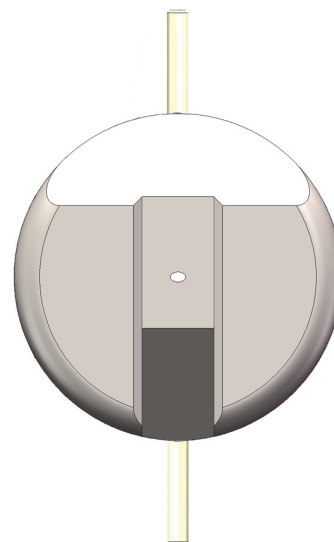
   b. Pull the unlocked assembly away from the housing adapter.

3. Disassemble the electrode assembly and set the components on a lint-free cloth. See "Clean the electrodes" on page 146.

4. Inspect the electrode components to ensure no particulate is present on the surfaces of the components. Use a stream of nitrogen gas to remove particulate matter if it is present.

5. Reassemble the electrode set. Then, install the electrode set in the entrance plate. See "Reassemble the electrode assembly" on page 148.

Connect the top FAIMS drain to the electrode assembly when using the OptaMax ion source

When you are installing the OptaMax NG ion source, you must connect the top FAIMS drain to the electrode assembly.

Required tools
2 mm hex wrench to tighten the M2.5 socket head cap screws that secure the top FAIMS drain to the entrance plate

❖ **To connect the top FAIMS drain to the electrode assembly**

1. Align the two small holes in the bottom of the drain with the two small holes at the bottom of the electrode assembly. See Figure 25 on page 40.

2. Insert the screws into the holes. Then, tighten the screws by using a hex wrench.

   Figure 30. Connecting the top FAIMS drain to the electrode assembly's entrance plate
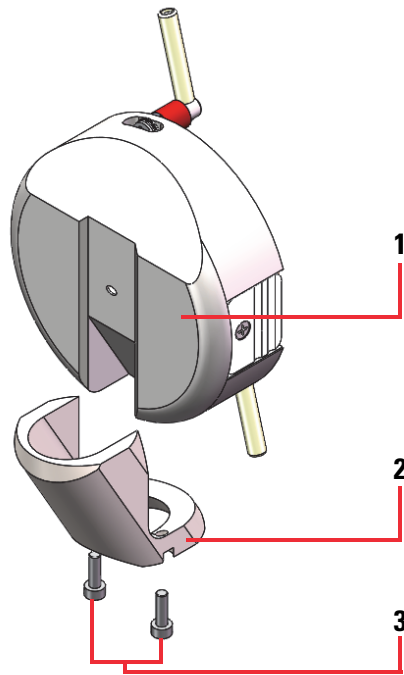
No.	Description	No.	Description
1	Front face of the entrance plate	3	Two screws that secure the drain to the electrode assembly
2	Top drain		

Install the electrode assembly on the FAIMS housing adapter

When the electrode assembly is mounted to the front of the housing adapter of the FAIMS interface, it is orientated so that the solvent waste flows into the ion source drain.

❖ **To install the electrode assembly on the housing adapter**

1. Check the following:

   • The O-ring on the front of the FAIMS housing adapter is seated properly.

   • The locking latches that secure the electrode assembly to the housing adapter are in the unlocked position.

   > **CAUTION** Use only your hands to open or close the electrode assembly's locking levers. If they do not move easily, the most likely cause is a misplaced O-ring. Make sure that the O-rings are properly seated. Do not force the latches or use a tool, as excessive force can damage the O-rings.

   • The electrode set is properly aligned. The notches on the outer electrode must line up with the notches on the end caps.

   Figure 31. Notches on the end caps and the outer electrode are properly aligned
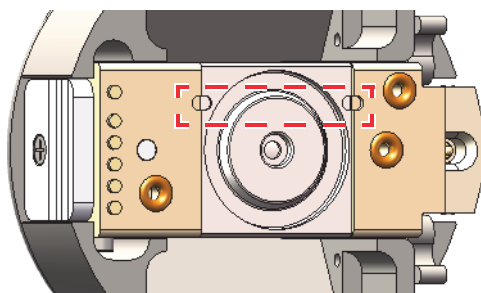
   • For high-flow applications, the top FAIMS drain is connected to the electrode assembly's entrance plate. See "Connect the top FAIMS drain to the electrode assembly when using the OptaMax ion source" on page 48.

2. Align the recessed areas on the top and bottom of the electrode assembly with the heaters for the outer electrode and carefully install the electrode assembly on the housing adapter. See Figure 32.

Figure 32. Electrode mount on the FAIMS housing adapter
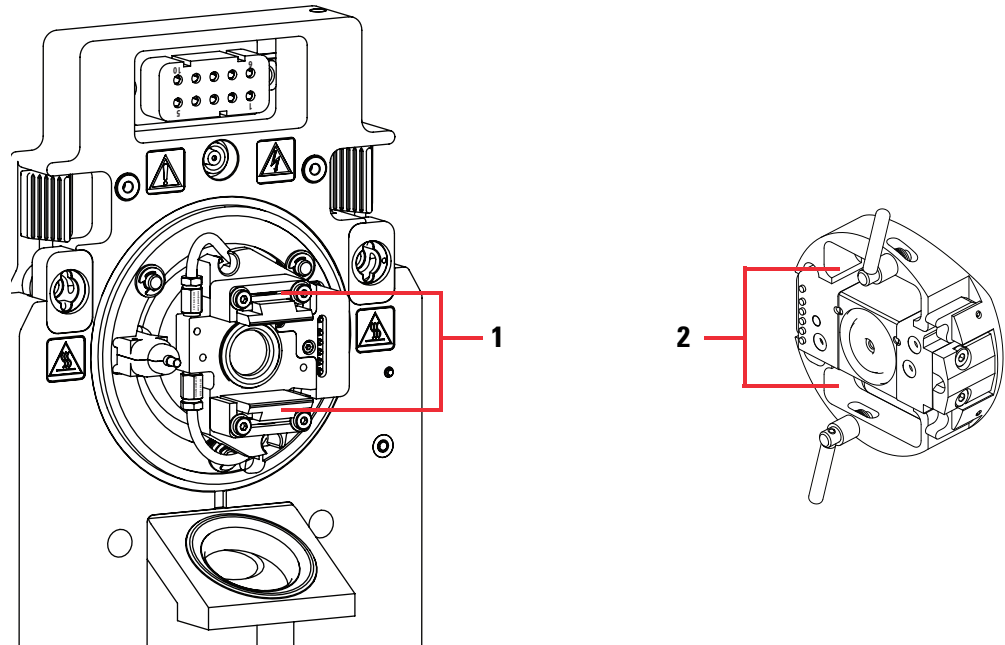
No.	Description	No.	Description
1	Heating blocks for the outer electrode	2	Recessed areas on the top and bottom of the electrode assembly

3. Lock the locking levers by swiveling the top latch to the right and the bottom latch to the left.

Install the FAIMS interface on the MS

Preconditions

The electrode assembly is installed on the FAIMS housing adapter.

The FAIMS interface consists of the FAIMS housing adapter and RF transformer box assembly and the electrode assembly.

❖ **To install the FAIMS interface on the MS**

1. Confirm that the large O-ring on the back of the FAIMS housing adapter is seated properly. The O-ring is slightly oversized and must seat flush in the groove.

Figure 33. Back of the FAIMS housing adapter
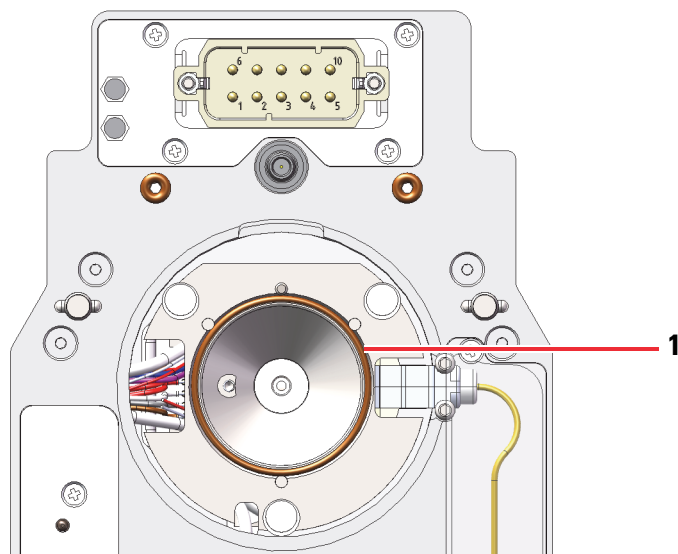
No.	Description
1	O-ring, Viton, 41 mm (1 5/8 in.) ID by 44.5 mm (1 3/4 in.) OD by 1.78 mm (1/16 in.) width, Parker size no. 2-030

2. Make sure that the housing adapter's latches are in the unlocked position.

3. Align the back of the FAIMS housing adapter with the mass spectrometer's mounting pins for the ion source housing. Then, mount the FAIMS housing adapter on the MS. See Figure 34.

Figure 34. Aligning the FAIMS housing adapter to the API source interface of the MS
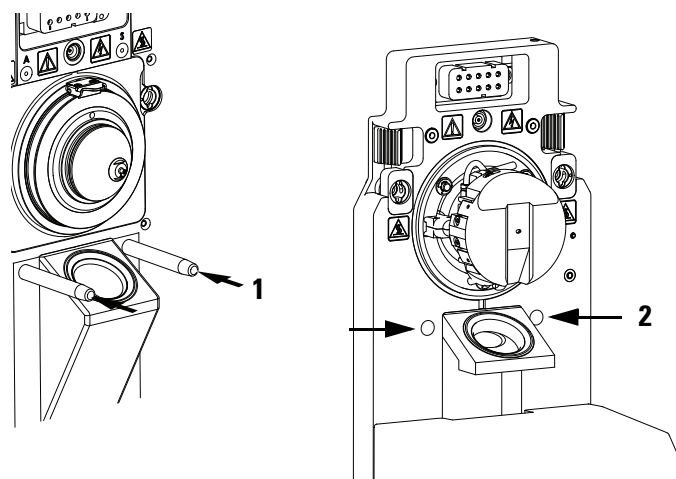
No.	Description	No.	Description
1	Mounting posts on the API source interface	2	Mounting holes in the FAIMS housing adapter

    4. Close the left and right latches on the housing adapter.

Set up and connect the main controller box

The power, electrical, communication, and nitrogen gas connections to the MCB are all on its back panel.

To set up and connect the main controller box, follow these topics in any order:

- Place the MCB on the top left of the MS

- Connect the laboratory nitrogen supply to the MCB

- Connect the MCB to the system Ethernet switch

- Connect the FAIMS cable to the MCB

- Connect the MCB to line power

Place the MCB on the top left of the MS

Thermo Fisher Scientific recommends that you place the FAIMS main controller box on the top left corner of the MS.

❖ **To set up the main controller box (MCB)**

1. If the syringe pump and the modular valve assembly are installed on a TSQ Series II MS or an Orbitrap Tribrid MS, remove them without disconnecting the cables.

2. Place the main controller box (MCB) on the top left corner of the MS (with the front panel facing forward so the FAIMS LEDs are visible from the front of the MS), and then place the optional syringe pump and the modular valve assembly on top of the MCB.

3. Route the FAIMS cable that exits from the bottom of the FAIMS RF transformer box along the left side of the MS.

Connect the laboratory nitrogen supply to the MCB

The FAIMS interfaces require a direct supply of nitrogen gas:

- In some cases, the FAIMS Pro interface can share the nitrogen gas supply line with a TSQ Series II MS or a Tribrid MS.

- The FAIMS Pro Duo interface requires a dedicated nitrogen gas supply. See "Nitrogen gas supply lines" on page 42.

❖ **To connect the laboratory nitrogen supply to the main controller box (MCB)**

1. Connect one end of the Teflon PFA tubing (1/4 in. ID) that is provided in the FAIMS Installation Kit to the Nitrogen In port on the back panel of the MCB. Connect the other end of the tubing to the laboratory nitrogen supply.

2. Set the nitrogen pressure for the laboratory nitrogen supply to 690 ± 140 kPa (100 ±20 psi).

Connect the MCB to the system Ethernet switch

The main controller box takes commands from the instrument control software by way of an Ethernet connection to the data system computer's Ethernet switch.

❖ **To connect the main controller box (MCB) to the data system computer**

Connect an Ethernet cable from the MCB's Ethernet port to the system switch. Make sure that the switch is connected to the data system computer.

> **Tip** For troubleshooting purposes, you might want to record the devices and their corresponding ports that connect to the data system's Ethernet switch.

Connect the FAIMS cable to the MCB

The free end of the FAIMS cable that exits the FAIMS interface from the bottom of the RF transformer box has two nitrogen lines, a nine-pin high-voltage connector, and a serial communication connector.

Required tools
Small flat-blade screwdriver to tighten the screws that secure the 37-pin connector to the main controller box

❖ **To connect the FAIMS cable to the main controller box (MCB)**

1. Cradle the 37-pin serial connector in the support bracket that is provided in the FAIMS Installation Kit.

   Figure 35. Serial connector cradled in the support bracket

2. Insert the prongs on both sides of the V-shaped support bracket into the hexagonal air vents above the 37-pin receptacle on the back panel of the MCB. Push the pins of the 37-pin connector into 37-pin receptacle. Then, use a small flat-blade screwdriver to tighten the connector's captive screws.

3. Push the end of the tubing labeled FAIMS into the port labeled FAIMS.

4. Push the end of the tubing labeled Cool into the inlet labeled Cool.

5. Connect the circular, high-voltage connector to the nine-pin receptacle. Turn the clamping ring clockwise to tighten the connection.

Figure 36 on page 55 shows the cable and nitrogen line connections to the MCB's back panel.

Connect the MCB to line power

The FAIMS main controller box (MCB) connects directly to the laboratory line power.

CAUTION When you connect the power cord to the MCB and line power, route the cord so that it is not a trip hazard.

❖ **To connect the MCB to line power**

1. Connect the socket end of the power cord to the male connector jack on the back panel of the MCB.

2. Connect the plug end of the power cord to the laboratory line power. Do not turn on the MCB power switch.

Figure 36. Cable and nitrogen line connections to the back panel of the MCB
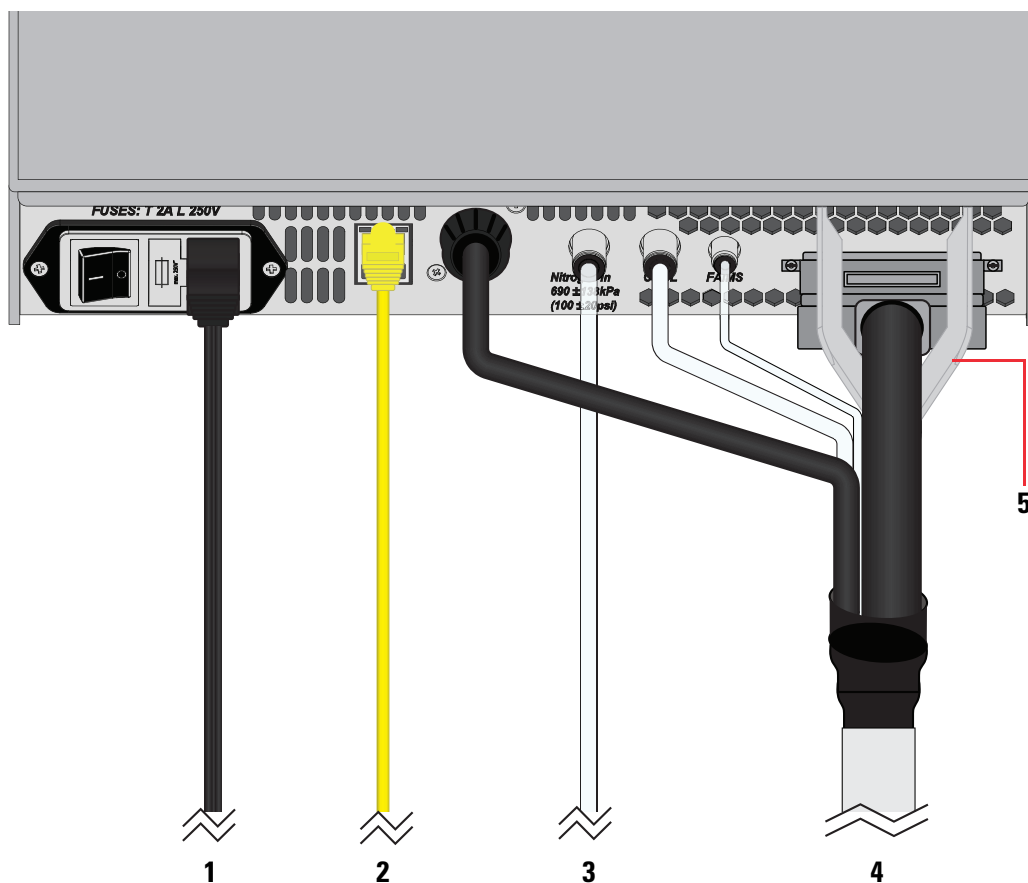
No.	Description	No.	Description
1	Power cable that connects the MCB to the laboratory power supply	4	FAIMS cable
2	Ethernet cable that connects the MCB to the LC/MS/FAIMS system Ethernet switch	5	Support bracket
3	Nitrogen line from the laboratory nitrogen supply (or from a union Tee that connects both the MS and the MCB to the laboratory nitrogen supply)		

Check for gas leaks between the FAIMS housing adapter and the MS

If the FAIMS housing adapter is not properly seated on the MS, nitrogen gas will leak from the faulty seal between the housing adapter and the API source interface.

The FAIMS main controller box must be connected to the laboratory nitrogen supply and the FAIMS interface.

❖ **To check for a gas leak between the FAIMS housing adapter and the MS**

1. Open the Tune application if it is closed.

2. Click the vertical **Status** tab at the right of the Tune window. Then, navigate to the pressure readbacks for your MS. See Table 7.

   • For a TSQ MS or an Orbitrap Tribrid MS, check the Source Pressure readback.

   • For an Orbitrap Exploris MS, check the Fore Vacuum Pressure readback.

Table 7. Location of the pressure readbacks (by board and by function) (Sheet 1 of 2)
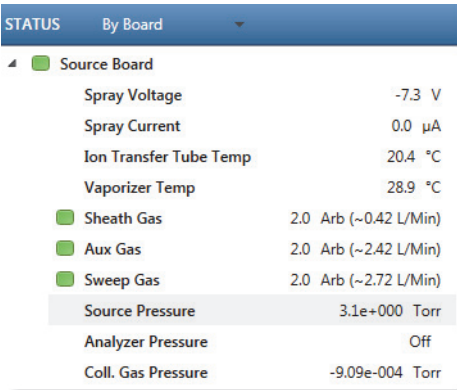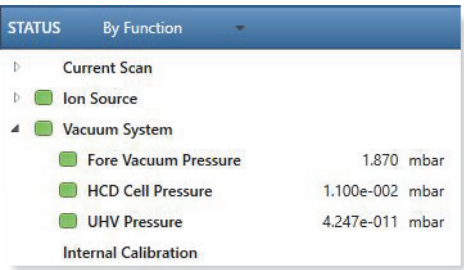
By Board	By Function
TSQ MS	

By Board	By Function
Orbitrap Exploris MS	

Table 7. Location of the pressure readbacks (by board and by function) (Sheet 2 of 2)

By Board	By Function
Orbitrap Tribrid MS	

3. Place a gloved finger over the entrance plate orifice.

4. Make sure that the pressure reading is less than the follow value.

Product line	Pressure reading
TSQ MS	<0.2 Torr
Orbitrap Exploris MS	<0.3 mbar
Orbitrap Tribrid MS	<0.2 Torr

Install the ion source housing on the FAIMS interface

After you install the FAIMS interface on the MS, install the ion source on the FAIMS interface.

Follow the procedure for the ion source you are using:

- Install the EASY-Spray NG ion source on the FAIMS interface

- Install the Nanospray Flex NG ion source on the FAIMS interface

- Install the OptaMax NG or the OptaMax Duet NG ion source on the FAIMS interface

- Install the VeriSpray ion source on the FAIMS interface

Install the EASY-Spray NG ion source on the FAIMS interface

The EASY-Spray NG ion source is compatible with nanoflow rates.

Preconditions

The FAIMS interface is installed on the mass spectrometer and the mass spectrometer is cooled to room temperature

❖ **To mount the EASY-Spray NG ion source onto the FAIMS interface**

1. Connect the power cable for the ion source heater to the bottom of the EASY-Spray NG ion source.

   Figure 37. P-Bus port on the bottom of the EASY-Spray NG ion source for the cable that supplies power to the column heater
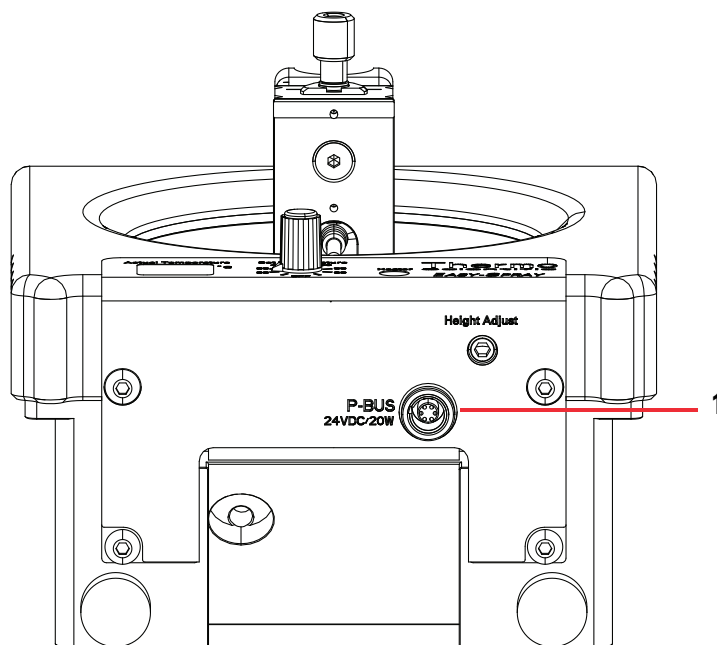
No.	Description
1	Input power connection

2. Unlock both of the ion source locking levers. See Figure 38.

3. Align the source mounting holes with the MS pins that extend through the housing adapter and carefully attach the source. Then, lock the source levers.

Figure 38. Mounting the EASY-Spray NG ion source on the FAIMS interface
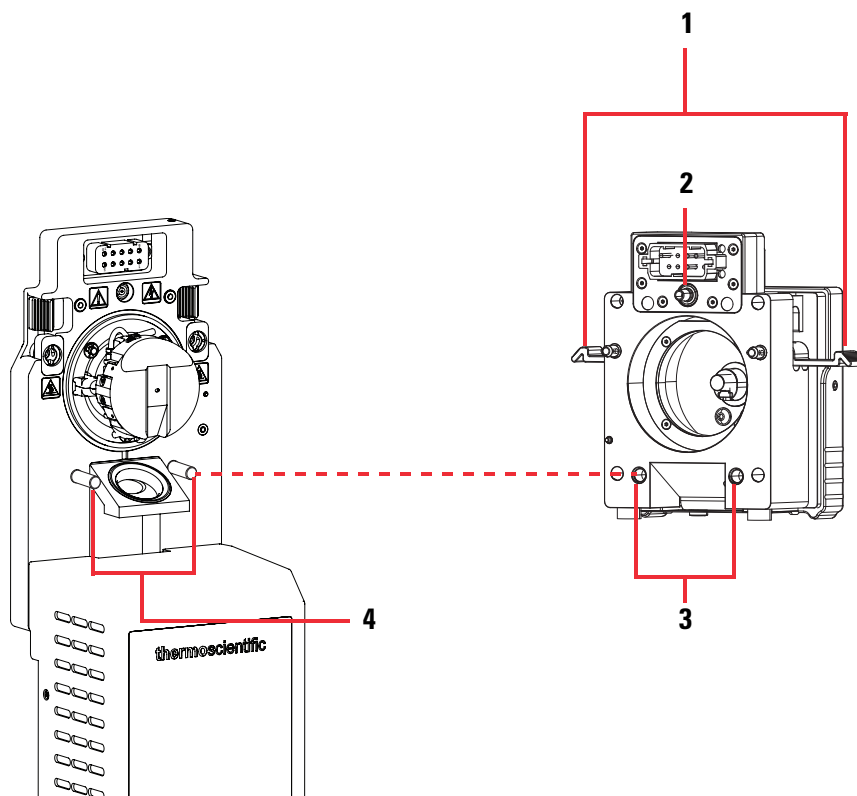
No.	Description	No.	Description
1	Source locking levers in the unlocked position	3	Mounting holes on the back of the ion source
2	High voltage connector	4	Mounting pins that extend through the FAIMS housing adapter

Tip For additional information, refer to the *EASY-Spray Series Ion Source User Guide*.

Install the Nanospray Flex NG ion source on the FAIMS interface

The Nanospray Flex NG ion source is compatible with nanoflow rates.

Preconditions

The FAIMS interface is installed on the mass spectrometer and the mass spectrometer is in Off mode and cooled to room temperature

❖ **To install the NanoSpray Flex NG source on the FAIMS interface**

1. Make sure that the MS is in Off mode and cooled to room temperature.

2. Unlock both of the ion source's locking levers.

3. Align the source mounting holes with the MS pins that extend through the housing adapter, and carefully attach the source. Then, lock the source levers.

Figure 39. Mounting the NanoSpray Flex NG ion source on the FAIMS interface
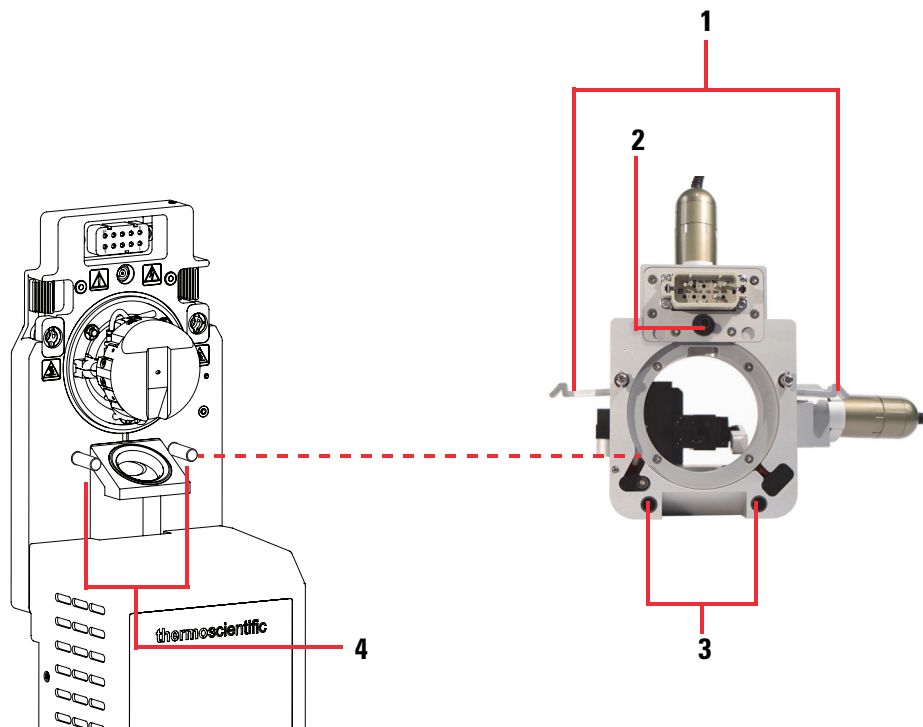
No.	Description	No.	Description
1	Source locking levers in the unlocked position	3	Mounting holes on the back of the ion source
2	High voltage connector	4	Mounting pins that extend through the FAIMS housing adapter

For additional information, refer to the *NanoSpray Flex NG Ion Source User Guide*.

Tip To access the ion source user guides that are available from the Tune window, click the **Set Options or View Help** icon, . Then, from the dropdown menu, choose **Instrument Manuals**, select the PDF that you want to view, and click **Open**.

Install the OptaMax NG or the OptaMax Duet NG ion source on the FAIMS interface

The OptaMax NG and OptaMax Duet are compatible with solvent flow rates from 1 to 1000 µL/min in the H-ESI mode and from 100 to 1000 µL/min in the APCI mode.

> **Note** The locking levers, high voltage connector, and source mounting holes are the same for the OptaMax and the OptaMax Duet.

To install the ion source housing on a mass spectrometer with a FAIMS interface, start at the appropriate step:

1. If the metal drain insert is installed in the source housing, remove it as described in "Remove the metal drain insert from the ion source housing."

   The metal drain insert that comes with the ion source housing is not compatible with the FAIMS interface.
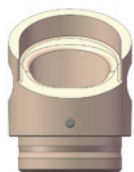
FAIMS-compatible drain insert	**Metal drain insert**
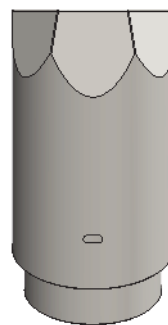
2. If the drain insert for operation with the FAIMS interface is not installed, install it as described in "Install the ion source drain insert that is compatible with the FAIMS interface."

3. If the FAIMS-compatible drain insert is already installed, install the ion source housing as described in "Install the ion source housing on the FAIMS interface" on page 65.

Remove the metal drain insert from the ion source housing

Preconditions
The ion source housing is removed from the mass spectrometer and cooled to room temperature.

❖ **To remove the metal drain inside the source housing at the bottom**

1. Make sure that the ion source housing is cooled to room temperature.

2. Remove the HESI source sprayer from the source housing as follows:

   a. Loosen the spray insert nut by turning it counterclockwise.

b. Pull the sprayer out of the heater block. See Figure 40.

Figure 40. HESI source sprayer removed from the ion source housing
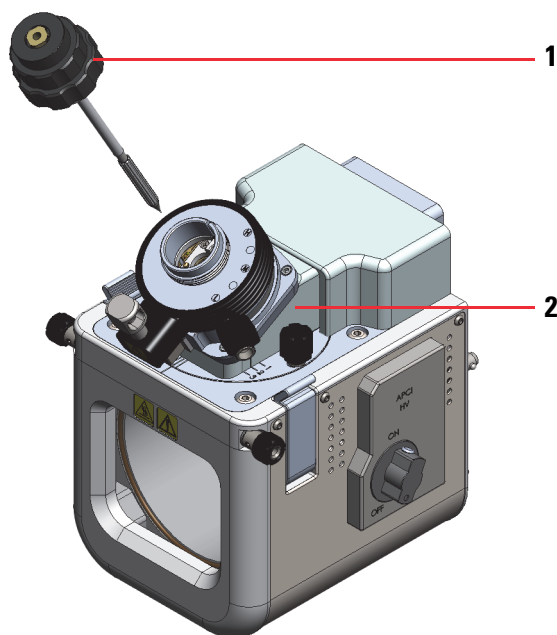
No.	Description	No.	Description
1	Sprayer insert nut	2	Heater block

> ⚠️ **CAUTION** If you do not remove the sprayer before removing the drain insert, you might accidentally damage the sprayer needle.

3. Put on a clean pair of lint-free and powder-free gloves.

> ⚠️ **CAUTION Sharp Object**. The corona discharge needle can puncture your skin. Handle it with care.

4. Using a needle-nosed pliers, grasp the base of the corona discharge needle and slowly pull it straight out of the socket. See Figure 41.

> **Note** The socket for the corona discharge needle is a push fit fitting.

Figure 41. View of the APCI needle inside the source housing
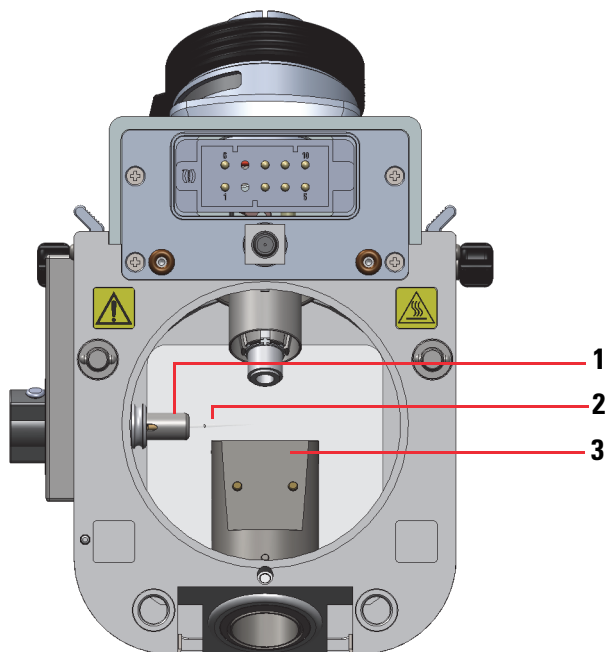
No.	Description	No.	Description
1	Press-fit needle socket	3	Metal drain insert
2	Corona discharge needle		

Go to the next topic to "Install the ion source drain insert that is compatible with the FAIMS interface."

Install the ion source drain insert that is compatible with the FAIMS interface

Preconditions

The ion source housing is removed from the mass spectrometer, and the metal drain insert is removed from the ion source housing.

❖ **To install the FAIMS-compatible drain insert**

1. Install the bottom FAIMS drain (FAIMS compatible drain insert) in the drain port at the bottom of the OptaMax NG ion source housing. The drain's pin aligns with the slot at the back of the ion source housing. See Figure 42.

Figure 42. Bottom drain port for the ion source housing and the bottom FAIMS drain
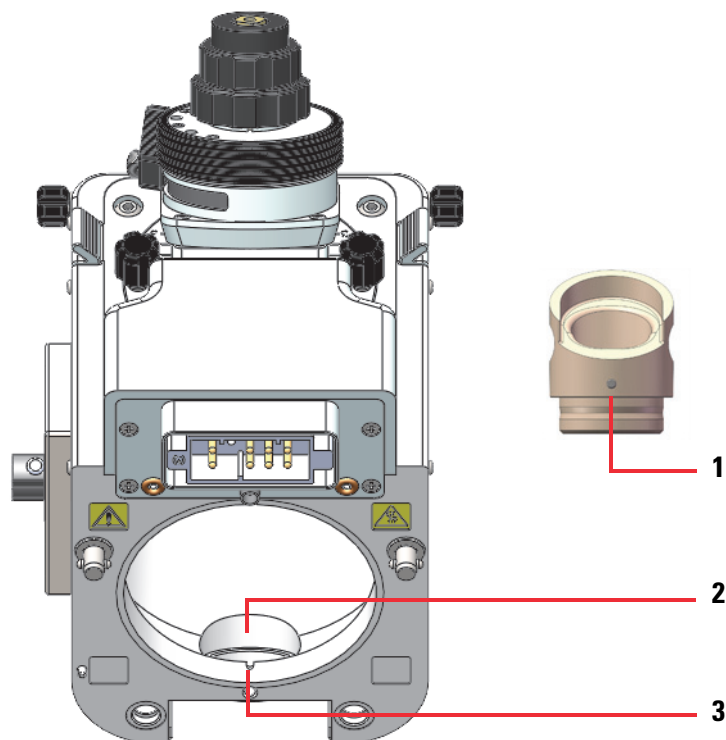
No.	Description	No.	Description
1	Alignment pin on the FAIMS bottom drain	3	Alignment slot at the back of the ion source housing
2	Drain port at the bottom of the ion source housing		

2. If you removed the corona discharge needle to remove the metal drain insert, do the following:

   a. Put on a clean pair of lint-free and powder-free gloves.

   > **CAUTION Sharp Object**. The corona discharge needle can puncture your skin. Handle it with care.

   b. Using a needle-nosed pliers, grasp the base of the corona discharge needle and slowly push it into the press-fit socket.

Go to the next topic to "Install the ion source housing on the FAIMS interface."

Install the ion source housing on the FAIMS interface

Preconditions

The FAIMS bottom drain insert and the corona discharge needle are installed in the ion source housing.

❖ **To mount the ion source housing to the FAIMS interface**

1. Unlock both of the ion source's locking levers.

2. Align the source mounting holes with the MS pins that extend through the housing adapter, and carefully attach the source. Then, lock the source levers.

Figure 43. Mounting the OptaMax NG ion source on the FAIMS housing adapter
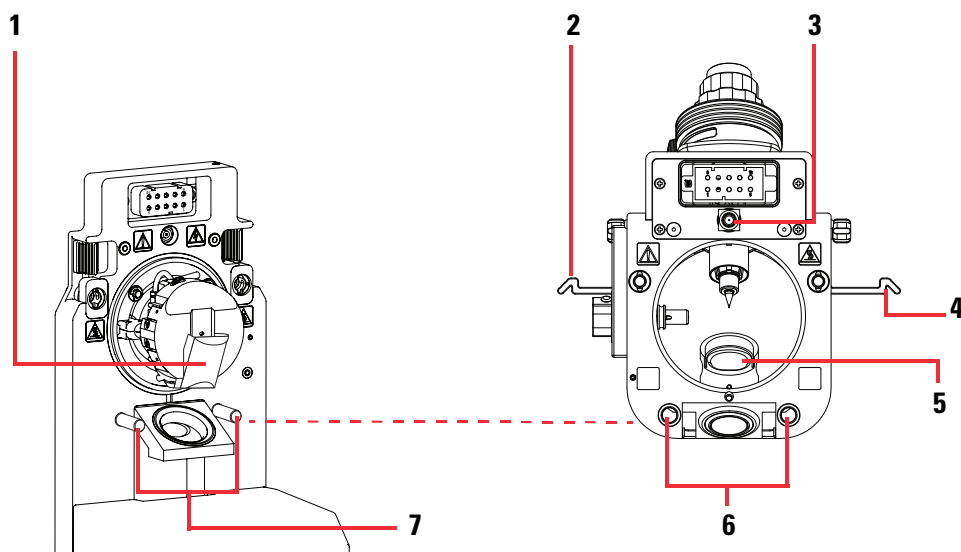
No.	Description	No.	Description
1	Upper FAIMS drain (high-flow applications)	5	Lower FAIMS drain for high-flow applications
2	Right ion source housing locking lever	6	Mounting holes at the back of the ion source housing
3	High voltage connector	7	Mounting pins that extend through the front of the FAIMS housing adapter
4	Left ion source housing locking lever		

For additional information, refer to the *OptaMax NG Ion Source User Guide* or the *OptaMax Duet NG Ion Source User Guide*.

> **Tip** To access the ion source user guides that are available from the Tune window, click the **Set Options or View Help** icon, ⚙▾. Then, from the dropdown menu, choose **Instrument Manuals**, select the PDF that you want to view, and click **Open**.

Install the VeriSpray ion source on the FAIMS interface

The VeriSpray ion source is a paper spray ion source. It mounts to the MS pins that extend through the mounting holes of the FAIMS housing adapter.

The VeriSpray ion source ships with the plate transport cover installed. Two rails align the cover to the module, and three magnets secure the cover to the module. See Figure 45.

❖ **To mount the VeriSpray ion source in front of the FAIMS interface**

1. Make sure that the MS is in Off mode and cooled to room temperature.

2. Install the FAIMS interface on the MS as described in "Install the FAIMS interface on the MS" on page 51.

3. If the plate transport cover is installed, remove it by doing one of the following, and then set it aside.

    • From the front of the module, pull the cover forward until it clears the alignment rails. See Figure 45.

   –or–

    • From the back of the module, use both hands to pull the back panels of the plate transport module and the solvent module forward as you push against the cover until you feel the magnets release the cover. Then, push the cover off the alignment rails.

Figure 44. Removing the plate transport cover
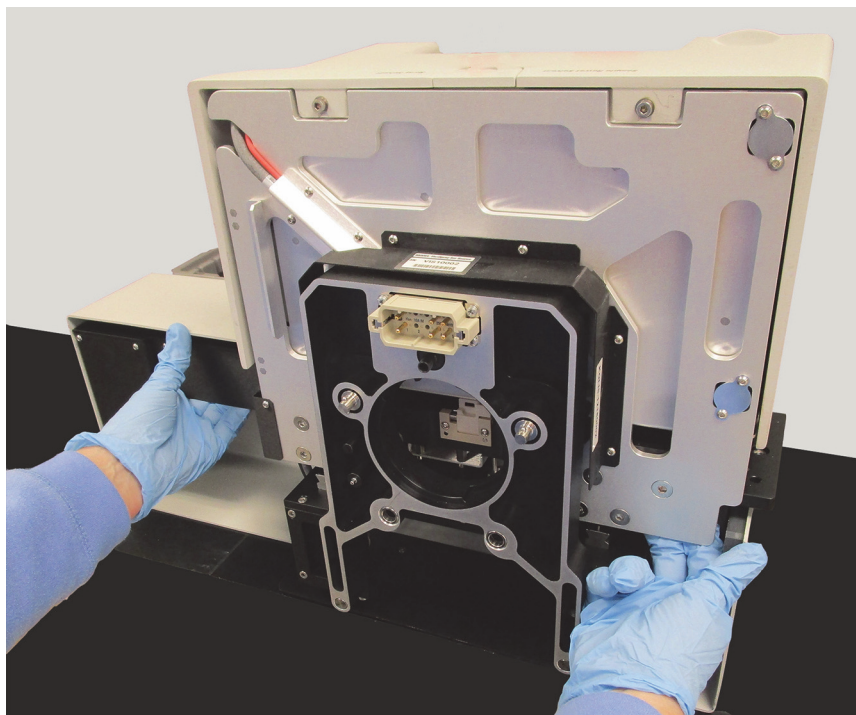
Figure 45. Back view of the plate transport's front cover showing the alignment rails and magnets

4. To mount the VeriSpray ion source in front of the FAIMS interface, do the following:

   a. Open the door of the VeriSpray ion source so you can see the mounting rails of the FAIMS interface above the plate transport platform.

   b. Open the ion source locking levers.

      Figure 46 shows the locking levers in the open position. It also shows the leg grips below the platform.

      Figure 46. Locking levers in the Open position
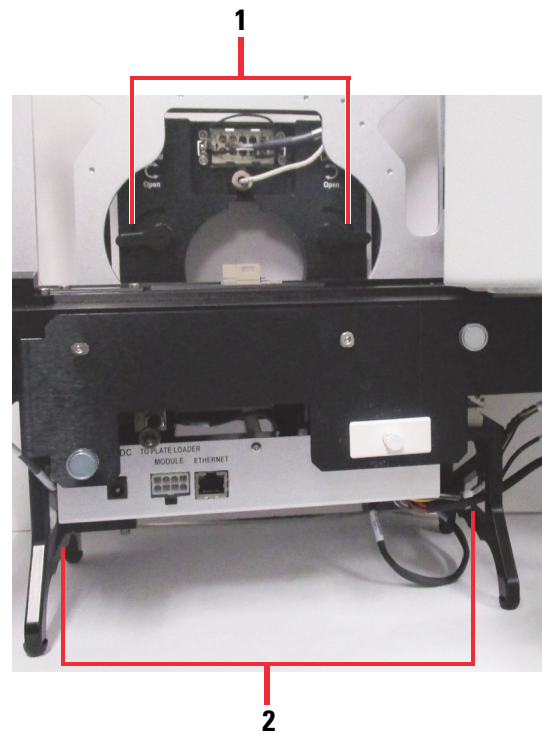
No.	Description	No.	Description
1	Locking levers in the open position	2	Leg grips

c. With the front of the ion source facing you, lift it by its leg grips.

d. Align the holes in the back of the ion source with the API source interface mounting rails that extend through the FAIMS housing adapter.

Figure 47. Back of the VeriSpray ion source with a view of the mounting holes
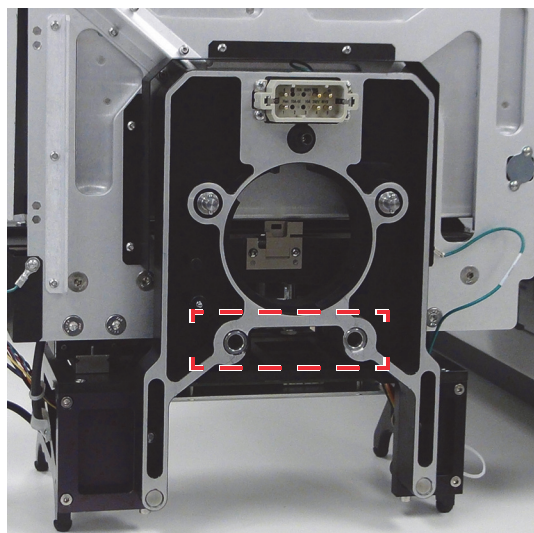
Figure 48. View of the mounting posts below the FAIMS electrode assembly and the mounting holes on the back of the VeriSpray ion source
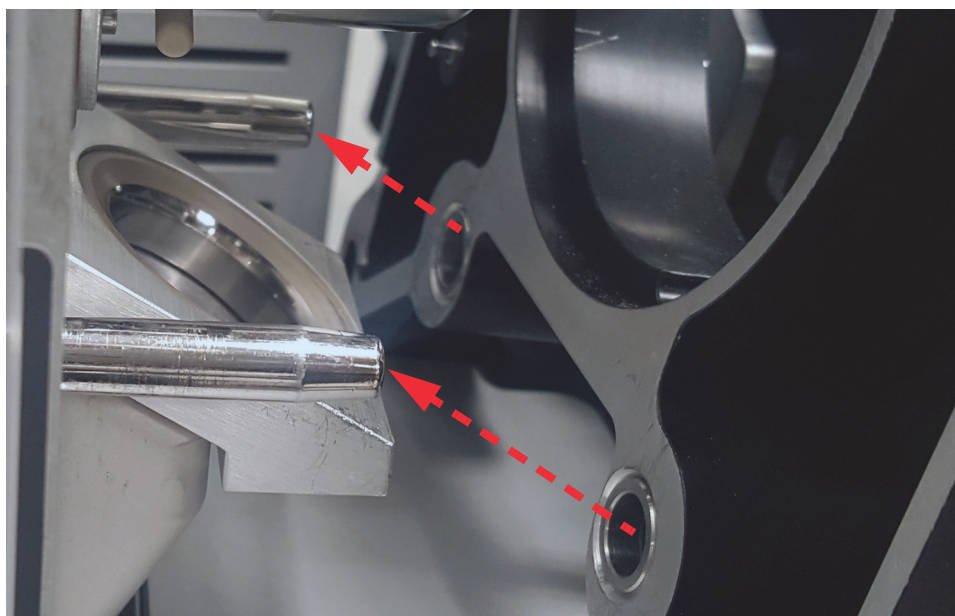
CAUTION As you mount the ion source on the FAIMS interface, take care to avoid dislodging any of the visible wires. If you accidentally dislodge a wire, a Thermo Fisher Scientific engineer must repair the damage.

e. Keep the ion source upright as you slide it onto the mounting rails until the mounting rails are supporting its weight.

    f.   Use one hand to hold the back panel of the ion source in place. Use the other hand to turn the locking levers to the Locked position.

5. Close the door of the VeriSpray ion source.

   As you close the door, you feel a slight resistance from the interlock and hear a click as the safety interlock engages.

6. To connect the VeriSpray ion source to the data system computer, use the Ethernet cable provided in the installation kit to connect the Ethernet port on the on front of the plate transport module to the data system's Ethernet switch. Route the cable through the upper slot in the left leg grip.

7. To connect the VeriSpray ion source to line power, do the following:

   a.   Route the cable from the 24V DC power supply module through the upper slot in the left leg grip, and then connect it to the 24V DC In port on the front of the plate transport module.

   b.   Using the supplied power cord, plug the power supply module into a 100–240 V ac electrical outlet.

CAUTION Only use the Limited Power Supply (LPS) module supplied with the ion source or an equivalent LPS module.

8. Turn on the VeriSpray ion source by toggling its power switch to the On (1) position.

9. Wait for the ion source to finish starting up. Then, from the Ion Source pane of the Tune application, verify that the data system recognizes the paper spray ion source—that is, make sure that the Ion Source Type readout displays Paper Spray. If the data system does not recognize the ion source, try remounting it to the MS ion source pins.

ION SOURCE	DEFINE SCAN	CALIBRATION	OPTIMIZATION
Ion Source Type		Paper Spray	
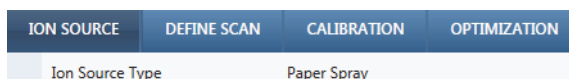
10. Adjust the *z*-axis position of the VeriSpray ion source—that is, adjust the distance between the paper strip tip and the orifice of the FAIMS entrance plate.

11. Install either the manual plate loader or the automated plate loader.

12. Install the plate transport cover.

13. Install the solvent bottles.

For additional information, refer to the *VeriSpray PaperSpray User Guide*.

Tip To access the ion source user guides that are available from the Tune window, click the **Set Options or View Help** icon, ⚙▾. Then, from the dropdown menu, choose **Instrument Manuals**, select the PDF that you want to view, and click **Open**.

Run the diagnostics for the FAIMS interface

This chapter describes how to run the diagnostics procedures for the FAIMS interface. The Tune DV RF process optimizes the dispersion voltage.

See the following topics:

- The FAIMS diagnostics
- Understanding the Tune DV RF diagnostic
- Run the Tune DV RF diagnostic
- Run the Check DV RF diagnostic

The FAIMS diagnostics

The following two FAIMS diagnostics options appear only when the FAIMS interface is installed on the MS and its main controller box is turned on.

- The Tune DV (dispersion voltage) RF diagnostic automatically sets the high electric field (HF) and low electric field (LF) that create the DV asymmetric waveform applied to the electrodes. The DV asymmetric waveform is the sum of two sine waves with voltage amplitudes for HF and LF.

- The Check DV RF diagnostic verifies that a tuned DV waveform delivers the appropriate output power at specific voltages.

Understanding the Tune DV RF diagnostic

FAIMS Pro use an asymmetric waveform to affect ion mobility. The FAIMS waveform (shown as a dark blue line in Figure 49) is produced by summing two sine waves:

- One with an high field amplitude (HF) of 1.67 KV at 3 MHz (dashed blue line)
- And the other ninety degrees out of phase with an low field amplitude (LF) of 3.33 KV at 1.5 MHz (dashed green line).

The resulting waveform is asymmetric (2.5 KV to –5.0 KV). The DV is the amplitude of the high field component of the waveform (–5.0KV).

Figure 49. Example ideal FAIMS waveform in positive mode
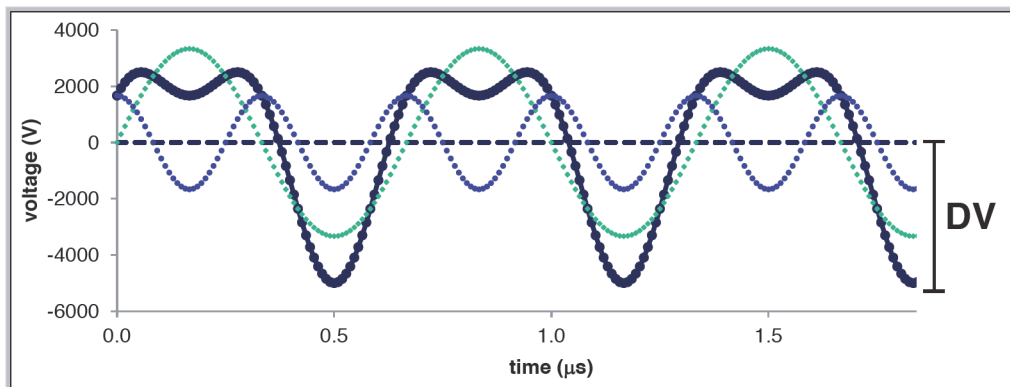
The six steps in the Tune DV RF diagnostic are as follows:

- Step 1: High Field RF Coarse Tuning

- Step 2: High Field Fine Rf Tuning

- Step 3: Low Field Coarse RF Tuning

- Step 4: Low Field RF Fine Tuning

- Step 6: Low Field and High Field DAC Adjustment

Step 1: High Field RF Coarse Tuning

The High Field RF Coarse Tuning Procedure of the Tune DV RF diagnostic sweeps the frequency of the tank circuit to find frequencies that correspond to the following:

- The minimum output current (black dashed line)

- The maximum amplitude (red dashed line)

Figure 50. High field RF coarse tuning result
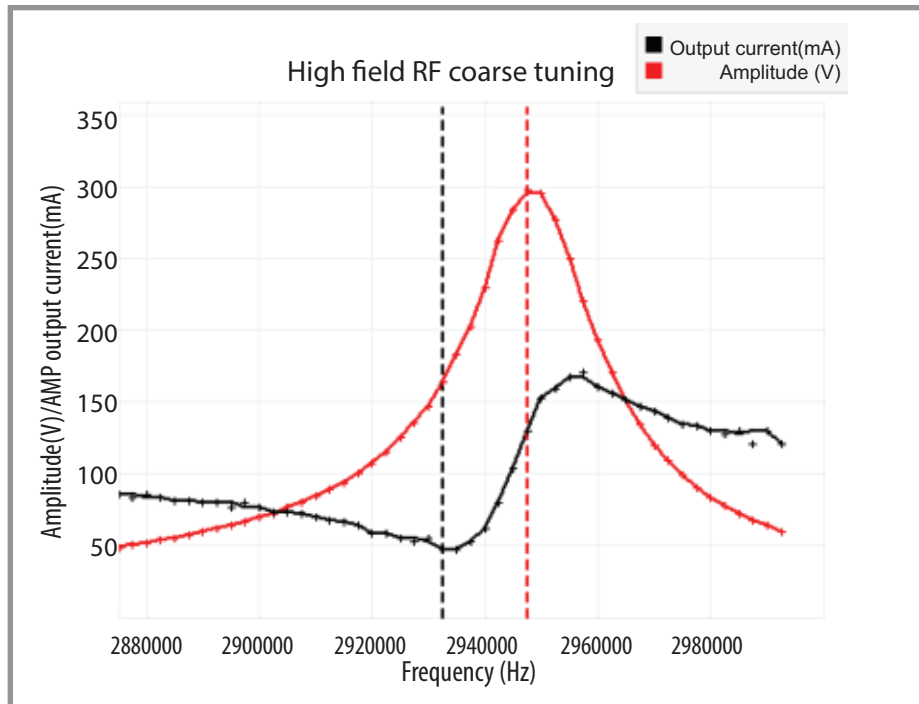
Step 2: High Field Fine Rf Tuning

The High Field Fine RF Tuning Procedure sweeps the frequency of the tank circuit between the previously determined boundaries. The procedure then tunes the frequency to a value that corresponds to the maximum amplitude at the minimum output current (red dashed line).

Figure 51. High field RF fine tuning result
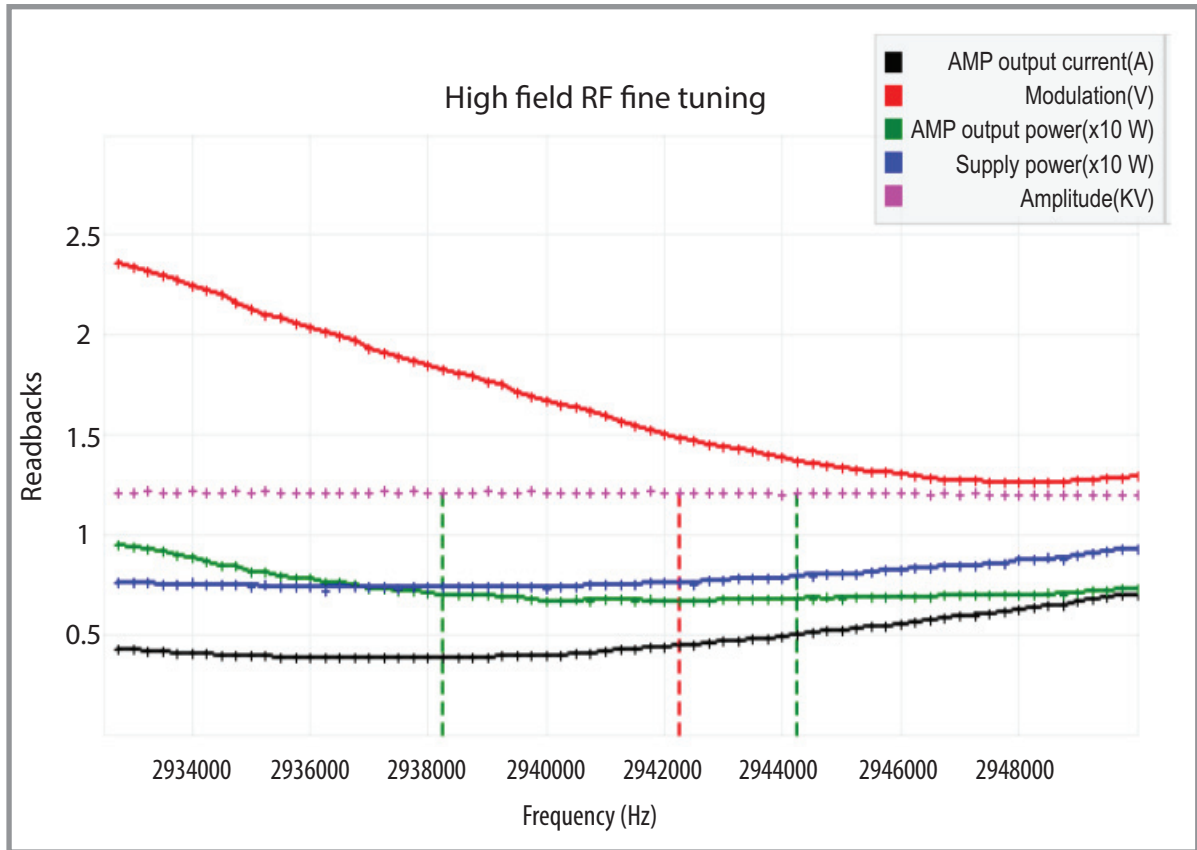
Step 3: Low Field Coarse RF Tuning

The Low Field Coarse RF Tuning procedure uses a stepper motor and air capacitor to sweep the frequency of the tank circuit to find the frequencies that correspond to the following:

- The minimum output current (black dashed line)

- The maximum amplitude (red dashed line)

Figure 52. Low field RF coarse tuning
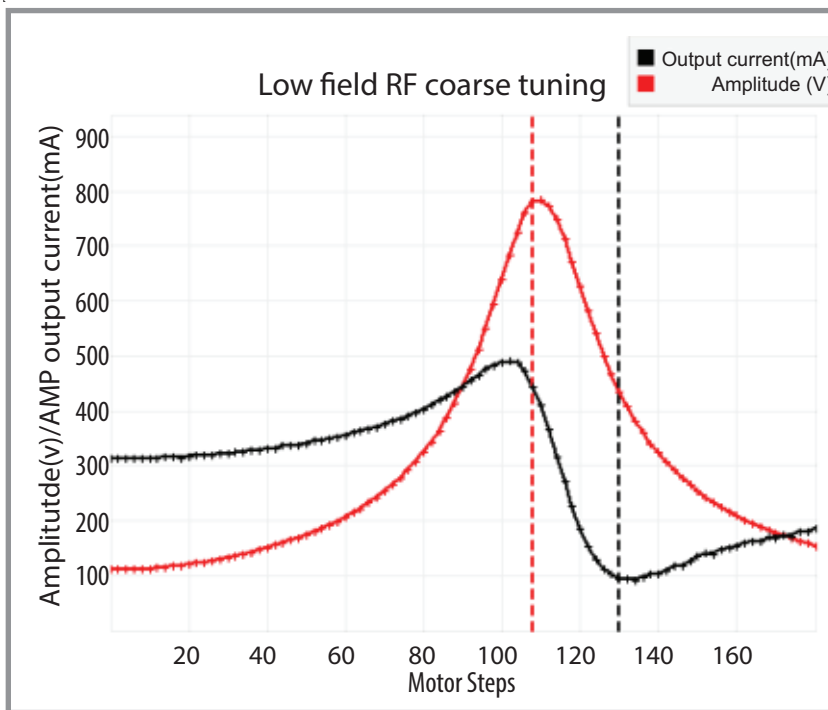
Step 4: Low Field RF Fine Tuning

The Low Field RF Fine Tuning step locates the motor step that has the resonance point. The resonance point has a minimum drive current, maximum output voltage, and minimum power for the amplifier (AMP) that generates the RF waveform for DV.

The application marks the resonance frequency by a dashed red line.

Figure 53. Low field RF fine tuning result
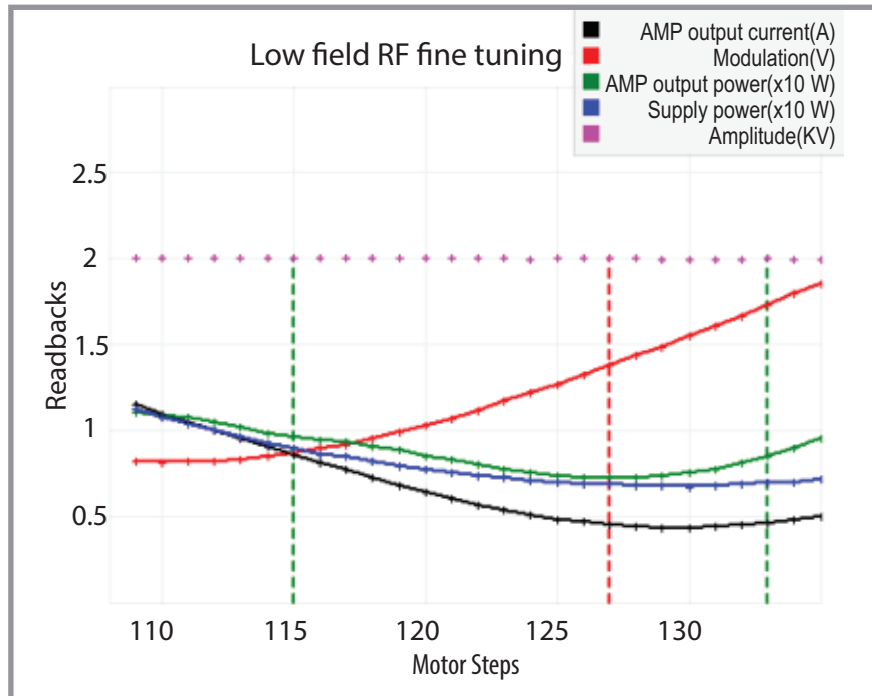
Step 5: Wait for DV Modulation DAC

The tuning procedure waits for the DV Modulation DAC to settle. The voltage settles as the circuit reaches the optimal operating temperature. The procedure verifies that the settling time is within the time specification. This procedure uses both the high field and the low field waveforms to generate the –5 kV DV.

See Figure 54 and Figure 55.

Figure 54. HF amplitude
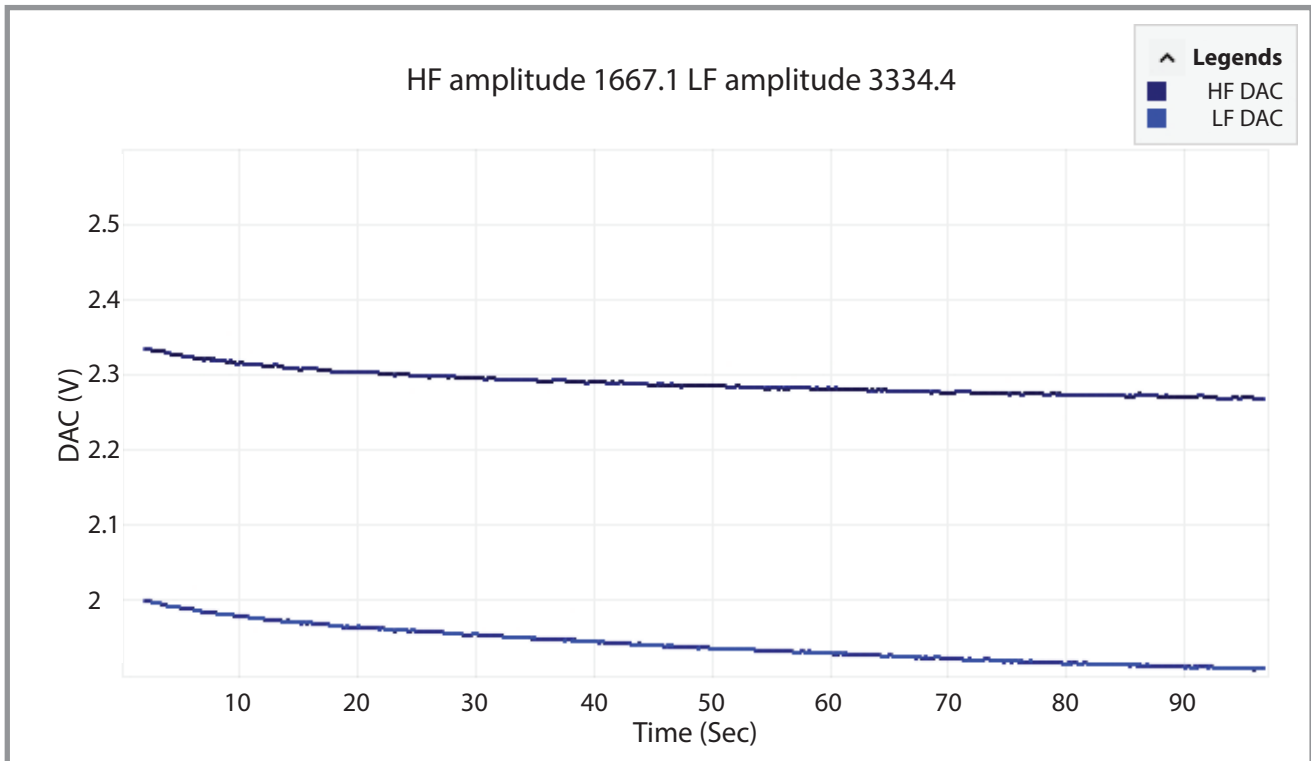
Figure 55. Settling time within specification
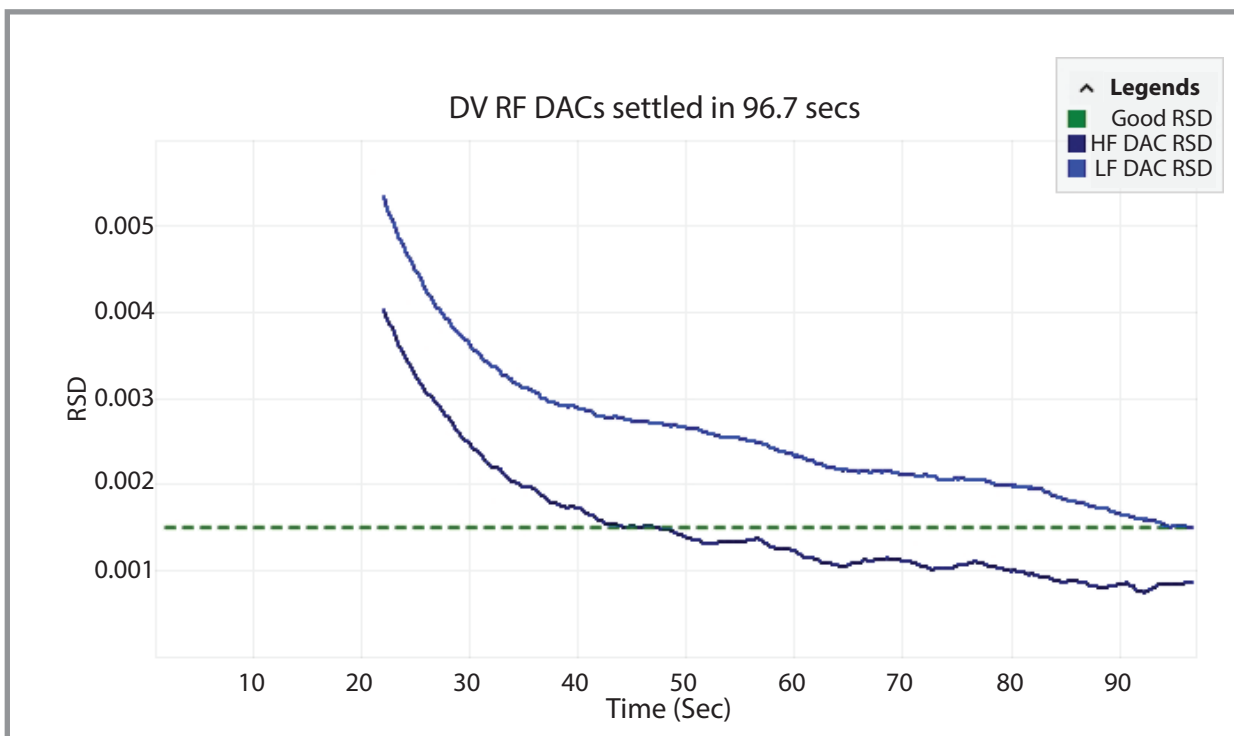
Step 6: Low Field and High Field DAC Adjustment

The tuning procedure next adjusts the high field and low field frequencies for the settled DV modulation DAC value.

After the diagnostic completes this step, the DV is tuned.

Figure 56.   High field modulation DAC adjustment
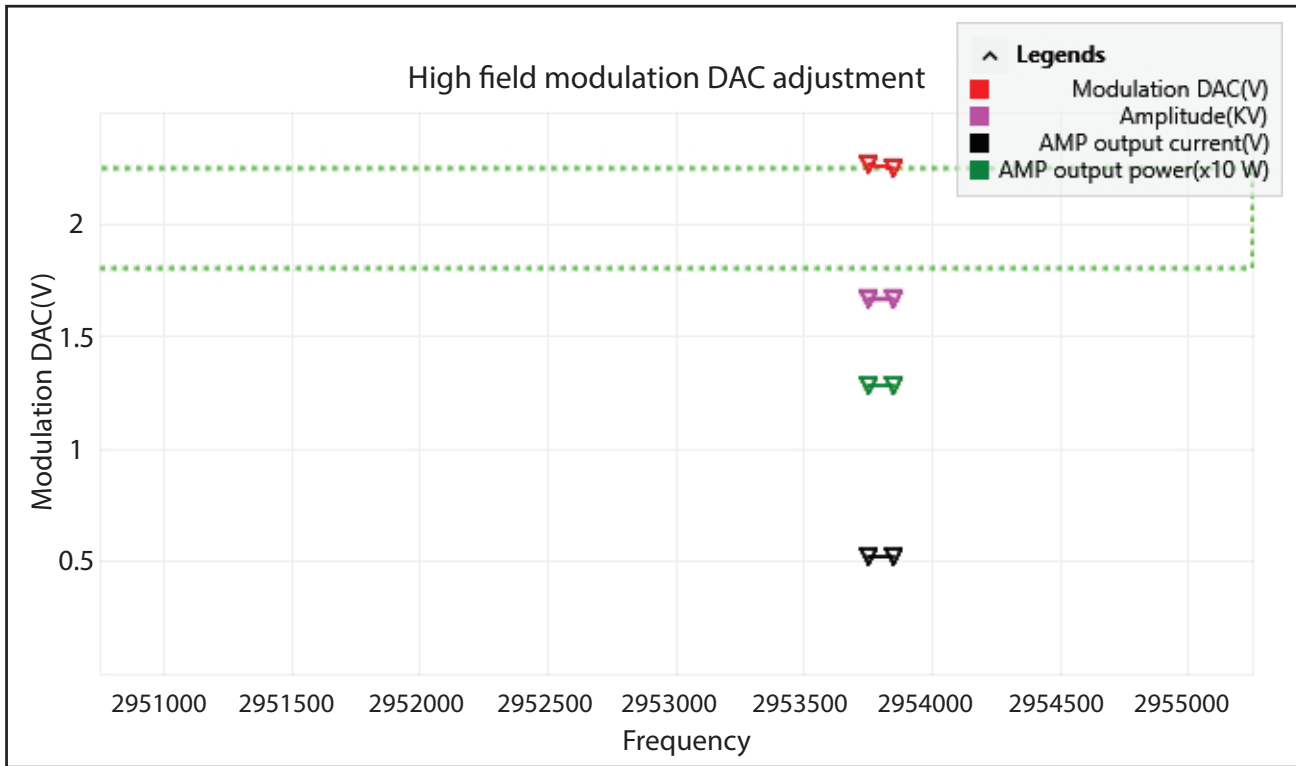
Figure 57. Low field modulation DAC adjustment
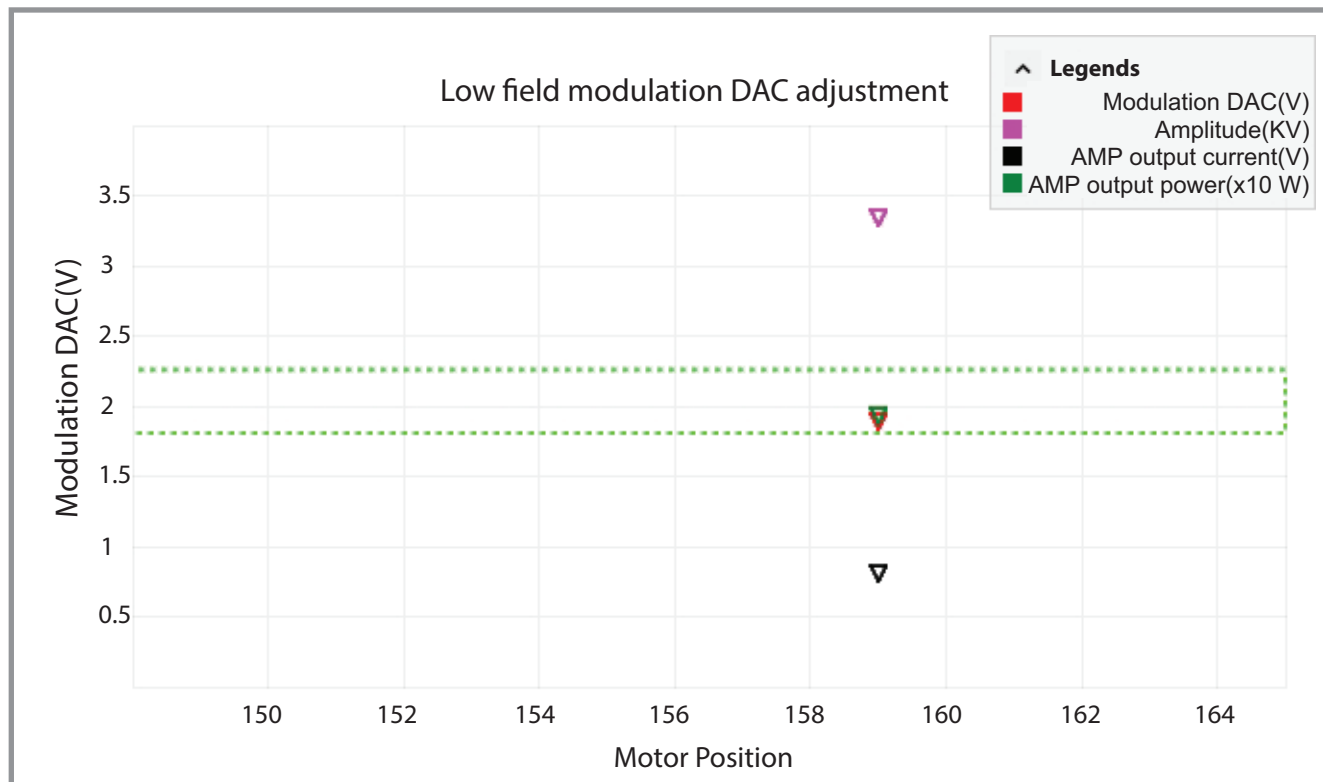
Run the Tune DV RF diagnostic

You must run the Tune DV RF diagnostic when you install the FAIMS interface on your MS, when you exchange the ion source housing for a different ion source housing, and when you remove the electrode assembly for cleaning, and then reinstall it.

The Tune DV RF diagnostic adjusts the input parameters to create a stable and consistent waveform output.

❖ **To run the FAIMS diagnostics—Tune DV RF option**

1. If the FAIMS interface is turned off, turn it on by toggling the power switch to the On (1) position on the back panel of the main controller box (MCB).

2. From the data system computer, open the Tune application.

3. Place the MS in **Standby** mode, ⏸ .

4. Wait for the electrode temperatures to reach their setpoints.

5. Click the **Diagnostics** icon, 🔧 , at the bottom left of the Tune window.

6. In the Diagnostics pane, expand the FAIMS section. Then, select the **Tune DV RF** check box.
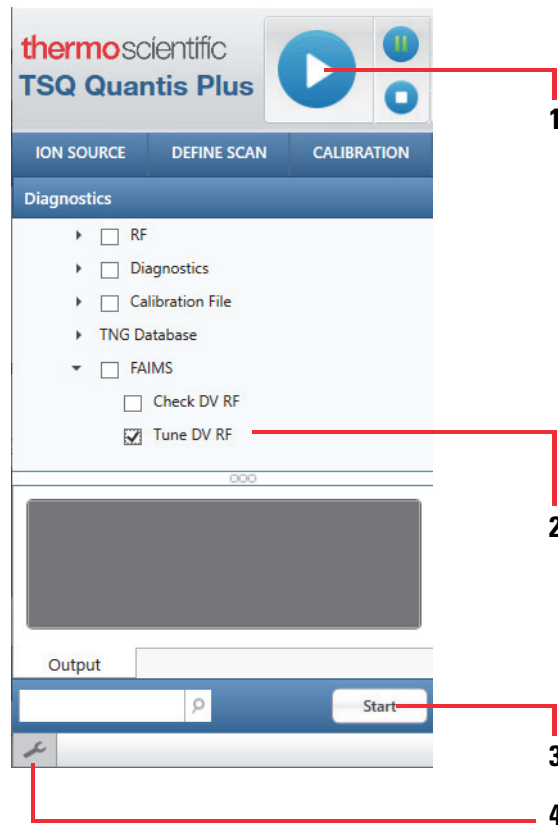
No.	Description	No.	Description
1	The green bars on the System Standby icon indicates that the MS is in Standby mode.	3	Clicking the Start button starts the of the diagnostics procedure that you selected.
2	Tune DV RF check box	4	Clicking the Diagnostics icon opens the diagnostics pane.

7. Click **Start**.

A yellow progress symbol appears to the left of the check box. The status panel at the bottom of the Diagnostics pane indicates "Run in progress."

Figure 58. FAIMS Diagnostics pane—Tune DV RF in progress (TSQ Quantis Plus shown)
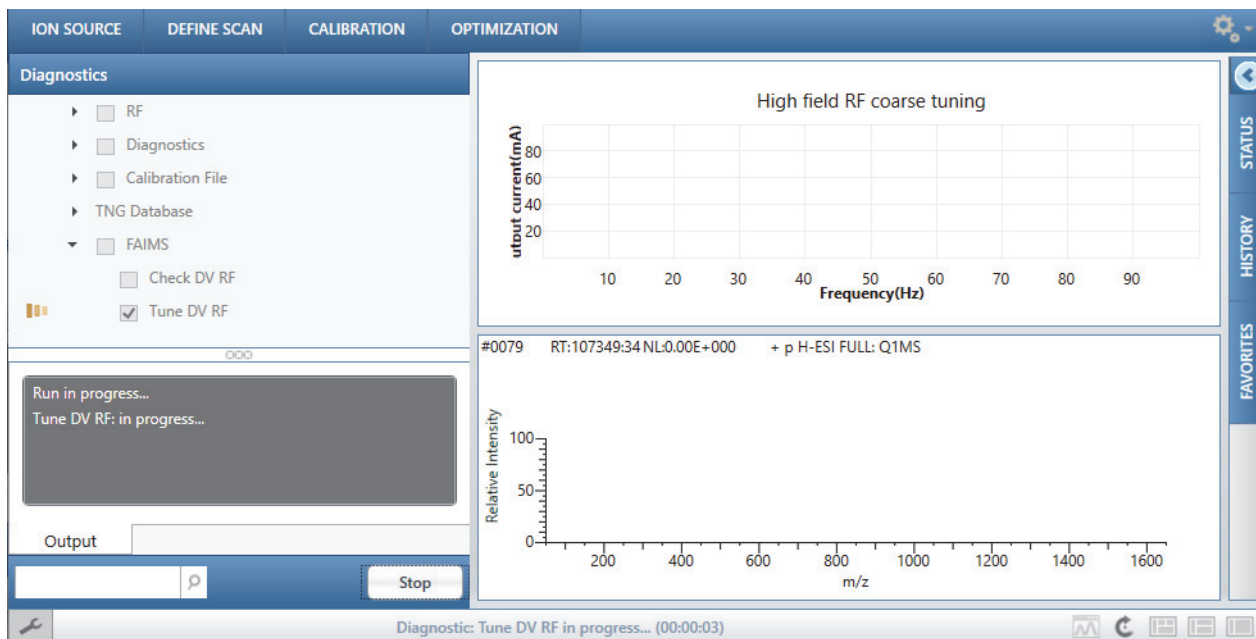
When the application completes the Tune DV RF diagnostic, a green check appears next to the Tune DV RF check box. The status panel at the bottom of the Diagnostics pane states that the diagnostic is completed.

Figure 59. FAIMS Diagnostics pane – Tune DV RF complete
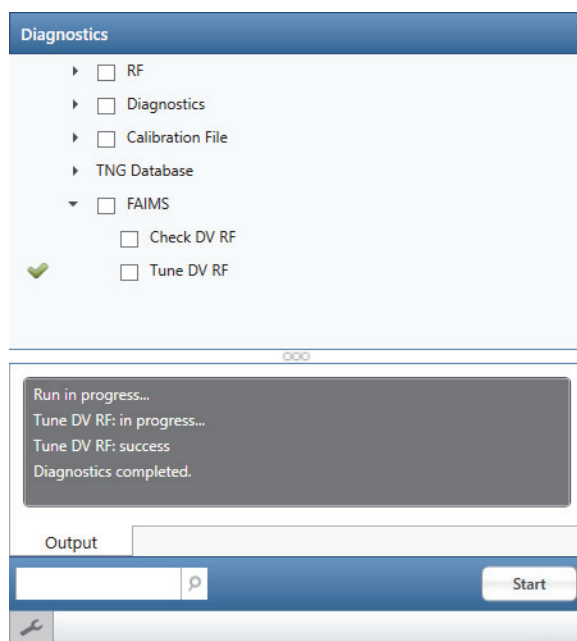
Run the Check DV RF diagnostic

The Check DV RF diagnostic performs the following steps:

- A DV RF ramp to check whether the DV amplitude can reach a list of different set points

- A fine head room check to verify that, at full power, the RF modulation DAC is in the specified range

Note The FAIMS interface continuously executes a Check DV RF verification for any ion source changes that you make. Changing the ion source housing results in a change to the output power, resonance frequency, and the motor step of the DV. These changes are due to the different electrical impedances between ion source housings.

If you change the ion source, the Tune application prompts you to run the Tune DV RF procedure.

❖ **To run the Check DV RF diagnostic**

1. If the FAIMS interface is turned off, turn it on by toggling the power switch to the On (1) position on the back panel of the main controller box (MCB).

2. From the data system computer, open the Tune application for your MS.

3. Place the MS in **On** mode, ▶, to turn on the system voltages.

4. Click the **Diagnostics** icon, 🔧, at the bottom left of the Tune window.

5. In the Diagnostics pane, expand the FAIMS section.

6. Select the **Check DV RF** check box.

7. Click **Start**.

   A yellow progress symbol to the left of the check box appears. The status panel at the bottom of the Diagnostics pane indicates "Run in progress."

   When the Check DV run is completed, a green check appears next to the Check DV RF check box. The status panel at the bottom of the Diagnostics pane states that the diagnostic is completed.

Adjust the emitter position or the probe depth

After you install the FAIMS interface on the MS and run the DV Tune process from the Diagnostics pane, adjust the emitter position in front of the orifice to the FAIMS electrode assembly. The adjustment procedure depends on the ion source you are using. If you are using the APCI mode, adjust the probe depth.

See these topics:

- Effect of the emitter position
- Quick procedure for adjusting the emitter position for nanoflow applications
- Complete procedure for adjusting the emitter position for nanoflow applications
- Probe depth for high-flow applications

Effect of the emitter position

The position of the emitter tip is critical for robust performance. The LC/MS/FAIMS system is usually more robust and delivers consistent spray stability when the sprayer position is optimized with respect to the orifice of the FAIMS entrance plate.

At nanoflow rates, the tip of the emitter must be no more than 1 mm from the entrance plate. This maximum distance is critical to optimize performance because the closer the spray tip, the better the spray stability and the lower the chance of droplet formation which can lead to DV instability.

Quick procedure for adjusting the emitter position for nanoflow applications

This procedure describes the basic adjustment procedure for the emitter position of a nanoflow ion source. Most of the nanoflow ion sources include a camera system for monitoring the emitter position and spray on a large screen.

❖ **To adjust the emitter position of a nanoflow ion source**

Place the emitter on the center of the x axis and just below center on the y axis.

Some emitters will optimize slightly off this recommendation. However, this is a good starting point for optimization.

Figure 60. Emitter position for nanoflow applications, showing the emitter centered on the x axis, but slightly below center on the y axis
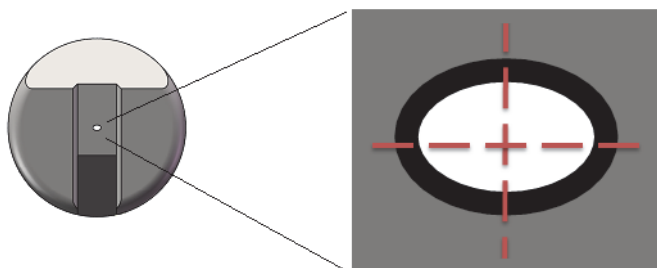
Figure 61. Example of an optimized position
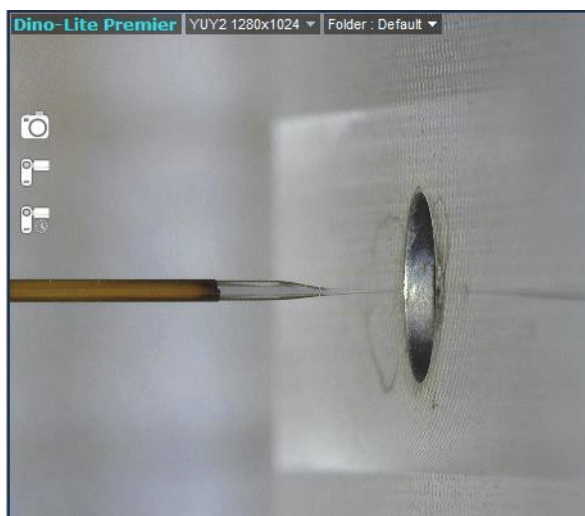
Figure 62. Example of an optimized position
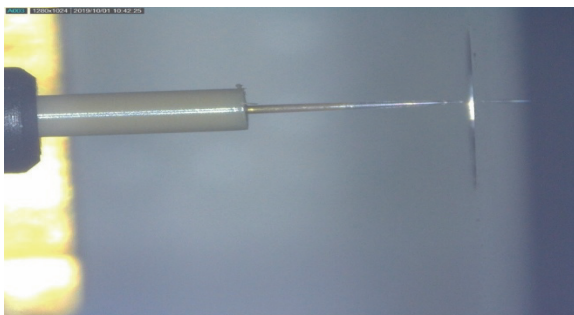
Complete procedure for adjusting the emitter position for nanoflow applications

You can follow this procedure for any nanoflow Thermo Scientific™ LC/MS/FAIMS system.

Required materials
Pierce Retention Time Calibration Mixture: 5 pmol/μL (P/N HAZMAT-01-00094) or any purified peptide
Solvent for dilution: 40% acetonitrile, 60% water, 0.1% formic acid (all solvents must be Optima™ LC/MS-grade)

Preconditions
The FAIMS interface is installed on the MS and the system has passed the DV RF Tune process.

Follow these topics in the order listed:

- Prepare the PRTC optimization solution

- Determine the optimum CV value for a specific peak in the spectrum

Prepare the PRTC optimization solution

In this user guide, the optimization procedure for the emitter position in a nanoflow system uses the Pierce Retention Time Calibration Mixture (PRTC), because it is available as a standard. But you can use any purified peptide that you are familiar with.

❖ **To prepare the appropriate concentration of the PRTC solution**

Dilute the Pierce Retention Time Calibration Mixture (PRTC) 20-fold in a diluant of 40% acetonitrile/60% water/ 0.1% formic acid. All solvents must be Optima™ LC/MS grade.

> **Note** In the emitter adjustment procedure, you optimize the emitter position by monitoring the intensity of the spectral peak at *m/z* 493.768 after you determine its optimal CV value.

Table 8. Expected spectral peaks in the full scan spectrum of PRTC

PRTC peptide (heavy labeled)	m/z (doubly charged)
SSAAPPPPPR	493.768
GISNEGQNASIK	613.316
HVLTSIGEK	496.286
DIPVPKPK	451.283
IGDYAGIK	422.736
TASEFDSAIAQDK	695.832
SAAGAFGPELSR	586.801
ELGQSGVDTYLQTK	773.895
GLILVGGYGTR	558.325
GILFVGSGVSGGEEGAR	801.411
SFANQPLEVVYSK	745.392
LTILEELR	498.801
NGFILDGFPR	573.302
ELASGLSFPVGFK	680.373
LSSEAPALFQFDLK	787.421

Determine the optimum CV value for a specific peak in the spectrum

The following procedure determines the optimum CV value for the selected ion in the Pierce
Retention Time Calibration Mixture (PRTC mixture) or an ion for a purified peptide of your
choosing.

❖ **To adjust the emitter position in front of the FAIMS entrance plate**

1. Prepare the LC/MS/FAIMS system to infuse the diluted PRTC solution (or another
   purified peptide solution). Use the same flow rate that you are using for your actual
   experiments.

2. Open the Tune application by clicking the **Tune** icon, , on the desktop.

3. Place the MS in **On** mode, .

4. Click the **Define Scan** tab.

5. While infusing the PRTC solution, monitor the ion at *m/z* 493. 768 in the selected ion
   monitoring (SIM) mode as follows:

   a. Select **SIM Scan** in the Scan Type list.

b.   Type the precursor *m/z* value of the ion to be monitored

c.   In the FAIMS Voltages list, select **On**.

Selecting On turns on the FAIMS voltages.

d.   Click **Apply**.

ION SOURCE	DEFINE SCAN	CALIBRATION	OPTIMIZATION
Scan Type		SIM Scan	
Precursor (m/z)		493.768	

FAIMS Voltages		On	
FAIMS CV (V)		0	

Apply

6.   Perform a CV scan on the selected PRTC ion to determine its optimum CV value as follows:

a.   In the data acquisition pane, click **Continuous Acquisition**.

The data acquisition pane drops down.

b.   Select the **Enable FAIMS CV Scan** check box.

The Continuous Acquisition button becomes the FAIMS CV Scan button.

c.   Specify the CV scan range and step size:

- In the Start box, type **–80**.

- In the Stop box, type **25**.

- In the Step box, type **1**.

The Tune application displays the estimated duration, in seconds, of the scan.

d.   Click the **Record** icon, 📹 .

The Tune application starts the optimization process.

When the Tune application completes the CV optimization process, it displays a plot of intensity versus CV value, and it displays the optimum CV value.

7. In the Define Scan pane, type the optimum CV value for the monitored peak in the FAIMS CV (V) box.

FAIMS Voltages	On
FAIMS CV (V)	– 46

Monitor the intensity and spray stability while changing the emitter position

To determine the optimal emitter position, you can monitor the intensity and spray stability for a specific spectral peak at its optimum CV value in the Tune application.

Preconditions

You have set up your LC/MS/FAIMS system to monitor the intensity of a specific ion at its optimal CV value. See "Determine the optimum CV value for a specific peak in the spectrum" on page 85.

❖ **To plot the intensity and spray stability as you reposition the emitter**

1. At the bottom right of the Tune window, click the **Plot Chromatogram** icon ⩜ .

2. In the Plot Chromatogram dialog box, select the **Spray Stability** check box and the **TIC** option.

Figure 63. Plot Chromatogram dialog box
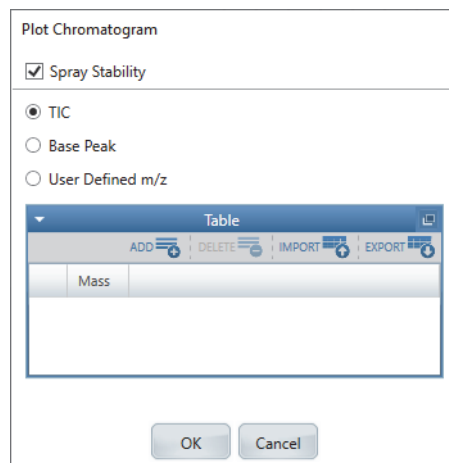
3. While monitoring the intensity and spray stability, optimize the emitter to a centered and close (x, y and z direction) position.

The final position must not be more than 1 mm from the orifice of the entrance plate (z-direction). While optimizing the position of the emitter, adjust the spray voltage for maximum intensity while maintaining stability (%RSD) at an acceptable level (< 5%).
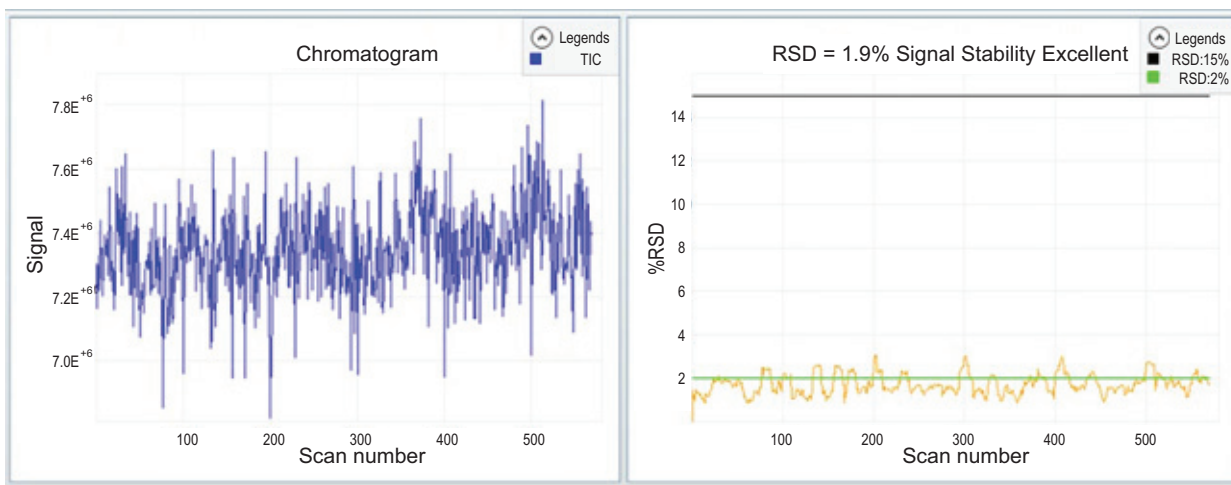
> **Tip** Additional recommendations for optimizing the spray stability and emitter position:
>
> - Mimic the actual experimental setup in terms of the flow rate and emitter type when you optimize the spray and emitter position.
>
> - For fused silica emitters, position the emitter tip within 1 mm or less of the FAIMS entrance plate orifice.
>
> - Keep an eye out for any arcing. The spray current for 0.1% formic acid in water at 300 nL/min should be between 0.3 to 0.7 µA.
>
> - Always use a sample with a known analyte or a standard for optimization. Do not use background ions, as they can change in intensity, for example, when you use a different batch of solvents or a different chromatography column.

Probe depth for high-flow applications

For high-flow applications with the FAIMS interface, adjust the sprayer position as follows:

- In APCI mode, start by moving the sprayer to the same position that a non-FAIMS experiment would use. If necessary, adjust the position for robustness and spray stability.

  Thermo Fisher Scientific recommends the following settings:

  – Depth: Position M to position H

  – Front-to-back: Position 1 or higher

  > **IMPORTANT** Thermo Fisher Scientific does not recommend setting the depth closer than position M or the front-to-back position closer than position 1. Placing the sprayer too close to the FAIMS entrance plate can cause arcing that results in DV dropouts or FAIMS hardware failure.

- In H-ESI mode, move the sprayer lower than a non-FAIMS experiment would use. Thermo Fisher Scientific recommends the following settings:

  – Depth: L or M/L position

  – Front-to-back: Position 1

Operate the FAIMS interface

This chapter describes how to operate the FAIMS interface after you install it on a Thermo Scientific mass spectrometer and run the DV Tune RF diagnostic.

> **Tip** For information about running the DV Tune RF diagnostic, see Chapter 6, "Run the diagnostics for the FAIMS interface."

> **Note** There are no calibration procedures for the FAIMS interface. To calibrate the mass accuracy of the MS, you must temporarily uninstall the FAIMS interface.

See the following topics:

- FAIMS parameter settings
- Effect of the ion transfer tube type on the FAIMS gas conductance
- Readback measurements
- FAIMS parameters in the Method Editor
- FAIMS parameters in the Tune application
- Acquire sample data manually by using the Tune application
- Acquire sample data with instrument method in the Tune window
- Acquire data by submitting a sequence run to the acquisition queue
- Recommendations for proteomics experiments
- Converting instrument methods without FAIMS settings
- On/Off status of the FAIMS interface under varying power conditions

FAIMS parameter settings

The temperature settings of the FAIMS electrodes (FAIMS Mode parameter setting) remain constant throughout the experiment, but you can define the CV voltages as scan dependent and the Total Carrier Gas flow rate as time dependent over the course of an experiment.

For details about the parameters for the FAIMS interface, see these topics:

- Compensation voltage

- FAIMS Mode

- Recommended resolution mode for proteomics applications

- Typical CV optima for peptides

- Total carrier gas flow rate

- Recommendations for the flow rate of the FAIMS carrier gas

Note When you turn on the MS, its firmware checks for the FAIMS interface by sending commands to the FAIMS waveform generator. If the MS receives valid responses to these commands, it assumes that the FAIMS interface is installed.

When the FAIMS interface is installed, the FAIMS parameters appear in the Tune application, but they do not automatically appear in the Method Editor. To make the FAIMS parameters available in the Method Editor, you must select a FAIMS mode on the Global Parameters page.

For information about installing the FAIMS interface, see Chapter 5, "Install the FAIMS interface."

Compensation voltage

For the FAIMS interface, the compensation voltage (CV) is the DC potential offset that is applied to the inner electrode to transmit selected subsets of ions through the electrodes. You optimize the CV for specific ion, and it is typically negative value for positive ions and a positive value for negative ions.

For information about determining the optimal CV values for your analytes, see "Determine the optimal CV values for your analytes" on page 115.

For information about setting the compensation voltages, see "FAIMS parameters in the Tune application" on page 103 and "FAIMS parameters in the Method Editor" on page 100.

FAIMS Mode

For the FAIMS interface, temperature can affect ion selection by changing the gas density in the radial space between the inner and outer electrodes.

In the FAIMS interface, two heaters for the outer electrode, one heater for the inner electrode, and the cooling gas provide temperature control.

The cooling gas, which cools the electrodes when the temperature rises above the specified settings, enters the electrode assembly through tubing in the FAIMS housing adapter and flows through the air channels in the inner and outer electrodes. These air channels for the cooling gas are separate from and orthogonal to the flow path for the FAIMS carrier gas.

For the FAIMS interface, you set the temperatures of the inner and outer electrodes by selecting the FAIMS Mode:

- Standard Resolution—Both electrodes are set to 100°C.

- High Resolution—The inner electrode is set to 80°C and the outer electrode is set to 100°C.

- User Defined—You specify the temperature settings independently for the inner and outer electrodes, within the range of 70 to 100°C.

  The separate heaters for the inner and outer electrodes provide independent temperature control of electrodes. Setting the inner and outer electrodes to different temperatures can enhance ion selectivity, but it also affects ion transmission (intensity) as follows:

  – When the inner electrode temperature is lower than the outer electrode temperature, ion transmission tends to decrease as the difference in temperature between the electrodes increases.

  – When the inner electrode temperature is higher than the outer electrode temperature, ion transmission (intensity) tends to increase as the difference in temperature between the electrodes increase.

  > **Note** At inner electrode temperature settings below 75 °C, the FAIMS interface might not be able to maintain the set temperature in the APCI mode when the instrument method includes any of the following conditions:
  >
  > - A mobile phase that contains a high percentage of methanol
  >
  > - A gradient where the organic composition changes rapidly
  >
  > - A vaporizer temperature setting above 400 °C

- Not Installed (Method Editor only)—Use this selection only to create instrument methods for LC/MS systems that do not include the FAIMS interface.

Recommended resolution mode for proteomics applications

For proteomics applications, start the optimization process by using the Standard Resolution mode. This mode maximizes transmission and the fraction of peptides collected, while sending common interfering ions found in biological samples to waste.

When running a targeted experiment, start the optimization process by using the Standard Resolution mode. If the Standard Resolution mode does not provide the necessary signal-to-noise enhancement, try using the High Resolution mode, which can give additional selectivity.

Table 9 shows a comparison of the CV scan results for the ion at *m/z* 922 in Flex Mix. The peak width is narrower in High Resolution mode, but the intensity is lower.

The High Resolution mode yields CV optima that are slightly less negative than the Standard Resolution mode because the DV field strength is proportional to the temperature differential between the electrodes.

The High Resolution mode decreases transmission (resulting in a lower intensity) because the temperature differential between the electrodes increases diffusion as ions pass through the electrode set.

Table 9. CV optimization results for the *m/z* 922 ion in Flex Mix solution

FAIMS mode	Optimum CV (V)	FWHM (V)	Intensity
Standard Resolution	–29	7.52	$1.4e^{+7}$
High Resolution	–26	6.39	$1.1e^{+7}$

Total carrier gas flow rate

In the FAIMS interface, the base carrier gas flow rate is determined by the type of ion transfer tube that the MS uses and is automatically set by the instrument control software.

In the instrument control software, the parameter for the FAIMS carrier gas is the Total FAIMS Carrier Gas. The default setting and the available range for this parameter depends on the cross-sectional area of the ion transfer tube bore that the MS uses. See Table 10.

To reduce or add more carrier gas, you can adjust the Total FAIMS Carrier Gas parameter setting in the Tune application and the Method Editor.

Table 10. Total FAIMS Carrier Gas settings for the compatible Thermo Scientific mass spectrometers

MS model	Ion transfer tube bore	Total FAIMS Carrier Gas	
		Default (L/min)	Range (L/Min
• TSQ Quantiva	 2.00 mm (0.079 in.) 0.60 mm (0.024 in.)	5.2	4.2 to 8.2
• TSQ Altis Plus • TSQ Altis • Orbitrap Eclipse • Orbitrap Fusion Lumos • Orbitrap Exploris 480	 1.60 mm (0.063 in.) 0.60 mm (0.024 in.)	4.6	3.5 to 7.7
• TSQ Quantis Plus • TSQ Quantis • TSQ Endura • Orbitrap Exploris 120 • Orbitrap Exploris 240 • Orbitrap Fusion • Orbitrap ID-X • Orbitrap IQ-X	 0.58 mm ID (0.023 in.)	1.2	0.7 to 4.3

Recommendations for the flow rate of the FAIMS carrier gas

You can set the Total FAIMS Carrier Gas within a defined flow rate range.

See the following topics:

- Nanoflow applications
- High-flow applications with the H-ESI ion source or the APCI ion source
- High-flow applications with the APCI ion source only

Nanoflow applications

For nanoflow and microflow rates (Easy-Spray™ and NanoFlex™ source), Thermo Fisher Scientific does not recommend adding additional gas to the default value for the Total FAIMS Carrier Gas parameter setting. Because the FAIMS carrier gas acts as a counter-gas to the spray, increasing its flow rate can decrease ion transmission significantly.

To increase ion transmission and spray stability, try decreasing the FAIMS gas when necessary.

High-flow applications with the H-ESI ion source or the APCI ion source

For high-flow applications with the OptaMax™ NG source housing, increase the Total FAIMS Carrier Gas setting above the default value (by an additional 0 to 3.1 L/min) to increase desolvation and resolve the following issues:

- The appearance of several peaks in the CV spectrum for a particular *m/z* value. These overlapping peaks might arise from variously solvated species.

- The transmission CV differs from a previously observed value for a particular ion.

  Note The CV required for the transmission of solvated species differs from the CV required for desolvated ions.

- The ion signal intensity is low.

If the FAIMS carrier gas flow rate is set too high, the FAIMS gas can act as a counter-gas to the spray. When the FAIMS gas acts as a counter-gas to the spray, the ion intensities decrease from the optimal value, but the CV of transmission remains unchanged.

Thermo Fisher Scientific does not recommend reducing the carrier gas below the default for high-flow applications. At high solvent flows, reducing the carrier gas flow can lead to liquid entering the electrodes, which causes DV instabilities.

High-flow applications with the APCI ion source only

For high-flow applications with the OptaMax™ NG ion source in the APCI mode, the spray is reasonably stable at the default Total FAIMS Carrier Gas flow rate for LC flow rates below 499 µL/min. Additional FAIMS gas is needed for a stable APCI spray as the LC flow rate increases (see Table 11).

Table 11. Recommended carrier gas flow rates for the APCI mode

LC flow rate	Total FAIMS carrier gas
<0.5 mL/min	Use the default setting.
0.5 mL to 0.8 mL/min	Add 0.5 to 0.7 L/min to the default setting.
> 0.8 mL/min	Add 1 L/min to the default setting.

Effect of the ion transfer tube type on the FAIMS gas conductance

The type of ion transfer tube that the MS uses affects the gas conductance through the FAIMS electrodes, which in turn affects other experimental variables.

As the FAIMS carrier gas flows through the space between the inner and outer electrodes, the mass spectrometer's vacuum system draws the gas into the orifice of the ion transfer tube. The gas conductance—which is the flow rate of a gas between two points divided by the pressure drop between those two points—is higher for mass spectrometers that use high-capacity ion transfer tubes[1] (HCTT) with elongated bores than for mass spectrometers that use ion transfer tubes[2] (ITT) with narrow round bores. The higher conductance for the high-capacity ion transfer tubes is due to their larger internal cross-section, as compared to narrow bore ion transfer tubes.

The higher gas conductance through an HCTT inlet leads to faster movement of the analytes through the FAIMS electrode assembly, as compared to an ITT inlet.

The difference in the ion residence time in the electrode assembly affects the following experimental variables:

- Effect of the ion transfer tube type on the CV switching time

- Effect of the ion transfer tube type on resolution and transmission

---

[1] The high-capacity ion transfer tubes (HCTT) have an elongated bore and are also known as letterbox inlets.
[2] The round bore ion transfer tubes (ITT) are also known as narrow bore inlets.

Table 12. Mass spectrometers categorized by the type of ion transfer tube they use

High-capacity ion transfer tube with an elongated bore (HCTT)	Ion transfer tube with a round bore (ITT)
• Orbitrap Exploris 480 • Orbitrap Eclipse • Orbitrap Fusion Lumos • TSQ Altis • TSQ Altis Plus • TSQ Quantiva	• Orbitrap Exploris 240 • Orbitrap Exploris 120 • Orbitrap Fusion • Orbitrap ID-X • Orbitrap IQ-X • TSQ Quantis • TSQ Quantis Plus • TSQ Endura

Effect of the ion transfer tube type on the CV switching time

The switching time for the compensation voltage (CV) is not the actual time it takes to switch CV values, but rather a post switch delay. It is dependent on the type of ion transfer tube the LC/MS/FAIMS system uses.

Because of the shorter residence time in the FAIMS electrode assembly on a system with a high-capacity ion transfer tube (HCTT), the CV switching time is shorter than on a system with a narrow bore ion transfer tube (ITT).

The maximum CV switching times are as follows:

- For mass spectrometers with HCTT inlets: 25 ms

- For mass spectrometers with ITT inlets: 40 ms

Effect of the ion transfer tube type on resolution and transmission

The compensation voltage (CV) resolution and the FAIMS transmission are affected by the type of ion transfer tube that the MS uses:

- The CV resolution is slightly higher on an MS that uses a narrow bore ion transfer tube (ITT) than on an MS that uses a high-capacity ion transfer tube (HCTT). This difference is due to the increased CV switching times for analytes on systems with ITT inlets.

- The FAIMS transmission is slightly decreased when the FAIMS interface is installed on an MS that uses a narrow bore ion transfer tube (ITT), as compared to an MS that uses a high-capacity ion transfer tube (HCTT).

- The optimum CV is the same on all MS platforms.

Table 13 and Figure 64 show the CV optimization results for the ion at *m/z* 1522 in Flex Mix.

Table 13. Resolution and transmission for the same ion (*m/z* 1522 in a sample of Flex Mix) on two different MS platforms

MS model	Ion transfer tube	Optimum CV (V)	FWHM (V)	Intensity
Orbitrap Exploris 240	narrow bore (ITT)	−22	4.96	$8.1e^{+6}$
Orbitrap Exploris 480	elongated bore (HCTT)	−22	7.54	$3.1e^{+7}$

Figure 64. CV optima for the *m/z* 1522 ion in Flex Mix
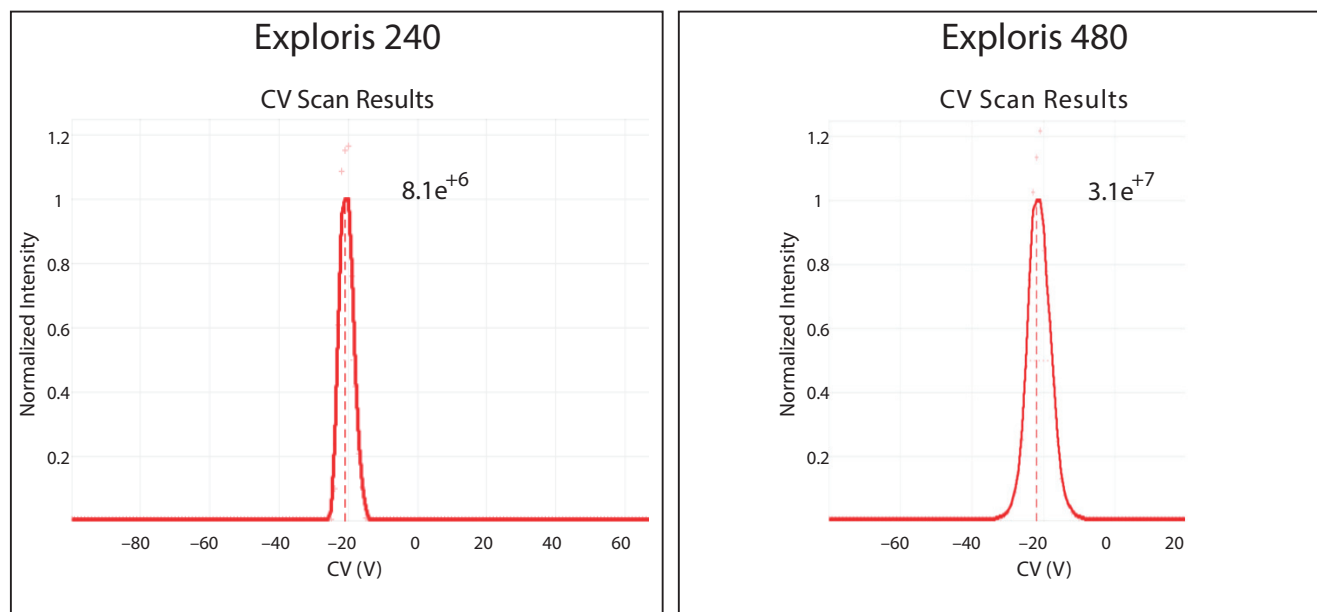
Readback measurements

The Status pane in the Tune window and the mass spectrometer's status page in the Xcalibur data system show the readback measurements for the FAIMS parameters. During data acquisition, the data system stores the readback measurements in the raw data files.

Figure 65. Status page for the TSQ Quantis Plus MS in the Xcalibur data system
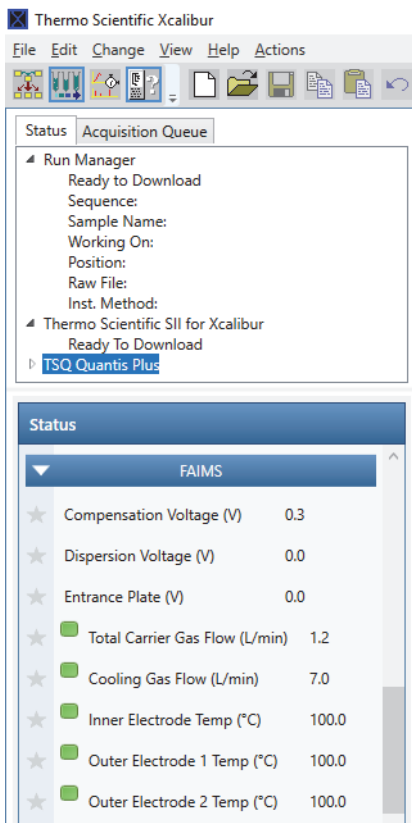
You can view the readback measurements for the FAIMS interface as a plot of the measurement versus time by opening the raw data files in the FreeStyle application and specifying MS Trending for the Detector Type and the readback measurement for the Trace Type.

The following readback measurements are available:

- CV value
- DV value
- Entrance Plate voltage
- FAIMS Gas flow
- Cooling gas flow
- Inner electrode temperature
- Outer electrode temperature by heater 1 and heater 2

FAIMS parameters in the Method Editor

In the Xcalibur data system, the method that controls all the devices for your LC/MS/FAIMS system is called an instrument method. You create instrument methods by entering the chromatographic settings for the LC pump, the sampling technique for the autosampler, the temperature control settings for the column oven, and the data acquisition settings for the MS. The user interface for the MS is called the Method Editor. The settings for the FAIMS interface are included with the settings for the MS because they affect the scans that the MS acquires.

> **Tip** To open the Method Editor for the MS from the Xcalibur data system, click the Instrument Setup icon on the XApps page of the Xcalibur Roadmap view. Then, in the left pane of the Instrument Setup view, click the icon for your MS.

Table 14. FAIMS parameters in the Method Editor (Sheet 1 of 3)

Parameter	Description
Global Parameters page–Ion Source Properties pane	
FAIMS Mode	• Not Installed: The instrument method does not control the FAIMS interface. When the FAIMS interface is installed on the MS, the data acquisition software recognizes the interface when you submit a run and rejects any sequence that includes an instrument method that does not specify one of the three active FAIMS modes—that is, a sequence submission failure prompt appears. When you clear the prompt, a second, more specific prompt about the invalid instrument method appears. • Standard Resolution: Provides the best transmission mode by setting the inner and outer electrodes to 100 °C. • High Resolution: Provides higher resolution than the standard resolution mode by setting the inner electrode to 80 °C and the outer electrode to 100 °C. • User Defined: Displays the boxes for entering the electrode temperatures.
Note If the inner electrode temperature is lower than the outer electrode temperature, the intensity decreases as the difference in temperature between the electrodes increases. If the inner electrode temperature is higher than the outer electrode temperature, the intensity increases as the difference in temperature between the electrodes increase.	
FAIMS Inner Electrode Temp (°C)	(User Defined mode) Specifies the temperature setting for the inner electrode of the FAIMS interface. Range: 70–100; default: 100

Table 14. FAIMS parameters in the Method Editor, continued (Sheet 2 of 3)

Parameter	Description
FAIMS Outer Electrode Temp (°C)	(User Defined mode) Specifies the temperature setting for the outer electrode of the FAIMS interface. Range: 70–100; default: 100
Total Carrier Gas Flow	Specifies whether the gas flow remains the same throughout the run or changes over time as specified in the Total Carrier table. Selections: Static or Time Dependent
Total FAIMS Carrier Gas (L/min)	Specifies the flow rate for the FAIMS carrier gas, which is nitrogen. The default and the available flow rate range depend on the cross-sectional area of the ion transfer tube that the MS uses. For more information, see "Total carrier gas flow rate" on page 93.
Total Carrier Gas Flow Table	(Time Dependent selected for the Total Carrier Gas Flow) Use this table to set up time-dependent gas flow rates for the FAIMS interface. To float the table, click the **Maximize** icon, ⬚ , at the upper right of the table.
Scan Parameters page – *Scan type* Properties pane	
FAIMS Voltages	Specifies whether the FAIMS compensation voltage and the dispersion voltage (DV) are on or off. Available when you select a FAIMS Mode on the Global Parameters page.
Run FAIMS CV Scanning (SRM scan type for a triple-quadrupole MS)	Enables the CV scanning tool that lets you optimize the CV values for your analytes by acquiring scan data with an instrument method. This check box is available only for the TSQ Series II mass spectrometers, and it is available only after you select a FAIMS Mode on the Global Parameters page.
FAIMS CV Range (V) (SRM scan type for a triple-quadrupole MS)	Available when you select the Run FAIMS CV Scanning check box. Specifies the CV range for the CV scanning tool.
FAIMS CV Step (V) (SRM scan type for a triple-quadrupole MS)	Available only for compatible TSQ Series II mass spectrometers when you select the Run FAIMS CV Scanning check box. Specifies the CV step for the CV scanning tool.

Table 14. FAIMS parameters in the Method Editor, continued (Sheet 3 of 3)

Parameter	Description
FAIMS CV (V)	The FAIMS compensation voltage lets a subset of ions to pass through the FAIMS electrodes. You can specify a single CV value for the entire experiment or you can specify a different CV value for each row in a scan table. Range: –300 to 300; default: 0
SRM Table (for a triple-quadrupole MS)	For a TSQ Series II MS, select SRM Scan for the Scan Type. Then, click the table icon, ▦, to the left of the FAIMS CV (V) parameter to add CV information to a table of SRM scans. For more information, refer to the Help topic for the Define Scan pane. CV values defined in the scan table To import a list of compounds with optimized CV values that the CV scanning tool determined when you acquired a raw data file for a sample that includes the compounds, choose *MS model >* **Import Data Column from Mass List CSV**, browse to and select the CSV file, and click **Open**.
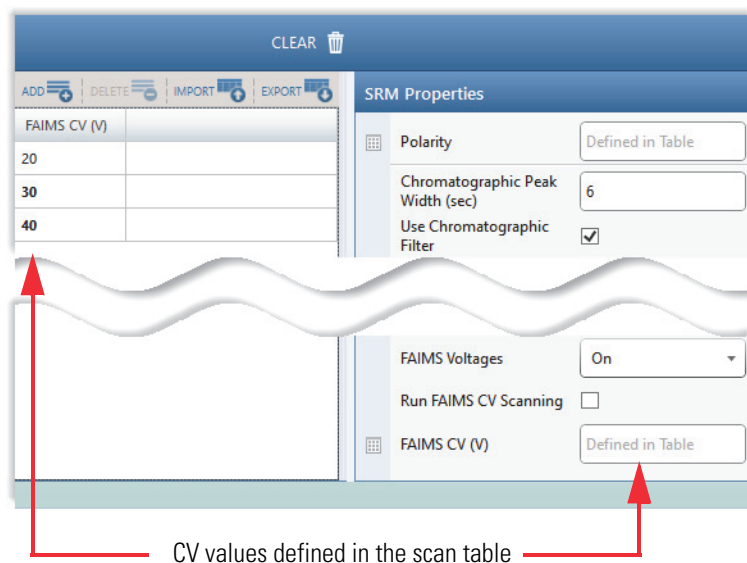
FAIMS parameters in the Tune application

You can control the FAIMS interface and monitor its status from the Tune application.

Table 15. FAIMS parameters in the Tune window (Sheet 1 of 4)

Parameter	Description
Data acquisition pane	

For information about using the CV scan tool, see "Run the FAIMS CV scan tool in the Tune application" on .

To open the dropdown Data acquisition pane, click **Continuous Acquisition**.
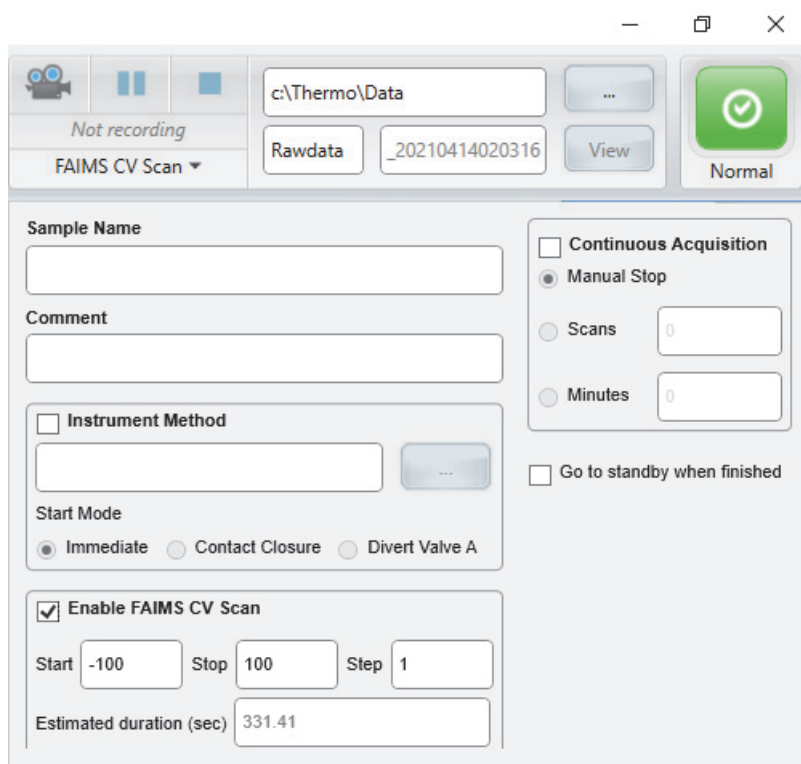
Enable CV Scans	Specifies the use of the FAIMS compensation voltage (CV) scan tool.
	Select the Enable CV Scan check box to turn on the CV scan tool. When you select the Enable CV scan check box, the Start, Stop, and Step boxes appear and the Continuous Acquisition button change to the FAIMS CV Scan button.

Table 15. FAIMS parameters in the Tune window, continued (Sheet 2 of 4)
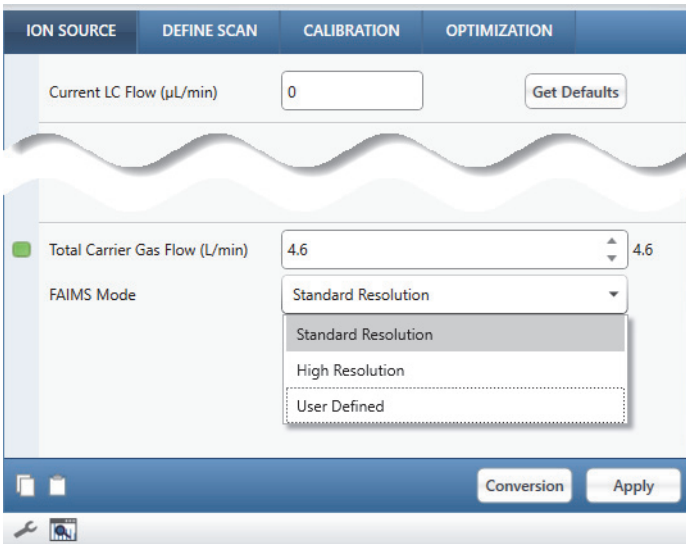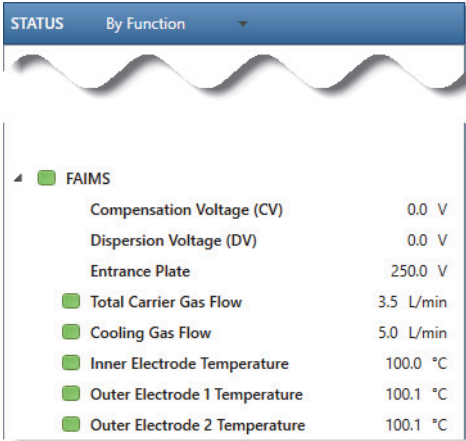
Parameter	Description
Start, Stop, and Step	The Start and Stop values define the FAIMS CV range. The Step value defines the step size in volts within the range.
	Start and Stop range: –300 to 300; default: –100 to 100
	Step range: 0.1–2; default: 1
Estimated duration (sec)	The Estimated Duration read-only value counts down the estimated completion time (in seconds) for the CV scan.

Ion Source pane

Total FAIMS Carrier Gas (L/min)	The flow rate for the FAIMS carrier gas, which is nitrogen.
	The default flow rate and the flow rate range depend on the MS model. See "Total carrier gas flow rate" on page 93
FAIMS Mode	The temperatures for the FAIMS electrodes are as follows:

- Standard Resolution: Provides the best transmission mode by setting the inner and outer electrodes to 100 °C.

- High Resolution: Provides higher resolution than the standard resolution mode by setting the inner electrode to 80 °C and the outer electrode to 100 °C.

- User Defined: Displays the boxes for entering the electrode temperatures.

Table 15. FAIMS parameters in the Tune window, continued (Sheet 3 of 4)

Parameter	Description
Note If the inner electrode temperature is lower than the outer electrode temperature, the intensity decreases as the difference in temperature between the electrodes increases. If the inner electrode temperature is higher than the outer electrode temperature, the intensity increases as the difference in temperature between the electrodes increase.	
FAIMS Inner Electrode Temp (°C)	(User Defined mode) Specifies the temperature setting for the inner electrode of the FAIMS interface. Range: 70–100; default: 100
FAIMS Outer Electrode Temp (°C)	(User Defined mode) Specifies the temperature setting for the outer electrode of the FAIMS interface. Range: 70–100; default: 100
Define Scan pane	
FAIMS Voltages	Specifies whether the FAIMS compensation voltage and the dispersion voltage (DV) are on or off.
FAIMS CV (V)	The FAIMS compensation voltage lets a subset of ions to pass through the FAIMS electrodes. Range: –300 to 300; default: 0
SRM Table (for a TSQ MS)	For a TSQ MS, select SRM Scan for the Scan Type. Then, click the table icon to the left of the FAIMS CV (V) parameter to add CV information to a table of SRM scans. For more information, refer to the Help topic for the Define Scan pane. To import a list of compounds with optimized CV values that the CV scanning tool determined when you acquired a raw data file for a sample that includes the compounds, choose ***MS model > Import Data Column from Mass List CSV***, browse to and select the CSV file, and click **Open**.
Diagnostics pane	
DV RF Tune	Adjusts the input parameters for the FAIMS interface to create a stable and consistent waveform output.
Check DV RF	The Check DV RF diagnostic verifies that a tuned DV waveform delivers the appropriate output power at specific voltages.

Table 15. FAIMS parameters in the Tune window, continued (Sheet 4 of 4)

Parameter	Description
Status pane	

Displays readbacks for the FAIMS voltages, gas flows, and electrode temperatures.

Acquire sample data manually by using the Tune application

Use the Tune application for your MS to manually acquire raw data files.

> **IMPORTANT** Make sure that your Thermo Scientific MS is properly calibrated before you install the FAIMS interface. For information about the calibration procedure for your MS, refer to the hardware manual for your MS.

> **Note** To access the hardware manual for your MS from the Tune application, click the **Set the Options or View Help** icon, ⚙ ▾, choose **Instrument Manuals** from the dropdown menu, select a PDF, and then click **Open**.

❖ **To manually acquire sample data**

1. Open the Tune application by double-clicking the **Tune** icon, 🔘 , on the desktop.

2. Check the calibration status of the FAIMS interface from the Diagnostics pane.

   > **Note** If the FAIMS interface requires tuning, wait for the electrode temperatures to stabilize, and then run the automated Tune DV RF diagnostic, which is available from the Diagnostics pane when the FAIMS interface is installed. See "Run the diagnostics for the FAIMS interface" on page 70.

3. Place the MS in **On** mode, 🔵 , and wait for the electrode temperatures to stabilize.
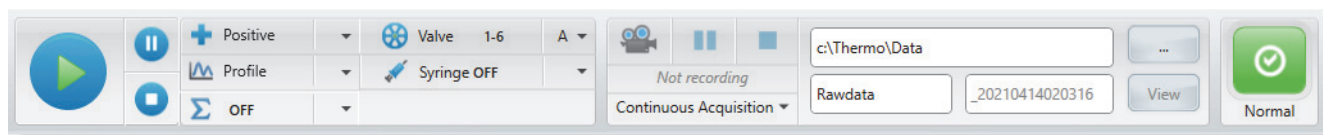
4. To specify the ion source parameters, do the following:

   a. Click the **Ion Source** tab.

   b. Specify the non-FAIMS parameter settings for the ion source.

   c. In the FAIMS Mode list, select **Standard Resolution**, **High Resolution**, or **User Defined**.

   d. If you selected the User Defined mode, specify the temperature settings for the inner and outer electrodes.

5. To specify the scan parameters, do the following:

   a. Click the **Define Scan** tab.

   b. Specify the non-FAIMS scan parameter settings.

   c. In the FAIMS Voltages list, select **On**.

   d. In the FAIMS CV (V) box, type the **CV voltage**.

6. Click **Apply**.

7. To acquire a data file, do the following:

   a. Set up the recording options in the data acquisition pane.

   b. Click the **Record** icon, .

   The instrument continues recording until it acquires the specified number of scans, acquires data for the specified length of time, or you stop the recording.

Acquire sample data with instrument method in the Tune window

You can acquire data in the Tune application by using an instrument method.

❖ **To acquire sample data by using an instrument method in the Tune application**

1. Open the Tune application by double-clicking the **Tune** icon, , on the desktop.

2. Place the MS in **On** mode.

3. In the data acquisition pane, click **Continuous Acquisition**.

4. Select the **Instrument Method** check box.

5. Click the **Browse** icon, select the instrument method, and click **Open**.

6. Click the **Record** icon, .

The Tune application acquires data until it completes the instrument method.

Acquire data by submitting a sequence run to the acquisition queue

You can acquire data for samples by creating one or more instrument methods and setting up an acquisition sequence.

❖ **To acquire data by submitting a sequence run**

1. Make sure the Keep Instrument Settings check box is selected in the Configuration dialog box for the Thermo Scientific mass spectrometer as follows:

   a. From the Windows 10 taskbar, click the **Start** icon, . Then, choose **Thermo Scientific Foundation 3.1 > Instrument Configuration** from the Start menu.

   b. In the Configured Devices area of the Thermo Foundation Instrument Configuration dialog box, double-click the icon for your Thermo Scientific mass spectrometer.

   c. In the Inlet section, select the **Keep Last Method Settings** check box if it is not already selected.

   Figure 66. Instrument Configuration dialog box for a TSQ Series II mass spectrometer
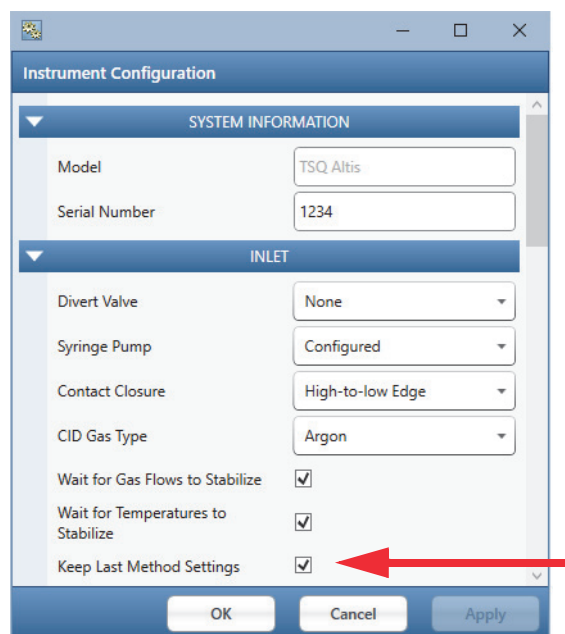
   d. Click **OK**. Then, click **Done**.

2. Set up an acquisition sequence.

3. Make sure that the instrument methods in the acquisition sequence include settings for the FAIMS parameters. See "Use a system template to set up a FAIMS experiment" on page 134 and "Create an instrument method that uses the FAIMS CV scanning tool" on page 120.

> **IMPORTANT** The Method Editor allows you to create and save instrument methods without a valid selection for the FAIMS Mode. You can use these methods to control the MS when the FAIMS interface is not installed.
>
> When the FAIMS interface is installed on the MS, the data system rejects sequences during sequence submission that include instrument methods without a valid selection for the FAIMS Mode—that is, a failure prompt for sequence submission appears. When you clear the prompt, a second, more specific prompt about the invalid instrument method appears.

> **Note** For the APCI mode, the FAIMS interface might not be able to maintain a stable temperature when the instrument method includes one or more of these conditions:
>
> - The inner electrode is set to a temperature below 75 °C and the outer electrode is set to 100 °C.
>
> - The chromatographic conditions include a mobile phase with a high percentage of methanol or a steep gradient.
>
> - The vaporizer temperature is above 400 °C.

4. Submit the sequence to the run queue.

Recommendations for proteomics experiments

The following topics provide recommendation for proteomics experiments:

- Typical CV optima for peptides

- Recommendations for bottom-up proteomics experiments with data-dependent acquisition

- Recommendations for using the FAIMS interface with TMT experiments

Typical CV optima for peptides

When specifying the CV voltages for peptides, consider the following:

- Most tryptic peptides transmit between –40 and –85 V.
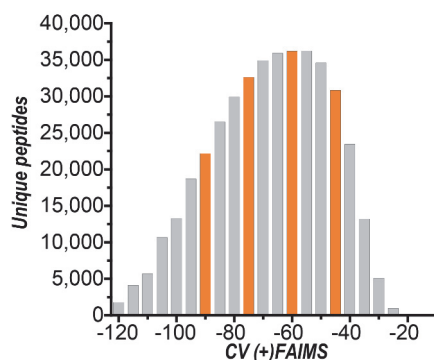
A. Hebert et al., Anal. Chem. 2018, 90, 9529-9537

- Most +1 interferences transmit around –20 V.

- When the CV resolution is low, the CV peak is wide, and not only peptides that optimize at a particular CV will be transmitted, but also peptides that optimize at adjacent CV values (at slightly reduced intensity).

Recommendations for bottom-up proteomics experiments with data-dependent acquisition

The recommendations for single CV runs versus multiple CV runs are as follows:

- In general, the recommended number of CVs per run depends on the gradient length.

Table 16. Recommended number of CV values (and recommended CV voltages) based on the length of the gradient

| LC gradient length	Number of CVs	CV voltages[a]
<1 hour	1	–45 or –50
1 to 2 hours	2	–50 and –70
	3	–50, –65, and –85
3 to 4 hours	4	–45, –60, –75, and –90

[a] Because CV values are consistent across platforms, Thermo Fisher Scientific recommends identical CV values for the Hybrid and Tribrid platforms.

- For new or unknown samples, it can be beneficial to map out the peptide space by running single CV runs in 10 V steps, similar to what was done by Hebert et al.[3] for tryptic peptides.

- For single CV runs, expect the number of identified peptides to decrease compared to runs without FAIMS. This decrease in identification happens because only a fraction of peptides is transmitted at a particular CV. However, often the protein identifications increase because of the increased confidence and better quality of the MS2 spectra.

- For multiple CV runs on Tribrid mass spectrometers when using ion trap MS2 identification, both peptide and protein IDs typically increase compared to runs without FAIMS.

Figure 67. Number of unique peptides or protein groups identified versus the number of CVs per run for gradients of different time spans
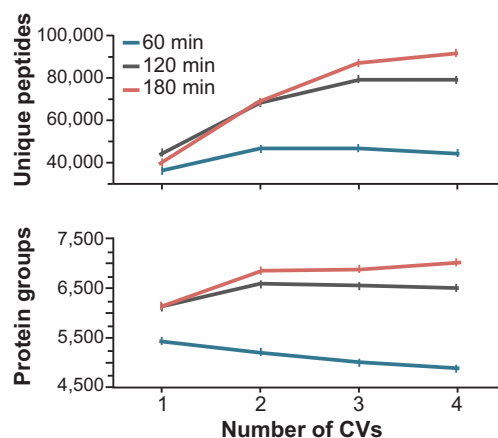
[3] A. Hebert et al., Anal. Chem. 2018, 90, 9529-9537

Recommendations for creating parallel experiments:

- Create parallel experiments for each CV value. Use the exact same settings for the parallel experiments, with the exception of a different CV value.

- Split up the cycle time (or number of dependent scans) by the number of parallel experiments. For example, if the cycle time without FAIMS is 3 s, for a 2 CV method it will be 1.5 s for each CV per each parallel experiment. The same applies for Top N experiments. The idea is to keep the overall cycle time and number of data points across a compound's chromatographic peak consistent.

- Depending on the sample and CVs used, it might be beneficial to use weighted cycle times. For example, –70 V typically transmits fewer ions than –50 V, so a cycle time weighting of 1.7 s for –50 V and 1.3 s for –70 can be applied.

Figure 68. Creating parallel experiments
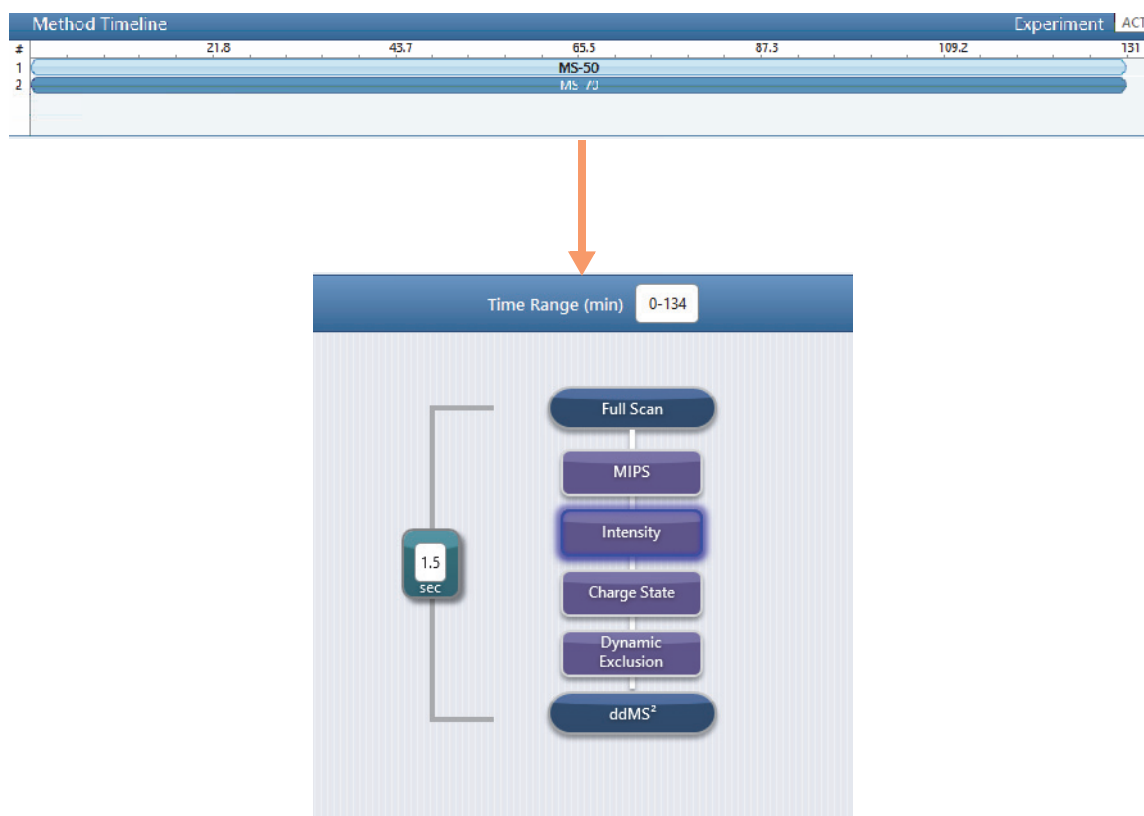
Recommendations for using the FAIMS interface with TMT experiments

High-field asymmetric waveform ion mobility spectrometry (FAIMS) reduces co-isolation interferences at the precursor level, which helps reduce chimeric spectra and improves quantitative accuracy.
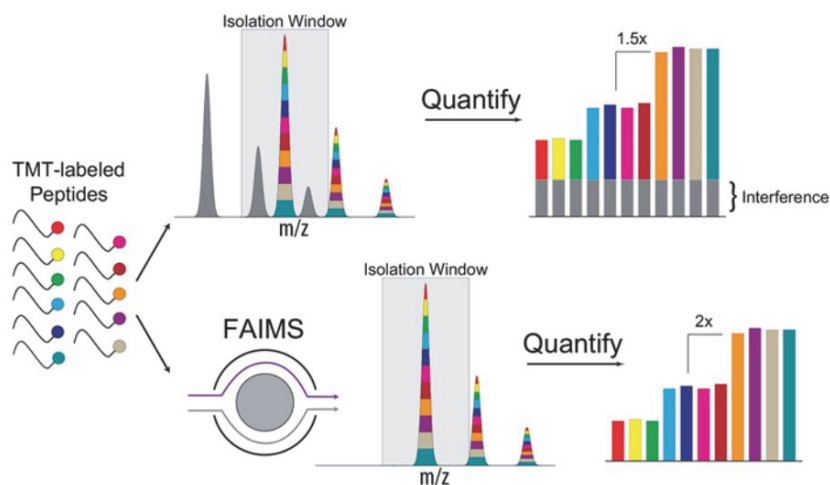
(D. K. Schweppe et al., Anal. Chem. **2019**, 91, 4010–4016)

Typically, you can achieve better results with methods using longer gradients (140–180 min) and three CV values (–45 / –60 / –75 V).

For TMT experiments, divide the cycle time equally between CV values. Because more +3 charge states are sampled, the abundance of precursors at more negative CV values is higher compared to a non-TMT labeled sample.

Figure 69. TMT method template on the Orbitrap Exploris 480

Converting instrument methods without FAIMS settings

The optimum MS2 injection time can differ for instrument methods with or without the FAIMS interface. In addition, the overall total ion current chromatogram from data acquired with FAIMS can be lower than the same data acquired without FAIMS.

When converting a standard instrument method to a method with the FAIMS interface, you might need to increase the MS2 injection time for a method with FAIMS compared to a method without FAIMS. If most MS2 scans max out the injection time specified in the method, consider increasing the MS2 injection time to 40 or 50 ms.

Overall TIC intensity can be lower with FAIMS compared to runs without FAIMS, but this is generally not a good measure of performance. If performance (for example, the number of identifications) is lower than expected, and you have ruled out other components of the setup (LC, column, and MS), make sure the emitter is positioned correctly.

On/Off status of the FAIMS interface under varying power conditions

Table 17 summarizes the on/off status of the FAIMS interface components and voltages when the FAIMS interface is installed on an MS and the main controller box (MCB) is turned on—that is, the power switch on the back of the MCB is in the On (1) position. Turning off the power to the MCB turns off all the MCB components.

For information about the MS components, refer to the appropriate instrument manual.

Table 17. On/off status of the FAIMS interface components and voltages when the MCB is turned on

FAIMS interface components	FAIMS MCB power switch in the On (1) position			
	MS Standby mode	**MS Off mode**	**MS electronics service switch, Service Mode position**	**MS Power switch, Off (0) position**
Compensation voltage, electrodes	Off	Off	Off	Off
Dispersion voltage, electrodes	Off	Off	Off	Off
High-voltage, MCB	Off	On	On	On
Temperature, electrodes	On	Off	Off	Off
Cooling fan, RF transformer box	On	On	On	On
Power supply, MCB	On	On	On	On

Determine the optimal CV values for your analytes

This chapter describes how to determine the optimal CV values for your analytes.

See the following topics:

- Run the FAIMS CV scan tool in the Tune application
- Save the settings for the FAIMS parameters in the Tune application
- Load the optimal FAIMS parameter settings to the Tune application
- Create an instrument method that uses the FAIMS CV scanning tool
- Import the optimal CV values into an instrument method

Run the FAIMS CV scan tool in the Tune application

To acquire data for your analytes across a range of CV values, you can use the FAIMS CV scan tool in the Tune application as you infuse a sample solution by using the syringe pump.

You can use this offline CV optimization method for low-flow applications only. For high-flow applications with a TSQ Series II mass spectrometer, use the online optimization method to determine the optimal CV values for your analytes.

The term *offline* refers to acquiring data for your analytes while infusing a sample solution into the MS. The term *online* refers to acquiring data while running a chromatographic method from the Xcalibur data system (or equivalent data acquisition application).

❖ **To run the CV scan tool in the Tune application**

1. Turn on the power switch on the back panel of the FAIMS main controller box.

2. Set up the syringe pump to infuse a sample of your analytes.

    For information about setting up the syringe pump, refer to the mass spectrometer's hardware manual.

3. Open the Tune window.

    When the FAIMS main controller box is turned on, the Tune application senses its presence.

4. Click the **Ion Source** tab.

The Ion Source pane opens.

Figure 70. Ion Source pane in the Tune window for a TSQ Altis mass spectrometer
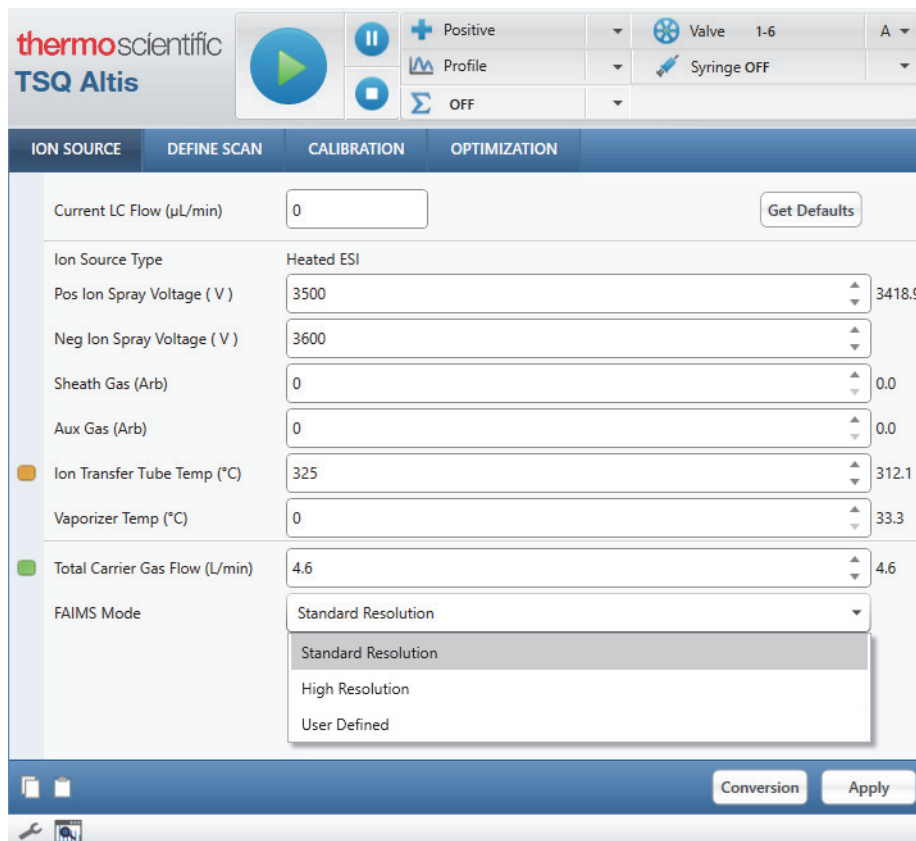
5. On the Ion Source page, do the following:

    a. Specify the settings for the ion source parameters.

    b. Type the flow rate for the FAIMS gas in the Total Carrier Gas Flow (L/min) box.

    The valid range depends on the model of your MS. Or, more specifically, the type of ion transfer tube the MS uses. See "Effect of the ion transfer tube type on the FAIMS gas conductance" on page 96.

    c. Select the resolution mode from the dropdown FAIMS Mode list:

    • High Resolution

    • Standard Resolution

    • User Defined

d. If you selected the User Defined mode, type the temperature for the inner electrode in the Inner Electrode Temp box and the temperature for the outer electrode in the Outer Electrode Temp box.

The valid temperature range for both electrodes is 70 to 100 °C.

6. Click the **Define Scan** tab. Then, specify the non-FAIMS parameter settings.

   - For a TSQ MS, select SRM Scan or SIM Scan in the Scan Type list.

   - For an Orbitrap Tribrid MS, select SIM Scan.

   - For an Orbitrap Exploris MS, select SIM Scan.

7. Place the MS in **On** mode, .

8. Turn on the syringe pump by clicking **Syringe Off** and wait until the analyte signal is observed with good intensity.

   The Syringe Off button changes to Syringe On.

9. On the Define Scan page, select **On** in the FAIMS Voltages dropdown menu.

10. In the data acquisition pane, do the following:

    a. Specify the folder where you want to store the raw data file for the CV scan experiment.

    The default folder is C:\Thermo\Data.

    b. Click **Continuous Acquisition** to display the FAIMS CV scan parameters.

    c. Select the **Enable FAIMS CV Scan** check box.

    The Continuous Acquisition button changes to FAIMS CV Scan.

    d. Type the starting voltage, the ending voltage, and the step size in the respective **Start**, **Stop**, and **Step** boxes.

    The Estimated Duration (sec) box displays the calculated scan time.

    > **Note** If the range between the start and stop values is 10 V or less, the Xcalibur data system uses a CV increment of 0.1 V instead of 0.3 V. This smaller step size enables the software to determine the optimum CV for CV peaks with a narrow bandwidth.

Figure 71. Data acquisition pane

11. To obtain a CV spectrum (that is, a plot of ion intensity versus CV) by performing a CV ramp, click the **Record** icon, [icon].

    Data acquisition automatically ends when the FAIMS CV scan tool determines the optimum CV value for the analytes in the specified scan range.

12. At the Generate Report prompt, select an option and click **OK**.

    When you select the Save option, the application generates the CV Scan Results report. The CV Scan Results report contains the CV scan results and the optimum CV values for the masses in the sample.

Figure 72. CV Scan Results report
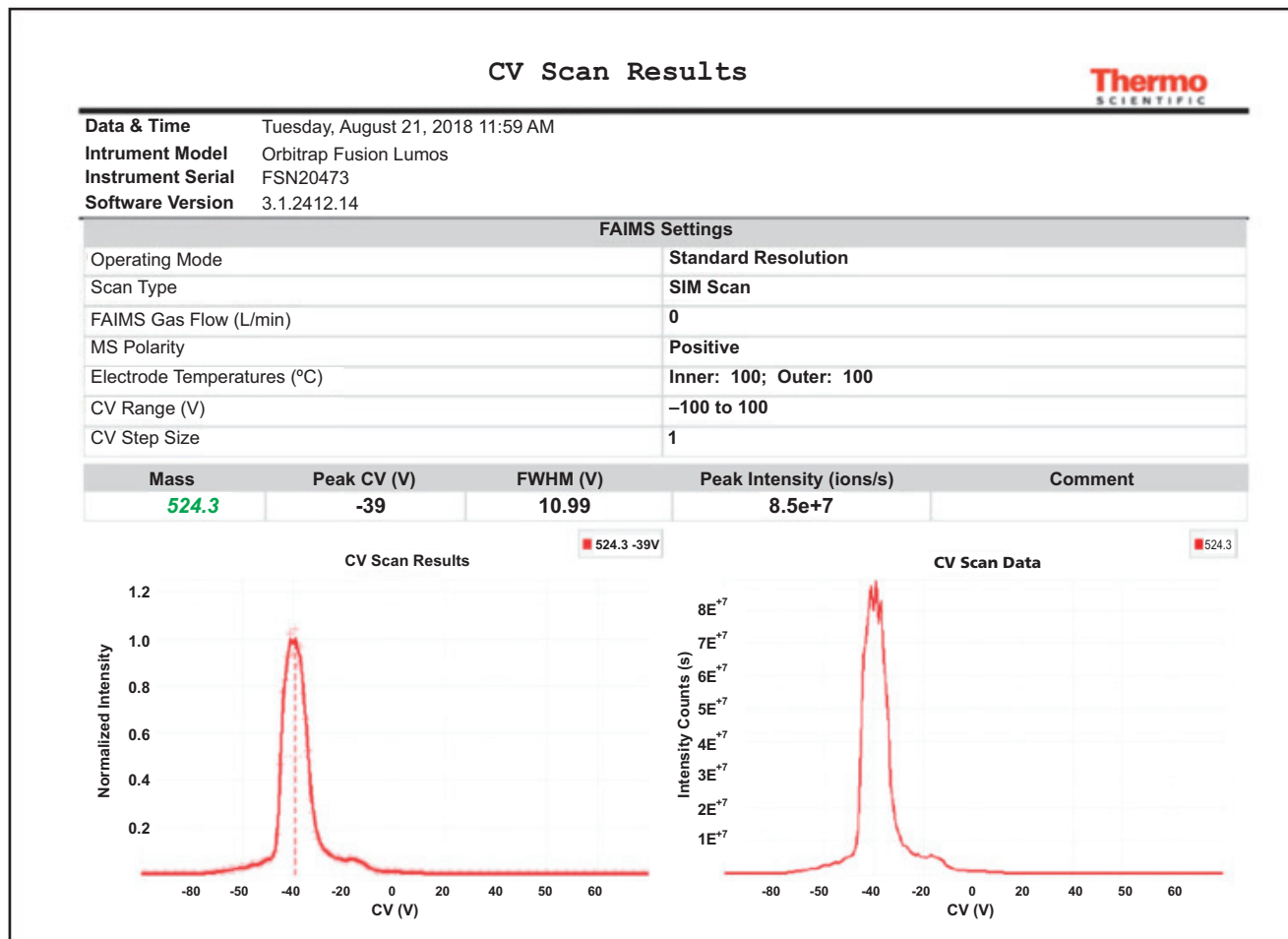
Save the settings for the FAIMS parameters in the Tune application

You can save the optimal settings for the FAIMS parameters for future use in the Tune application or the Method Editor.

❖ **To save the settings for the FAIMS parameters**

1. In the Tune window, modify the parameters on the Ion Source or Define Scan pages.

2. Click **Apply** or **Export**.

3. Click the **Favorites** tab to display the Favorites pane.

4. Click **Save Current State**, and then type a unique name in the box.

5. Click **Save Current State** again to save the state.

Load the optimal FAIMS parameter settings to the Tune application

❖ **To load the FAIMS parameter settings**

1. In the Tune window, click the **Favorites tab** to display the Favorites pane.

2. Under User Settings, right-click the *name* for the settings that you saved.

3. Choose one of the following:

   • **Load** to only display the parameter settings.

   • **Apply** to submit the parameter settings to the MS.

   Tip You can also choose Load to review the parameters settings. And then, choose Apply to submit the settings to the MS.

Create an instrument method that uses the FAIMS CV scanning tool

The following procedure focuses on the parameters you must set in an instrument method to perform CV scanning on a set of compounds. You can use the Method Editor's CV scan tool to optimize the CV values for your low-flow or high-flow applications.

The FAIMS CV scanning tool is available in the TSQ version 3.4 or later instrument control software for SRM methods.

❖ **To acquire a raw data file with CV scanning data**

1. Set up your LC/MS system to run a a chromatographic method for a sample containing the compounds of interest.

2. Open the Instrument Setup window. Then, open the Method Editor for the MS.

3. On the Global Parameters page of the Method Editor, do the following:

   a. In the Method Duration box, type the length of the data acquisition time.

   b. Specify the ion source settings in the Ion Source Properties pane.

   c. Select the FAIMS Mode from the dropdown list: **Standard Resolution**, **High Resolution**, or **User Defined**.

   d. If you selected the User Defined mode, enter the electrode temperatures in their respective boxes.

   e. In the Total Carrier Gas Flow list, select **Static** or **Time Dependent**. Then, do one of the following:

      • For a static carrier gas flow, type the flow rate in the Total Carrier Gas Flow box.

      • For a time-dependent gas flow, set up the time segments in the Total Carrier Gas table.

4. Click the **Scan Parameters** tab.

5. In the Experiment pane on the Scan Parameters page, set up a table of SRM transitions.

6. In the SRM Properties pane on the Scan Parameters page, specify the SRM properties.

   a. In the FAIMS Voltages list, select **On**.

   b. Select the **FAIMS CV Scanning** check box.

   c. In the FAIMS CV Step (V) box, type a step size from **1** to **20**.

   > **IMPORTANT** In an instrument method, the CV range and the step size is limited by the number of transitions and the cycle time.

   > **Tip** When running CV scans to determine the optimal CV values for a set of compounds, begin with a coarse optimization—that is, use a larger step size (for example 5 V steps) for the first CV scan. Then, run a fine optimization scan using a narrower scan range with a smaller step size (for example, 2 V steps).

   d. Specify the FAIMS CV Range (V) by typing a value from –300 to 299 in the first box and a value from –299 to 300 in the second box.

   The value in the second box must be higher than the value in the first box, and the difference between the two values cannot be less than the step size. The maximum range is –300 to 300.

Figure 73. FAIMS parameter settings in the SRM Properties pane on the Scan Parameters page of the Method Editor

FAIMS Voltages	On
Run FAIMS CV Scanning	☑
FAIMS CV Range (V)	-300 to 300
FAIMS CV Step (V)	1

7. Specify the parameter settings for the other devices controlled by the instrument method.

8. Save the instrument method.

9. Create a data acquisition sequence with this instrument method and acquire a raw data file with CV scan data for your analytes.

10. To review the results of the CV scans, open the raw data file that you acquired in the FreeStyle version 1.8 SP1 or later application. See "Export the CV values for a set of SRM transitions to a CSV file" on page 128.

Import the optimal CV values into an instrument method

After you run a CV scanning experiment with SRM transitions for one or more named compounds (see "Create an instrument method that uses the FAIMS CV scanning tool" on page 120) and use the FreeStyle application to export the optimal CV values for these compounds to a CSV file ("Export the CV values for a set of SRM transitions to a CSV file" on page 128), you can import the optimal CV values into the original instrument method or another instrument method with the same SRM table.

❖ **To import CV values from a CSV file into an instrument method**

1. Open the instrument method in the Method Editor for your MS.

2. On the Global Parameters page, select a resolution mode from the FAIMS Mode list.

3. On the Scan Parameters page, check that the method includes an SRM table with the same named compounds and precursor ions as the spreadsheet.

4. From the *MS Model* menu, choose **Import Data Column from Mass List CSV**.

   If the FAIMS Mode is set to Not Installed, the application states that it cannot import FAIMS CV information when the FAIMS interface is not installed.

   If the SRM table does not include any named compounds, the application states that it found no matching rows.

5. Browse to the CSV file, select it, and click **Open**.

   The application populates the matching compounds in the SRM table with their optimized CV values.

Use FreeStyle to review your raw data files

This chapter describes how to use the FreeStyle 1.8 SP1 application to review raw data files from an LC/MS/FAIMS experiment.

See the following topics:

- Open a raw data file in FreeStyle
- View a plot of the dispersion voltage's stability
- View plots of the readback measurements for the FAIMS interface
- Export the CV values for a set of SRM transitions to a CSV file

Open a raw data file in FreeStyle

You can open a raw data file directly from the Tune window or after you open the FreeStyle application.

See the following topics:

- Open a raw data file from the Tune window
- Open a raw data file from the FreeStyle application

Open a raw data file from the Tune window

You can open a new workspace for a raw data file in the FreeStyle application from the Tune window.

❖ **To open a raw data file in FreeStyle from the Tune window**

1. Open the Tune application.

2. In the data acquisition pane, browse to the raw data file of

3. Click **View** from the data acquisition pane of the Tune window.

   Clicking View from the Tune window opens the active data file or the data file that you browse to and select.

Open a raw data file from the FreeStyle application

There are several ways to open a raw data file in the FreeStyle application.

❖ **To open a raw data file in the FreeStyle application**

1. Open the FreeStyle application by doing one of the following:

    - Clicking the Windows™ **Start** icon, ⊞, and then choosing **Thermo FreeStyle > FreeStyle**.

    - Clicking the **FreeStyle** icon, ⚛, in the taskbar.

    - Double-clicking the **FreeStyle** icon, [FreeStyle], on your desktop.

2. Do one of the following:

    - From the application menu bar, choose **File > New Workspace**.

    - On the Workspace Options toolbar, click **New Workspace**.
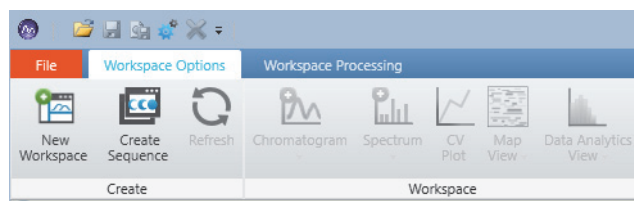
    The Open Raw File dialog box opens.

3. Browse to the raw data file (.raw) of interest, select it, and click **Open**.

View a plot of the dispersion voltage's stability

To troubleshoot problems with the FAIMS interface, view plots of the dispersion voltage by using the FreeStyle application.

Preconditions
A raw data file with CV scans
An installation of the FreeStyle 1.4 or later application

Tip The following procedure describes how to display a plot of the dispersion voltage versus time in the FreeStyle 1.8 SP1 application.

You can download the latest version of the FreeStyle application from the Xcalibur AppStore page of the Xcalibur data system.

For later versions of the FreeStyle application, refer to the FreeStyle Help, if necessary.

❖ **To view a plot of the DV stability over the course of a run**

1. Open a raw data file with CV scans.

2. In the Workspace Options toolbar, click **Chromatogram**. Then, choose **Ranges** in the dropdown menu.

   Figure 74. Chromatogram menu on the Workspace Options toolbar
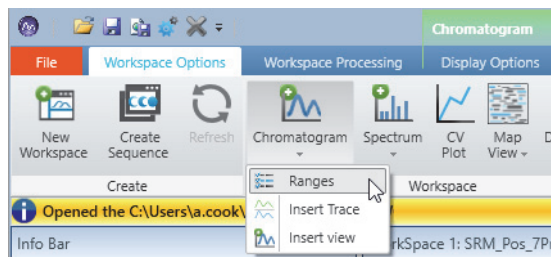
   The Chromatogram Ranges view appears below the Spectrum view.

3. Select the check box to the left of the second row to enable the row.

4. In the Detector Type column, select **MS Trending** for the second row.

5. In the Trace Type column, select **Dispersion Voltage DV (V)** for the second row.

6. To open the Display Options toolbar for the Chromatogram view, click the **Display Options** tab under Chromatogram.

7. In the Chromatogram Display Options toolbar, click the **Absolute** icon in the Y-Scale section.

8. If necessary, zoom in on the *y* axis.

Figure 75 shows the MS Trending–Dispersion plot in the Chromatogram view. The Spectrum view is closed.

Figure 75. Dispersion voltage plot (DV versus time) from a TSQ Series II MS
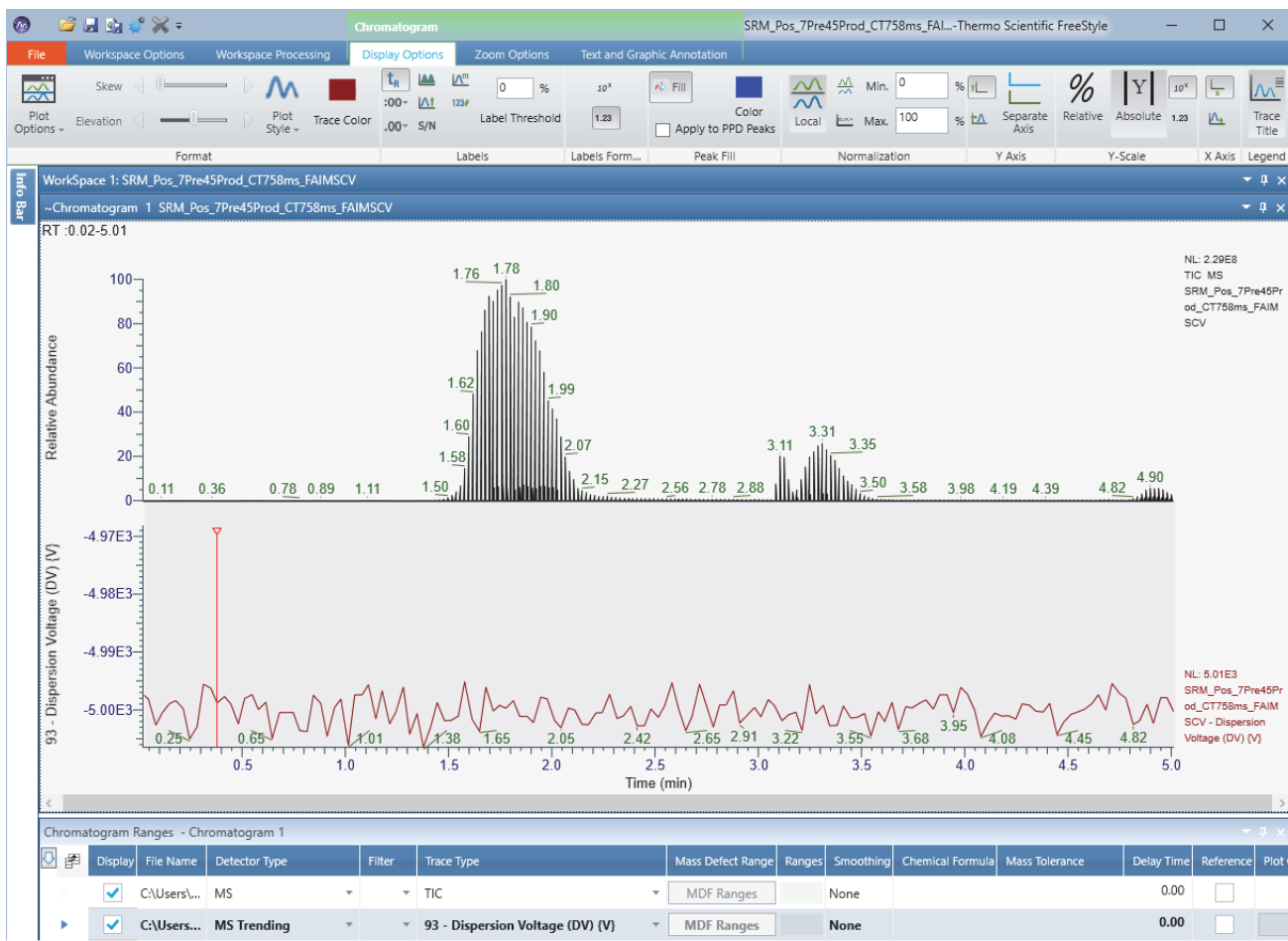

Figure 76 shows an example of a dispersion plot for an LC/FAIMS/MS system that is experiencing DV dropouts. A DV dropout is an attempt of the FAIMS interface to protect the electrodes and the power circuit when one of the following occurs:

- A droplet of liquid enters the electrodes.

- Arcing occurs at the spray tip.

- Particulate matter or lint contaminates the electrodes.

Figure 76. Example of a dispersion plot with DV dropouts
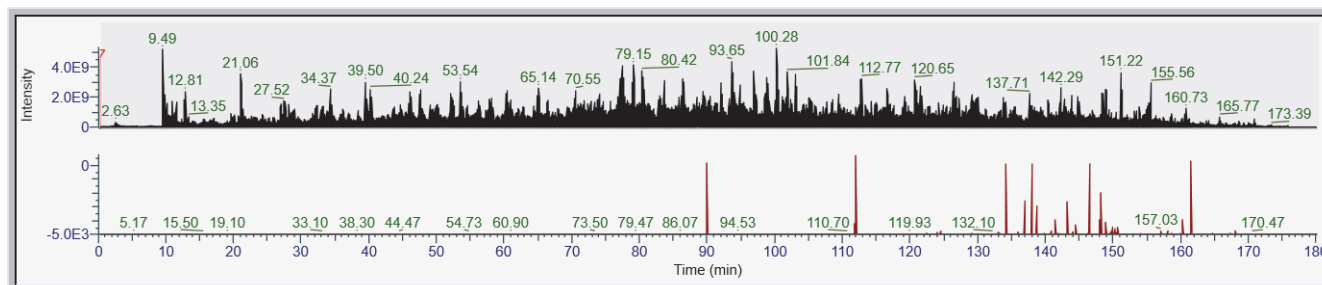
View plots of the readback measurements for the FAIMS interface

During data acquisition, the data system stores the readback measurements for the FAIMS interface in the raw data file. You can view each measurement as a plot of the measurement value on the y axis versus time on the x axis in the FreeStyle application.

Figure 77. FreeStyle application showing selected MS trending traces (from a TSQ Series II MS)
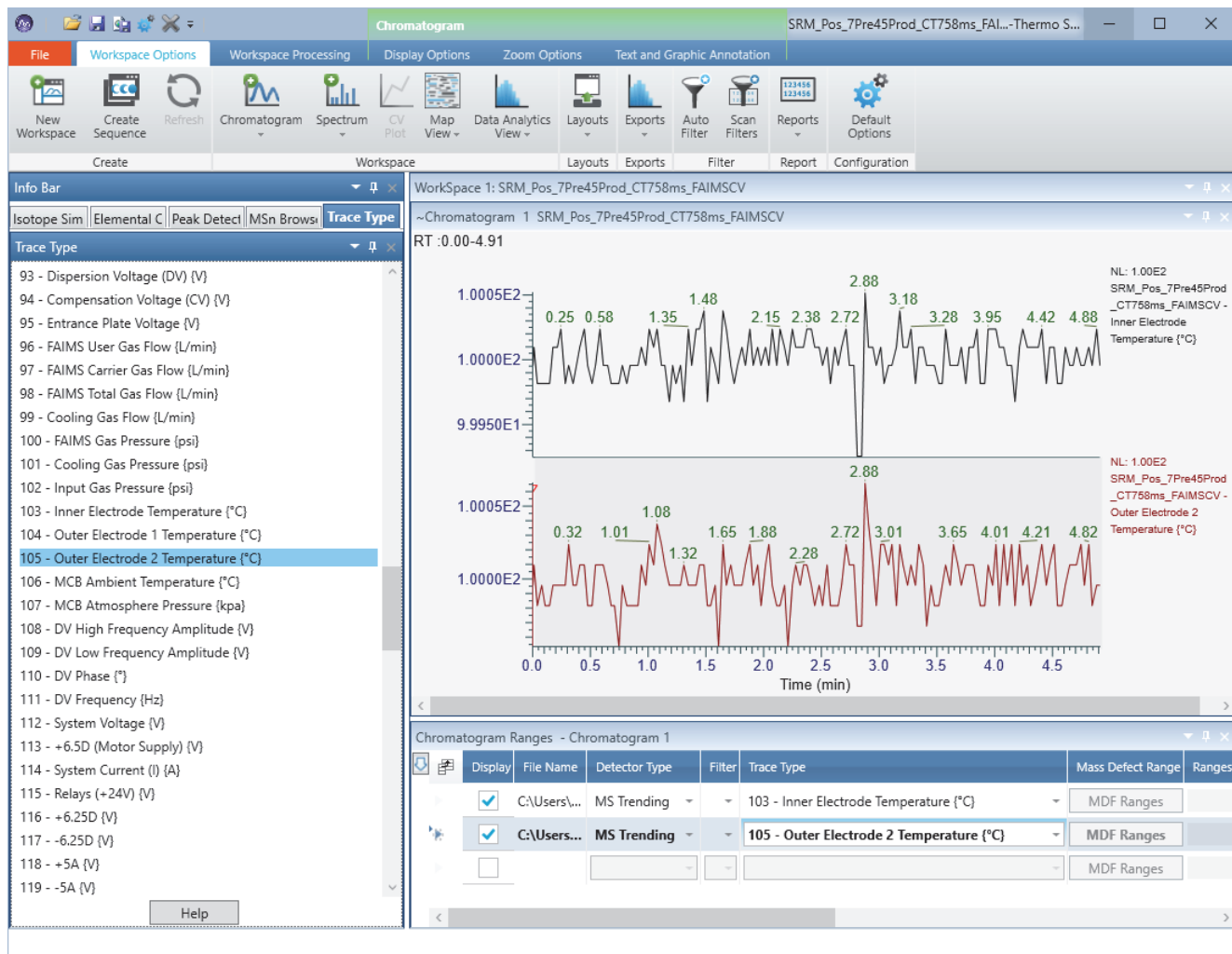
Export the CV values for a set of SRM transitions to a CSV file

Preconditions

- A raw data file that includes CV scanning information for your analytes

- A data processing computer with an installation of the FreeStyle 1.8 SP1 or later application

❖ **To create a CSV file that includes the optimal CV values for your analytes**

1. Open the FreeStyle application.

2. In the FreeStyle application, open a raw data file that includes CV scanning for your analytes.

3. In the Workspace Options toolbar, click the **AutoFilter** icon, [Auto Filter] .

    By default, the AutoFilter dialog box opens with eight filters selected. These filters include the generic MS2 scan filter, the generic SRM scan filter, and up to six specific filters.

    > **Note** In the Default Configuration Options dialog box for the FreeStyle application, you can set the default number of scan filters to a value from 1 to 500.

Figure 78. AutoFilter dialog box with the default parameter settings
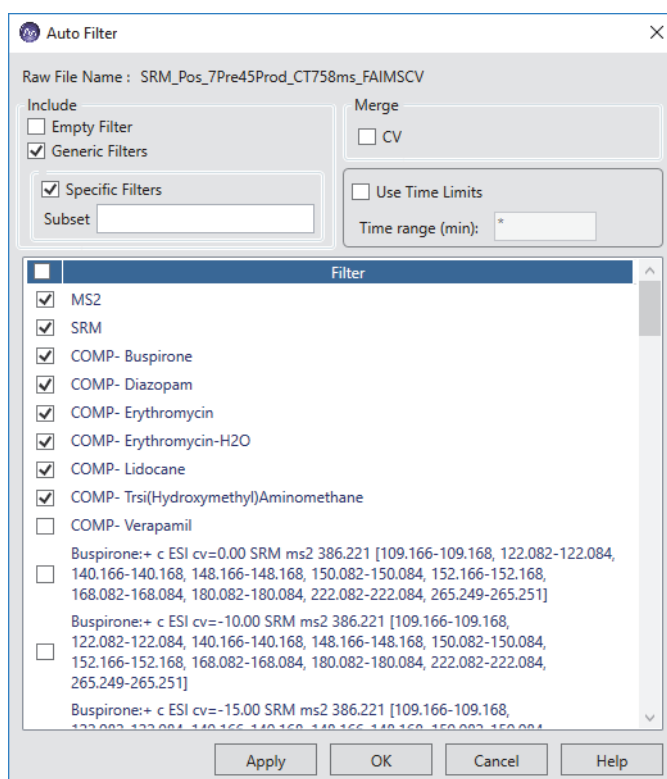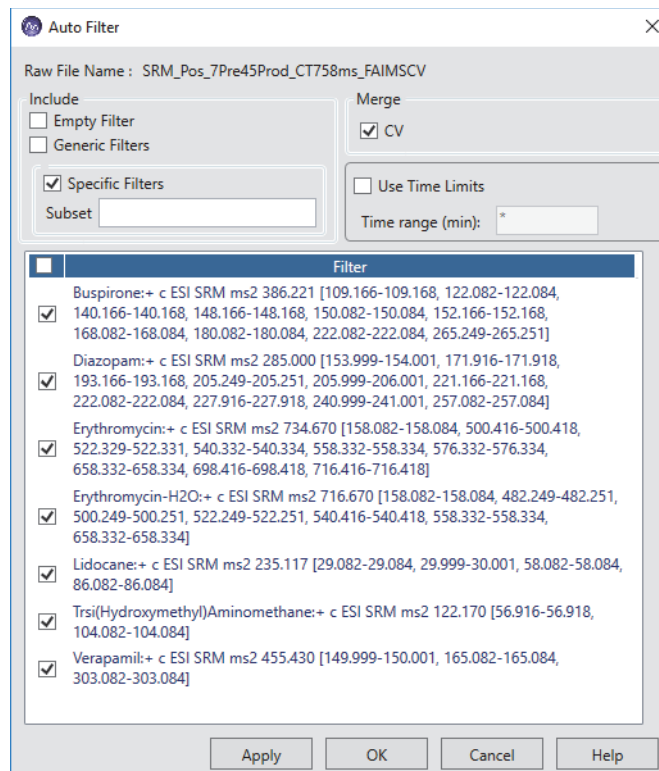

4. In the Include area, clear the **Generic Filters** check box.

5. In the Merge area, select the **CV** check box.

The application merges the scans with the same named compound.

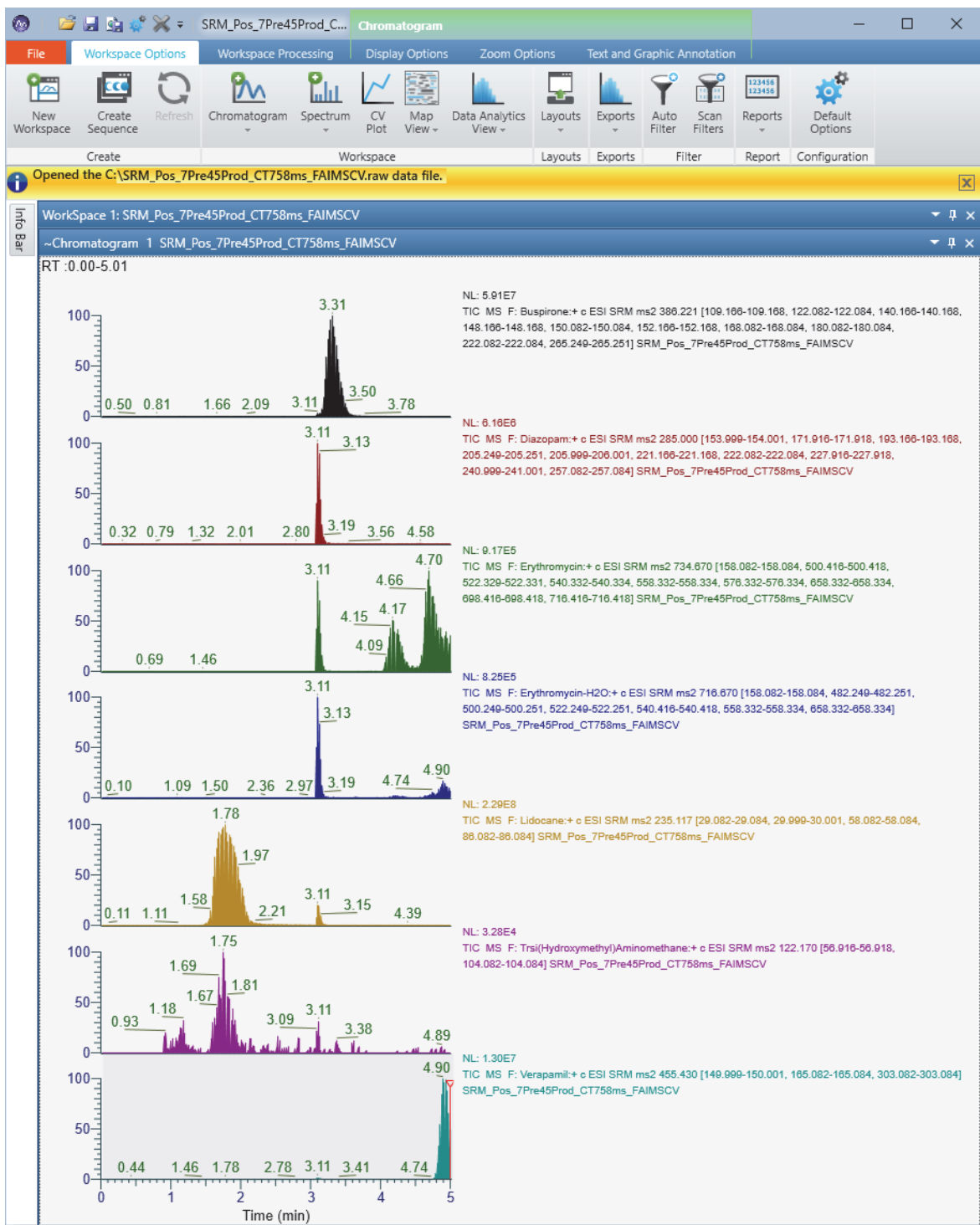**Figure 79.**   AutoFilter dialog box with modified parameter settings

6. Click **Apply**. Then, click **OK** to close the dialog box.

The FreeStyle application displays the filtered chromatograms for the named compounds.

Figure 80. Filtered chromatograms (from a TSQ Series II MS)

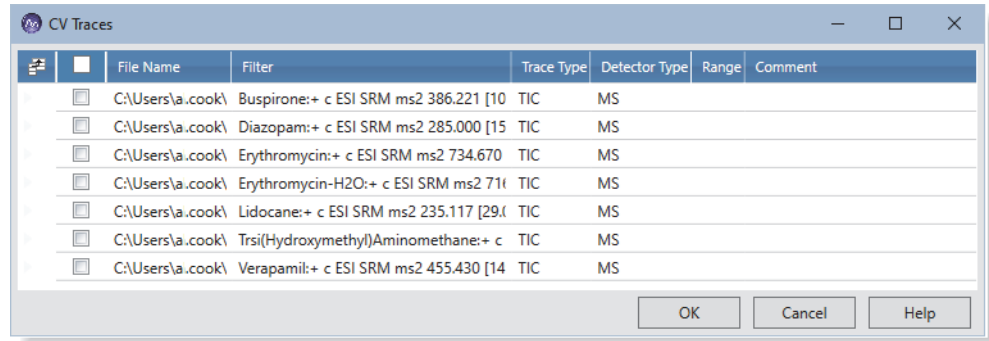7. In the Workspace Options toolbar, click the **CV Plot** icon,
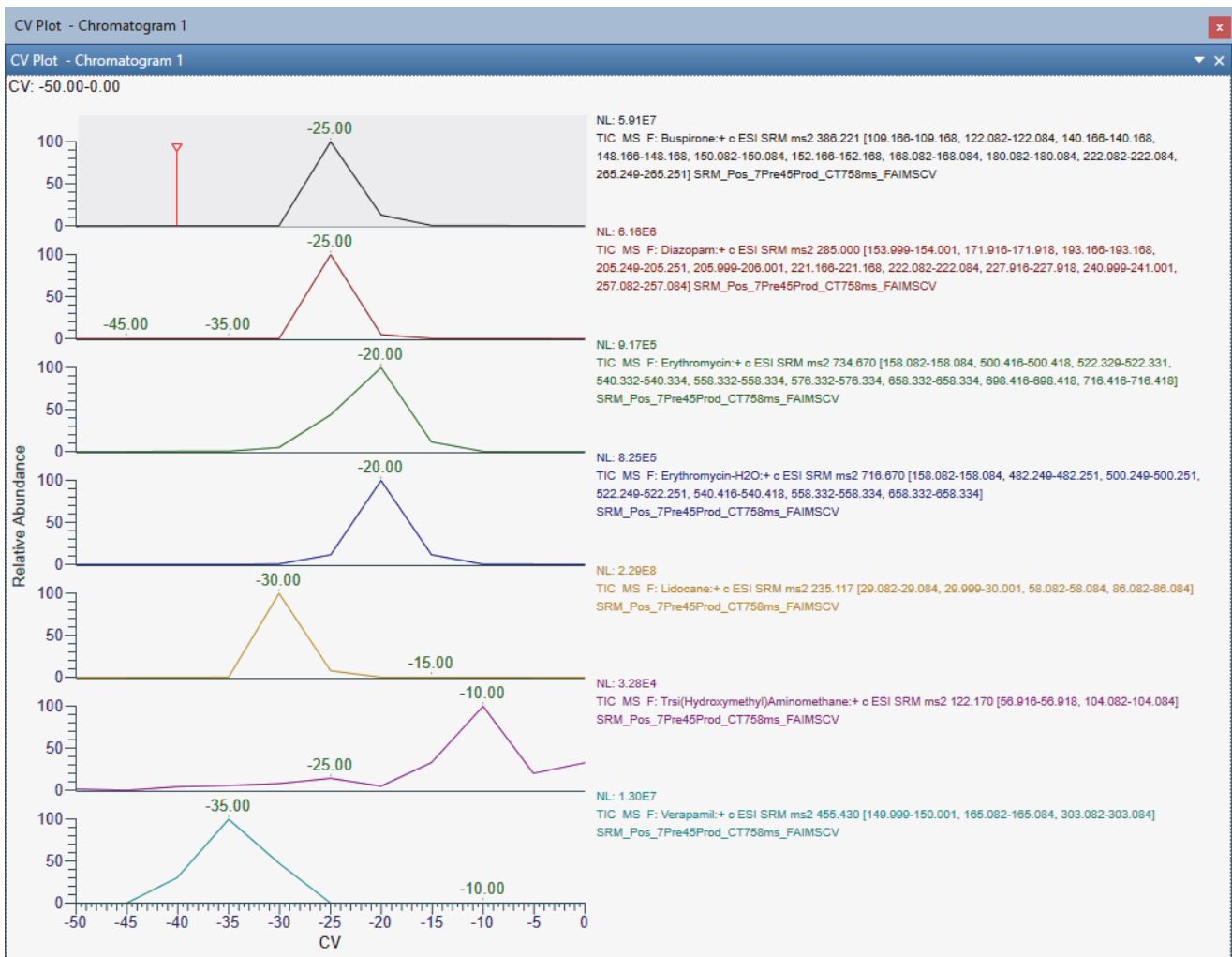
    The CV Traces dialog box opens.

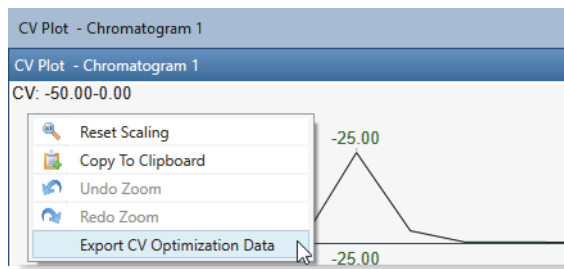**Figure 81.** CV Traces dialog box with the merged CV scans for seven named compounds

8. In the CV Traces dialog box, select the check boxes for the filtered scans you want to plot. Then, click **OK**.

The CV Plot view appears.

Figure 82. Floating CV Plot view with seven plots, one for each named compound

9. Right-click the CV Plot view and choose **Export CV Optimization Data**.

10. Browse to the folder where you want to store your exported CSV files, name the file, and click **Save**.

The CSV file opens in your spreadsheet application.

	A	B	C
1	Compound	Precursor (m/z)	FAIMS CV (V)
2	Buspirone	386.221	-25
3	Diazopam	285	-25
4	Erythromycin	734.67	-20
5	Erythromycin-H2O	716.67	-20
6	Lidocane	235.117	-30
7	Trsi(Hydroxymethyl)Aminomethane	122.17	-10
8	Verapamil	455.43	-35

To import the optimized CV values into an instrument that includes the named compounds and SRM transitions in your spreadsheet, see "Import the optimal CV values into an instrument method" on page 122.

Method Editor templates

This chapter describes how to use the system templates as a starting point for your FAIMS experiments.

See the following topics:

- Method Editor templates for FAIMS experiments
- Use a system template to set up a FAIMS experiment

Method Editor templates for FAIMS experiments

The Method Editor in the Xcalibur Instrument Setup window contains several FAIMS method templates that serve as starting points for DDA peptide ID, TMT, and label-free quantitation workflows. The results are suitable results for bottom-up proteomics applications.

- Methods greater than 90 minutes might benefit from two to three CV values in the experiments used throughout the entire run.

- Methods greater than 2 hours can benefit from three to four CV values in the experiments used throughout the entire run.

Optimization and data evaluation include ensuring that an appropriate number of points are detected across the MS1 chromatographic peak at each CV scan (≥8) and adjusting the MS cycle time according to the chromatographic peak widths.

- For tryptic peptides, the default CVs in the method templates are a good starting point, but you can change them. The CV range for tryptic peptides is –30 to –120V.

- For intact protein analyses, the CVs are not well predicted, and some optimization might be required for best performance. The CV range for intact proteins is –70 to +60.

- For targeted high-flow methods on a TSQ Series II mass spectrometer use the existing method templates (without FAIMS), finalize the chromatography, and then run the on-line CV optimization tool on the Scan Parameters page of the Method Editor to determine the optimum CVs for all the compounds in the method. See "Create an instrument method that uses the FAIMS CV scanning tool" on page 120.

Use a system template to set up a FAIMS experiment

Follow this procedure to customize a system template for a TSQ Series II mass spectrometer.

❖ **To set up an instrument method by using a system template**

1. In the Instrument Setup window, open the Method Editor for your MS.

2. Click the **Global Parameters** tab if the Global Parameter page is not open.

3. In the Ion Source Properties pane, select the FAIMS Mode: **Standard Resolution**, **High Resolution**, or **User Defined**.

> **Tip** Not Installed is the default selection for the FAIMS Mode. With this default selection, the Scan Parameters page does not include the FAIMS Voltages parameter.

4. If you selected the User Defined mode, specify the temperatures for the inner and outer electrodes.

   • FAIMS Inner Electrode Temp (°C): Default: 90; range: 70 to 100

   • FAIMS Outer Electrode Temp (°C): Default: 90; range: 70 to 100

5. In the Total Carrier Gas Flow list, select **Static** or **Time Dependent**.

6. Do one of the following:

   • If you selected Static for the Total Carrier Gas Flow, use the default value for your MS or specify a different value.

   If you specify an invalid value for your MS, a tooltip appears with information about the acceptable range for your MS.

   • If you selected Time Dependent, set up the Total Carrier time table.

   The application highlights incorrect values in red.

7. Click the **Scan Parameters** tab.

8. In the Scans pane, click the **Templates View** icon, ▦ .

9. Open the system template designed for the experiment type that you want to perform.

> **Tip** To clear the Experiment pane, click **Clear**.

10. In the Properties pane to the right of the Experiment pane, select **On** in the FAIMS Voltages list.

11. Save the entries as part of an Xcalibur instrument method (.meth file name extension).

Maintain the FAIMS interface

This chapter describes how to maintain the optimal performance of the FAIMS interface.

See the following topics:

- Maintenance Schedule
- Guidelines
- Tools and supplies
- Flush the syringe and the inlet components
- Cool the ion source housing to room temperature
- Remove the ion source housing from the FAIMS interface
- Maintain the electrode assembly
- Remove the FAIMS interface from the MS
- Clean the air filter at the bottom of the RF transformer box
- Clean the drainage system
- Fix a gas leak between the MS and the FAIMS interface
- Install the FAIMS interface on the API source interface
- Shut down the LC/MS/FAIMS system for storage

For a list of replaceable parts, see Appendix B, "Replaceable parts."

CAUTION Before performing maintenance tasks where you touch any of the components of the mass spectrometer's API source interface, place the MS in the Off mode from the Tune window. Or, toggle the Electronics switch on the right panel of the MS to the Service Mode position. Then, wait for the ion source housing to cool to room temperature.

During operation, the ion source housing can get hot enough to burn your skin when touched.

Maintenance Schedule

Table 18 lists the maintenance procedures and their recommended frequency.

Table 18. FAIMS system maintenance procedures and frequency

Component	Procedure	Recommended frequency	Topic
Inlet components	Flush (clean) the path from the sample transfer line to the source.	Daily	"Flush the syringe and the inlet components" on page 138
Housing adapter	Clean the inner and outer electrodes.	As needed	"Clean the electrodes" on page 146
	Clean the drain adapter.	As needed	"Clean the drainage system" on page 156
	Clean the entrance plate.	As needed	"Clean the entrance plate of the electrode assembly" on page 144
	Replace the entrance plate O-ring.	As needed	"Fix a gas leak between the MS and the FAIMS interface" on page 158
Main control box	Replace one or both fuses.	As needed	—
RF transformer box	Clean the air filter.	Every 4 months	"Clean the air filter at the bottom of the RF transformer box" on page 155

Guidelines

For optimal results, follow these guidelines when performing the procedures in this chapter:

- Always wear a new pair of lint- and powder-free gloves when handling internal components. Never reuse gloves after you remove them because the surface contaminants on them can recontaminate clean parts.

- Always place the components on a clean, lint-free work surface.

- Have nearby the necessary tools, supplies, and replacement parts (when applicable).

- Never over-tighten a screw or use excessive force.

- Proceed methodically.

IMPORTANT Make sure that you do not introduce any scratches or surface abrasions while handling the entrance plate and electrodes. Even small scratches can affect performance if they are close to the ion transmission path. Avoid using tools, such as metal pliers, that might scratch these components.

Tools and supplies

The FAIMS interface requires very few tools for its maintenance. Three separate sets of latches secure the electrode set to the electrode assembly, the electrode assembly to the housing adapter, and the housing adapter to the API source interface.

Table 19 lists the necessary chemicals, tools, and equipment for maintaining the system.

CAUTION To prevent corrosion, do not use nitric acid to clean metal parts.

CAUTION Avoid exposure to potentially harmful materials.

By law, producers and suppliers of chemical compounds are required to provide their customers with the most current health and safety information in the form of Material Safety Data Sheets (MSDS) or Safety Data Sheet (SDS). The MSDS and SDS must be freely available to lab personnel to examine at any time. These data sheets describe the chemicals and summarize information on the hazard and toxicity of specific chemical compounds. They also provide information on the proper handling of compounds, first aid for accidental exposure, and procedures to remedy spills or leaks.

Read the MSDS or SDS for each chemical you use. Store and handle all chemicals in accordance with standard safety procedures. Always wear protective gloves and safety glasses when you use solvents or corrosives. Also, contain waste streams, use proper ventilation, and dispose of all laboratory reagents according to the directions in the MSDS or SDS.

Table 19. Chemicals, tools, and equipment (Sheet 1 of 2)

Description	Part number
Chemicals	
Detergent (for example, Liquinox™)	(Liquinox) Fisher Scientific: • 50-821-299 (1 quart) • 50-821-298 (1 gallon)
Methanol, Optima™ LC/MS-grade	Fisher Scientific A456-4 (4L bottle)
Nitrogen gas, clean and dry	–
Water, Optima LC/MS-grade	Fisher Scientific W64 (4L bottle)
Tools and equipment	
Phillips screwdriver (for replacing the fuse)	–
Magnification device	–

Table 19. Chemicals, tools, and equipment (Sheet 2 of 2)

Description	Part number
Ultrasonic bath	–
Materials	
Gloves, lint-free and powder-free	Fisher Scientific 19-120-2947[a]
	Unity Lab Services: • 23827-0008 (medium size) • 23827-0009 (large size)
Industrial tissues, lint-free	–

[a] Multiple sizes are available.

Flush the syringe and the inlet components

Leaving the FAIMS interface attached to the MS, flush the syringe and the inlet components at the end of each work day (or more often if you suspect contamination).

> **CAUTION** When the MS ion transfer tube is installed, do not flush the MS with cleaning solution, which flushes the residue into it.

The following procedure describes how to flush a system that is set up for direct infusion.

To flush a system that is set up to perform chromatographic separations, plumb the system to bypass the LC column and the autosampler. Then, set the LC pump to deliver a 50:50 methanol/water solution through the inlet components to the ion source at a flow rate of 200 to 400 µL/min for approximately 15 minutes.

❖ **To flush the inlet components**

1. Turn off the sample flow from the syringe pump.

2. Place the MS in **Standby** mode, ⏸ .

3. Remove the syringe from the syringe pump, and then carefully remove the syringe needle from the Teflon™ tube on the syringe adapter assembly.

4. Rinse the syringe with a solution of 50:50 methanol/water.

5. Flush the sample transfer line, sample tube, and spray insert as follows:

   a. Load the clean syringe with a solution of 0.1% formic acid in 50:50 methanol/water (or another appropriate solvent).

   b. Carefully reinsert the syringe needle into the Teflon tube on the syringe adapter assembly.

    c.   Slowly depress the syringe plunger to flush the solution through the sample transfer line, sample tube, and spray insert.

    d.   Remove the syringe needle from the syringe adapter assembly.

Cool the ion source housing to room temperature

Before you remove the ion source housing from the MS, you must cool it to room temperature. During operation, the ion source housing can get hot enough to burn skin when touched.

To cool the ion source housing to room temperature, follow one of these topics:

- Cool the ion source housing quickly

- Cool the ion source housing to room temperature by placing the MS in Off mode

Cool the ion source housing quickly

To cool the ion source housing quickly, you can reduce the transfer tube temperature from the Tune window and place the MS in Standby mode as described in the following procedure.

❖   **To cool the ion source housing to room temperature more quickly**

1. Set the temperature of the ion transfer tube to **40°C**.

2. Place the MS in **Standby** mode.

> **Note** In Standby mode, the temperature control for the ion transfer tube is on. In addition, there is a steady flow of nitrogen through the orifice of the API source interface. which can help cool the external API source components.

3. Wait approximately 20 minutes for the ion transfer tube to cool to 40°C.

4. Place the MS in **Off** mode.

Because you waited for the ion transfer tube temperature to drop to 40°C. The ion source housing is now at 40°C or lower. With the MS in the Off mode, the ion source continues to cool to room temperature.

Cool the ion source housing to room temperature by placing the MS in Off mode

When you place the MS in Off mode, which turns off the heaters for the ion transfer tube and the steady low flow of nitrogen though the API source interface, it can take 30 to 40 minutes for the ion source housing to cool to room temperature.

❖ **To cool the ion source housing to room temperature**

1. Place the MS in **Off** mode.

> **Note** In the Off mode, the heaters for the ion transfer tube are turned off. However, the API source gases are also turned off. So, it takes longer for the external API source components to cool.

2. Wait approximately 30 minutes for the ion source to cool to room temperature.

Remove the ion source housing from the FAIMS interface

❖ **To remove the ion source housing from the FAIMS interface**

1. When applicable, turn off the LC liquid flow to the source, and disconnect the LC plumbing.

2. Do one of the following from the Tune window:

   a. Set the temperature of the ion transfer tube to **40°C**.

   b. Place the MS in **Standby** mode, ⏸ .

   c. Wait approximately 20 minutes for the ion transfer tube temperature to cool to 40°C.

   d. Place the MS in **Off** mode, ⏹ .

   Because you waited for the ion transfer tube temperature to drop to 40°C. The ion source housing is now at 40°C or lower. With the MS in the Off state, the ion source continues to cool to room temperature.

   –or–

   e. Place the MS in **Off** mode, ⏹ .

   f. Wait approximately 30 minutes for the ion source to cool to room temperature.

> **CAUTION Hot surface**. The external surface of the spray insert, API source housing, MS Ion sweep cone, and entry to the ion transfer tube can be hot enough to burn your skin. Allow the parts to cool to room temperature (approximately 20 minutes) before you touch them.

3. Follow the instructions in the ion source user guide to remove it from the FAIMS interface mounting posts.

> **Tip** The user guides for the ion sources that are compatible with your MS are available from the Options menu in the Tune window. To open any of these user guides, click the **Options** icon, ⚙ . Then, choose **Instrument Manuals** from the dropdown menu.

Maintain the electrode assembly

To maintain the electrode assembly, follow these steps in the order listed:

1. Remove the electrode assembly from the housing adapter

2. Remove the electrode set from the entrance plate

3. Clean the components of the electrode assembly

4. Reassemble the electrode assembly

Remove the electrode assembly from the housing adapter

Preconditions
The MS is in Off mode, the ion source housing is removed, and the FAIMS interface is at room temperature.

IMPORTANT To avoid contaminating the LC/MS/FAIMS system, wear clean, power-free gloves when handling components that come into contact with samples.

❖ **To remove the electrode assembly from the housing adapter**

1. While wearing clean lint-free and powder-free gloves, lightly touch the electrode assembly to make sure it is cool enough to touch.

CAUTION Hot surface. The external surface of the spray insert, API source housing, MS Ion sweep cone, and entry to the ion transfer tube can be hot enough to burn your skin. Allow the parts to cool to room temperature (approximately 20 minutes) before you touch them.

2. Unlock the locking latches that secure the electrode assembly to the housing adapter.

Figure 83. Electrode assembly with unlocked levers
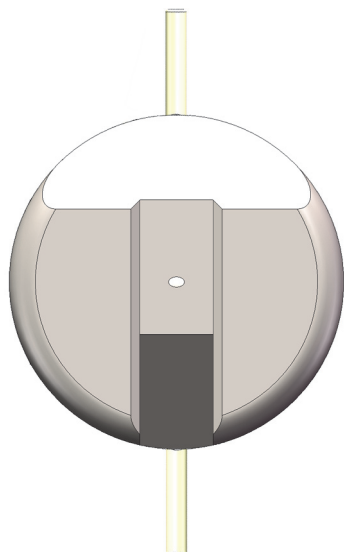
3. Remove the electrode assembly by grasping its sides and pulling it off.

Remove the upper drain for high-flow applications from the electrode assembly

For high-flow applications, the electrode assembly includes a detachable drain.

| Preconditions |
| --- |
| The electrode assembly is removed from the FAIMS housing adapter. |

Tools
2 mm hex wrench to loosen the M2.5 socket head cap screws that secure the top FAIMS drain to the entrance plate

❖ **To remove the drain from the electrode assembly**

1. Use a 2 mm hex wrench to loosen the two screws that secure the upper FAIMS drain to the electrode assembly's entrance plate.

2. Remove the loosened screws from the drain and pull the drain away from the entrance plate.

Figure 84. Removing the top FAIMS drain from the electrode assembly's entrance plate
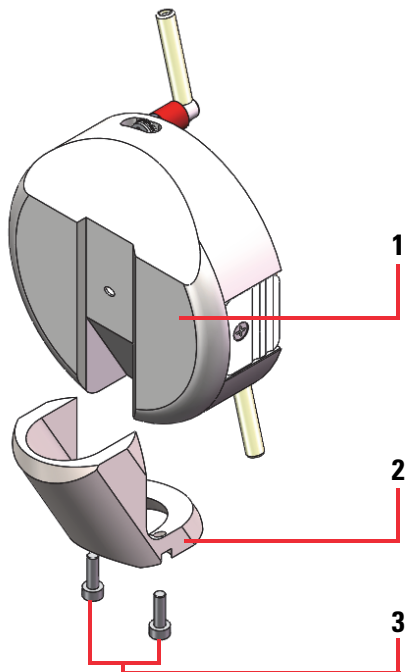
No.	Description	No.	Description
1	Front face of the entrance plate	3	Two screws that secure the drain to the electrode assembly
2	Top drain		

Remove the electrode set from the entrance plate

Before you can clean the inner and outer electrodes, you must remove the electrode set from the entrance plate as described in the following procedure.

Preconditions

The FAIMS electrode assembly is removed from the FAIMS housing adapter, and you have prepared a clean and lint-free surface where you can disassemble the assembly.

❖ **To remove the electrode set from the entrance plate**

1. While wearing clean lint-free and powder-free gloves, unlock both of the entrance plate's RF locking latches (shown).

   IMPORTANT Nothing secures the components of the electrode set to each other. Put firm pressure on both ends of the electrode set as you remove it from the entrance plate.

2. Remove the electrode set by grasping its ends and pulling it out of the entrance plate.

Figure 85. Removing the electrode set from the entrance plate
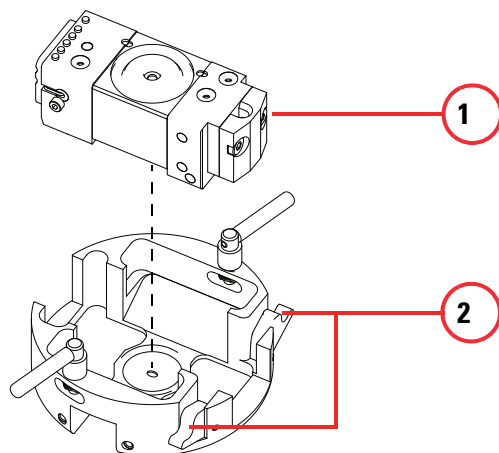
No.	Description	No.	Description
1	Electrode set	2	RF locking latches in the unlocked position

Related Topics

- "Remove the electrode assembly from the housing adapter" on page 141

- "Clean the electrodes" on page 146

Clean the components of the electrode assembly

Follow these procedures to clean the components of the electrode assembly:

- Clean the entrance plate of the electrode assembly

- Clean the electrodes

Clean the entrance plate of the electrode assembly

Preconditions

The FAIMS electrode assembly is removed from the FAIMS housing adapter, and the electrode set is removed from the electrode assembly.

Chemicals

- Liquinox™

- Optima™ LC/MS grade water

- Optima LC/MS grade methanol

Tools and materials

- 2 mm hex wrench to tighten the M2.5 socket head cap screws that secure the top FAIMS drain to the entrance plate

- Lint-free and powder-free gloves

- Lint-free tissues

- Foam-tipped swabs

- Soft toothbrush

❖ **To clean the entrance plate**

1. While wearing lint-free and powder-free gloves, remove the O-ring behind the orifice of the entrance plate and set it aside on a lint-free tissue.

   Figure 86. Back of the entrance plate with the electrode set removed
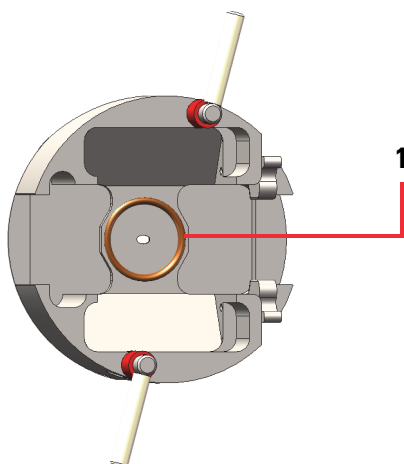
No.	Description
1	O-ring behind the entrance plate's orifice

2. Prepare a solution of 1% Liquinox in Optima LC/MS grade water.

3. Use a soft toothbrush to clean the entrance plate with the 1% solution of Liquinox in water. Clean both the entrance and exit sides of the entrance plate.

4. Use a foam-tipped swab dipped in the 1% solution of Liquinox in water to clean inside the entrance plate orifice.

5. Thoroughly rinse the entrance plate with Optima LC/MS grade water.

6. Thoroughly rinse the entrance plate with Optima LC/MS grade methanol.

7. Use a stream of nitrogen gas (purity: 99.5% or higher) to dry the entrance plate, or let it air-dry on a lint-free cloth.

8. Seat the O-ring in groove on the back side of the entrance plate.

> **IMPORTANT** After you clean the entrance plate make sure that the O-ring is seated properly on the entrance plate before you reinsert the electrode set.

Clean the electrodes

When you see a high frequency of DV dropouts in your DV plots, clean the electrodes. For information about monitoring the DV stability of your system, see "View a plot of the dispersion voltage's stability" on page 124.

With typical use, you might need to clean the electrodes every two weeks.

Preconditions

The FAIMS electrode assembly is removed from the FAIMS housing adapter, and the electrode set is removed from the electrode assembly.

Chemicals

- Liquinox™

- Optima LC/MS grade water

- Optima LC/MS grade methanol

Materials and equipment

- Foam-tipped swabs

- Lint- and powder-free gloves

- Two 100 mL glass beakers

- Ultrasonic bath

❖ **To clean the inner and the outer electrodes of the FAIMS electrode assembly**

1. Prepare a clean and lint-free surface to work on.

2. Prepare a solution of 1% Liquinox in Optima LC/MS grade water.

3. While wearing lint-free and powder-free gloves, separate the inner electrode and the outer electrode from the electrode set.

Figure 87. Electrode set components
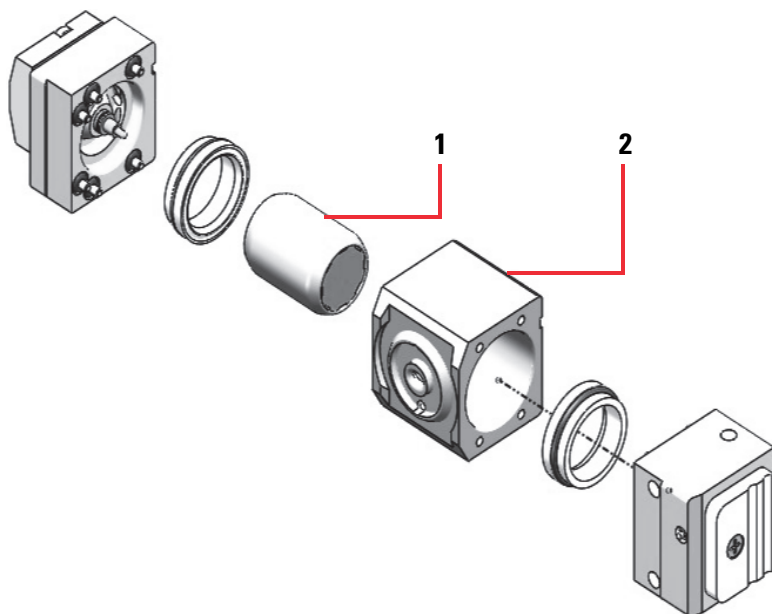
No.	Description	No.	Description
1	Inner electrode	2	Outer electrode

CAUTION Do not use Micro-Mesh (TM) products or any abrasive substance that could damage the metal surfaces of the electrodes.

4. Wipe the inner and outer electrodes using a foam-tipped swab dipped in the 1% solution of Liquinox in water.

> **Tip** You can order the cleaning kit (P/N 70111-62112) from Thermo Fisher Scientific. The cleaning kit includes foam-tipped swabs.

> **IMPORTANT** Use only Optima LC/MS grade solvents to clean the electrodes.

5. Use two separate beakers to sonicate the inner and outer electrodes in 100% Optima LC/MS grade water for 10 minutes.

6. Replace the water with 50:50 water/methanol and sonicate the electrodes for an additional 10 minutes.

7. Use a stream of nitrogen gas (purity: 99.5% or higher) to dry the electrodes, or let them air-dry on a lint-free cloth.

After you clean the electrodes and the entrance plate, reassemble the electrode assembly and install the electrode assembly on the FAIMS housing adapter.

Reassemble the electrode assembly

After you clean the electrodes, reassemble the electrode assembly as described in the following procedure.

Preconditions
The FAIMS electrode assembly is removed from the FAIMS housing adapter, and the electrode set is removed from the electrode assembly.

❖ **To reassemble the electrode assembly**

1. If the O-ring is not installed in the groove on the back side of the entrance plate, install it.

   Figure 88. O-ring seal on the back of the entrance plate
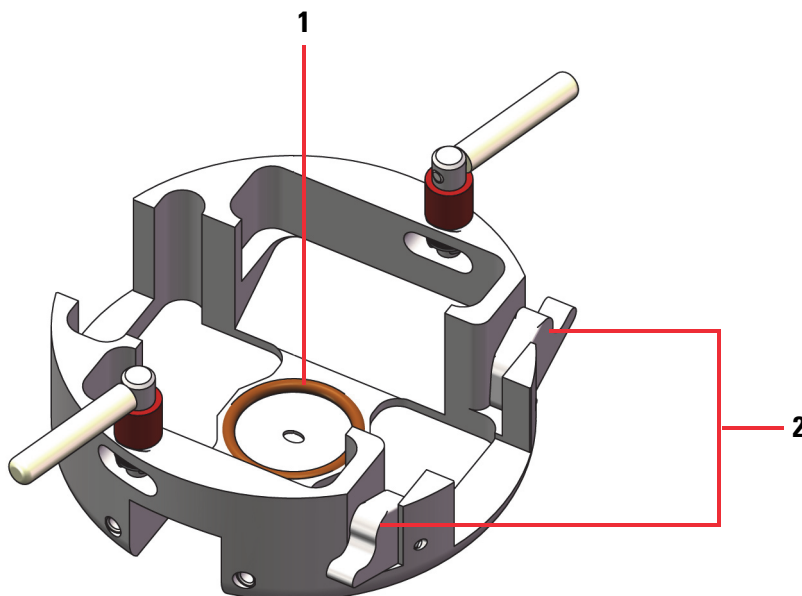
No.	Description	No.	Description
1	O-ring on the back side of the entrance plate, behind the entrance plate's orifice	2	RF locking latches

2. Reassemble the electrode set as follows:

   a. Install the bushing with its seated O-ring in the heater endcap. The bushing's O-ring must face the endcap.

   Figure 89 shows the heater side of the heater endcap (with four gas ports) that faces the outer electrode and the bushing with its O-ring.

Figure 89. View of the heater endcap and bushing with O-ring
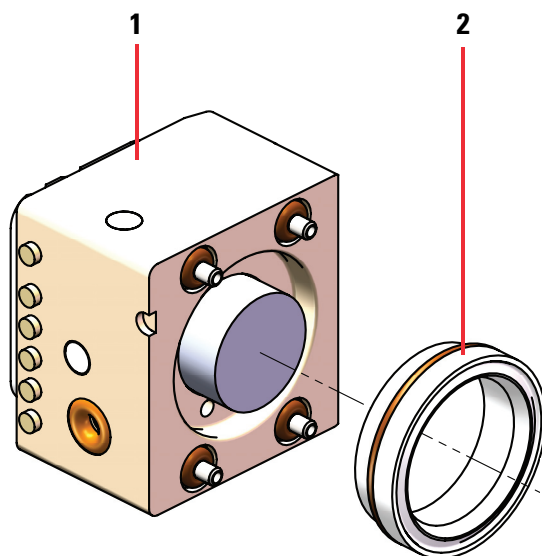
No.	Description	No.	Description
1	Heater endcap, showing the four gas ports	2	Bushing with O-ring

Figure 90. View of the bushing installed in the heater endcap
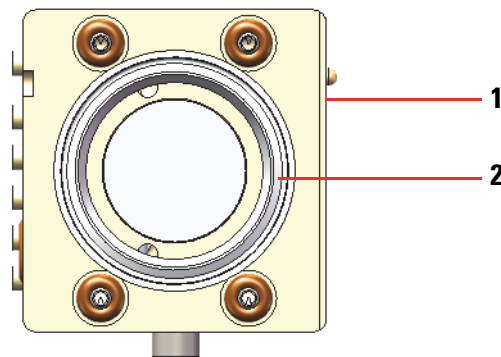
No.	Description	No.	Description
1	Heater endcap, showing the four gas ports	2	Bushing with O-ring facing the heater endcap

b. Slide the inner electrode into the heater endcap and bushing assembly. See Figure 91.

The ends of the inner electrode are the same. It does not matter which end faces the heater endcap and which end faces the RF endcap.

Figure 91. View of the inner electrode aligned with the heater endcap and bushing assembly (from the top) on the left and the inner electrode by itself on the right
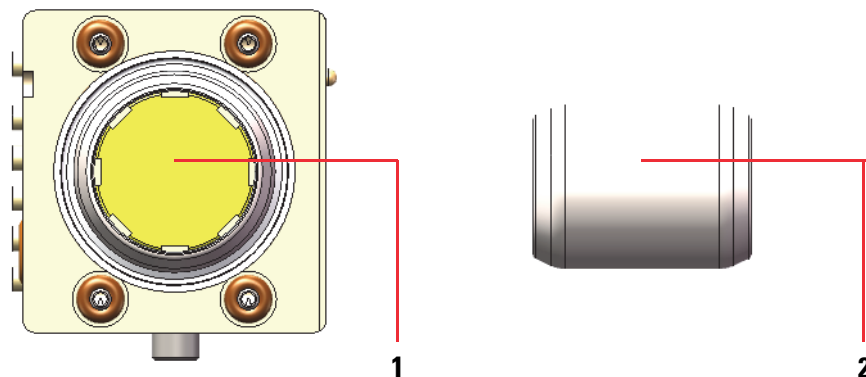
No.	Description	No.	Description
1	Top view of the inner electrode aligned with the bushing in the heater endcap	2	Side view of the inner electrode

c. Align the side of the outer electrode that has four gas channels with the heater endcap. Then, slide the outer electrode over the inner electrode.
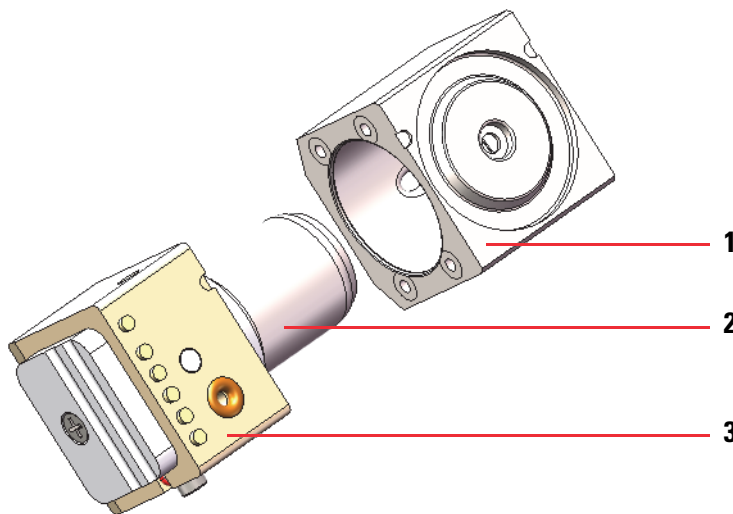
No.	Description	No.	Description
1	Outer electrode, showing the side with four gas channels facing the heater endcap	3	Heater endcap
2	Inner electrode		

The alignment notch on the heater endcap and alignment notch on the outer electrode must align with each other. See Figure 92.

Figure 92. View of the alignment notches on the heater endcap and outer electrode
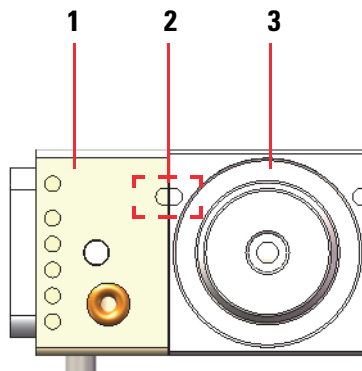
No.	Description	No.	Description
1	Heater endcap	3	Outer electrode
2	Alignment notches		

Figure 93. View of the six channel side of the outer electrode
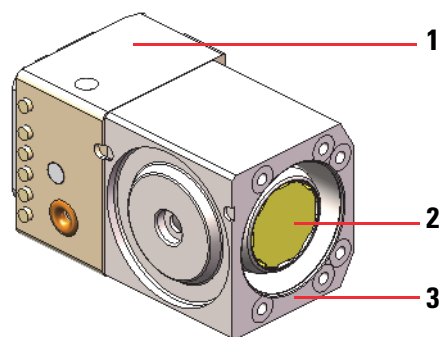
No.	Description	No.	Description
1	Heater endcap	3	Six channel side of the outer electrode
2	Inner electrode		

d. Install the bushing (with the seated O-ring) in the RF endcap. See Figure 94 and Figure 95.

Figure 94. Bushing and sealing O-ring facing toward the RF endcap
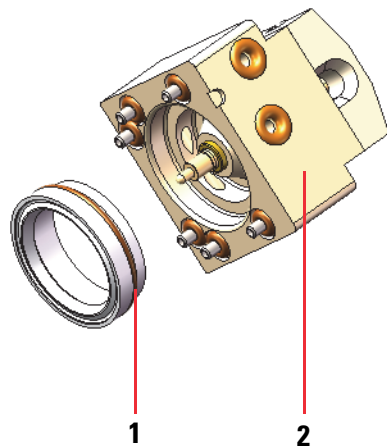
No.	Description	No.	Description
1	Bushing with O-ring	2	RF endcap

e. Align the alignment notch on the RF endcap with the alignment notch on the six channel side of the outer electrode. Then, slip the six ports that extend from the RF endcap into the six channels on the outer electrode.

Figure 95. RF endcap and bushing assembly aligned with the outer electrode
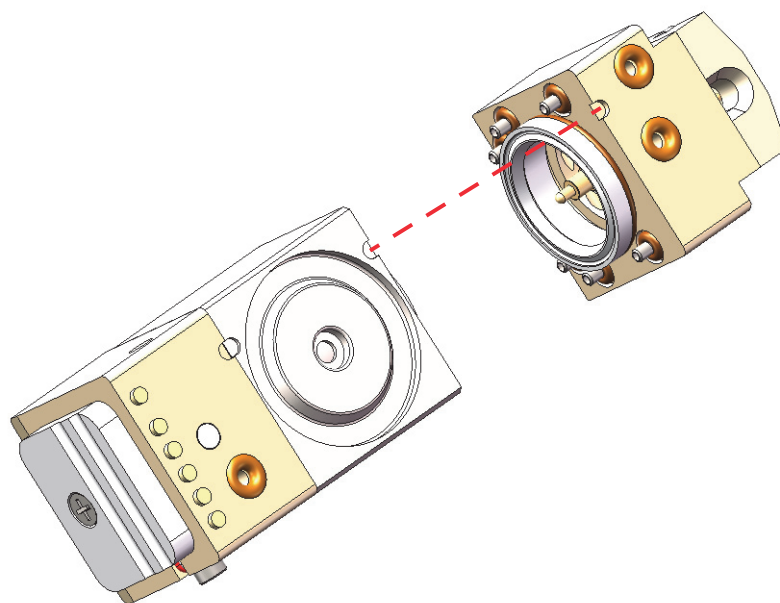
3. Hold the assembled electrode set with your thumb and forefinger.

Figure 96. Assembled electrode set (the alignment notches are on the side that is not visible)
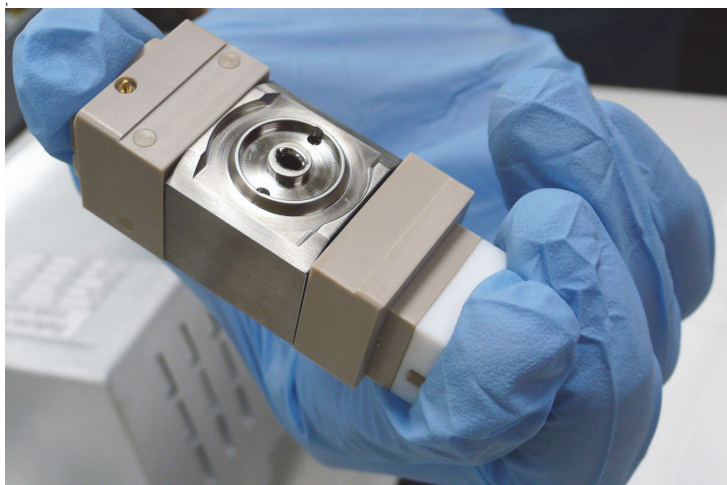
4. Place the assembled electrode set into the entrance plate above the O-ring.

   The electrode set is self aligning and fits in only one position within the entrance plate.

5. Close the two RF locking latches on the entrance plate.

Figure 97. RF locking latches in the locked position
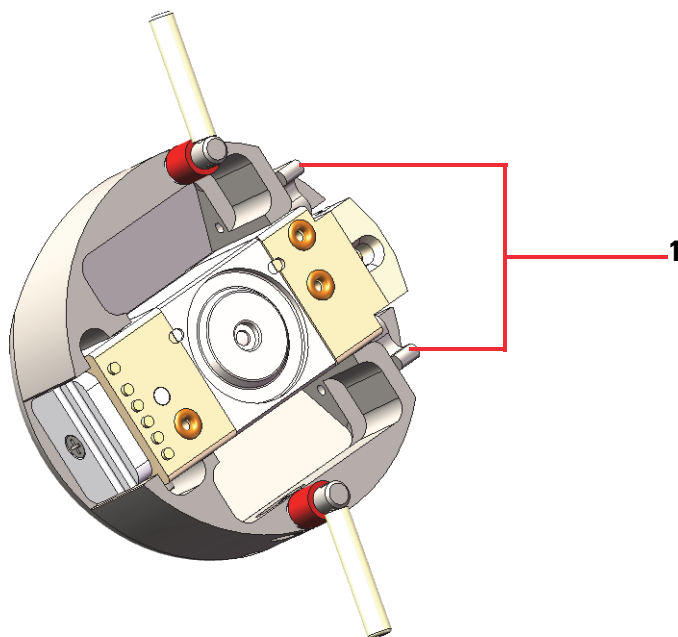
No.	Description
1	RF locking latches in the locked position

6. For high-flow applications, install the top FAIMS drain. See "Connect the top FAIMS drain to the electrode assembly when using the OptaMax ion source" on page 48.

Remove the FAIMS interface from the MS

For optimal performance of non-FAIMS experiments, remove the FAIMS interface from the MS. You can optionally disconnect the connections to the main controller box (MCB) and leave the box on top of the MS. You might need a small flat-blade screwdriver to remove the 37-pin connector from the MCB. You do not need tools to remove or install the FAIMS housing adapter and RF transformer box assembly.

Tip If you are removing the FAIMS interface for a short period of time, place the assembly on top of the MS and place a clean tissue over the electrode assembly to prevent contamination.

❖ **To remove the FAIMS interface from the MS**

1. From the Tune window, place the MS in the **Off** mode.

2. After the ion source housing has cooled to room temperature, remove it as described in its user guide.

   Tip The user guides for the ion sources that are compatible with your MS are available from the Tune window's Options menu. To open any of these user guides, click the **Options** icon, ⚙ ▾. Then, choose **Instrument Manuals** from the dropdown menu.

   Note You cannot unlock and remove the FAIMS interface while the ion source housing is installed.

3. Turn off the power switch on the back panel of the FAIMS main controller box (MCB). Then, disconnect its power cord from the electrical outlet.

   IMPORTANT Do not pull on or hold the FAIMS housing adapter and RF transformer assembly by its cable.

4. Do one of the following:

   • If you want to temporarily leave the MCB on top of the MS, do not disconnect the connections to the back panel of the MCB.

   • If you want to store the FAIMS interface in a different location, disconnect all the connections to the back panel of the MCB.

5. Unlock the housing adapter's locking latches, grasp behind the RF transformer box and pull off the housing adapter and RF transformer box assembly away from the MS mounting posts.

Figure 98. Housing adapter's locking latches in the unlocked position
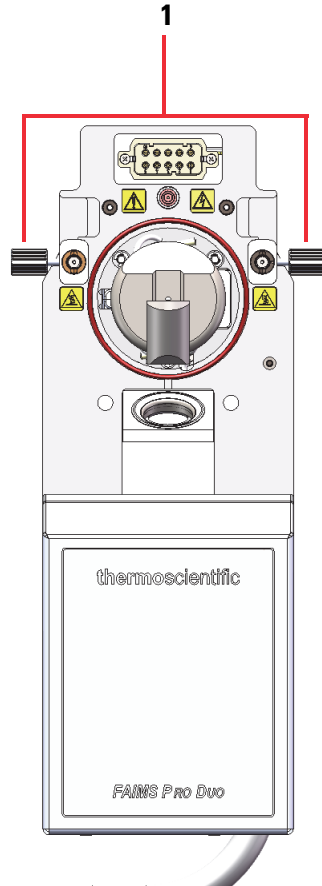
No.	Description
1	Locking latches in the unlocked position

Clean the air filter at the bottom of the RF transformer box

Preconditions
The FAIMS housing adapter and RF transformer box assembly is removed from the MS.

Tools
#2 Phillips screwdriver

❖ **To clean the air filter**

1. Use a Phillips screwdriver (#2) to remove the two Phillips head screws that secure the fan grill to the bottom of the RF transformer box.

2. Remove the air filter for cleaning.

3. Wash the air filter with water and pat it dry with a paper towel.

Figure 99. Air filter on the bottom of the RF transformer box
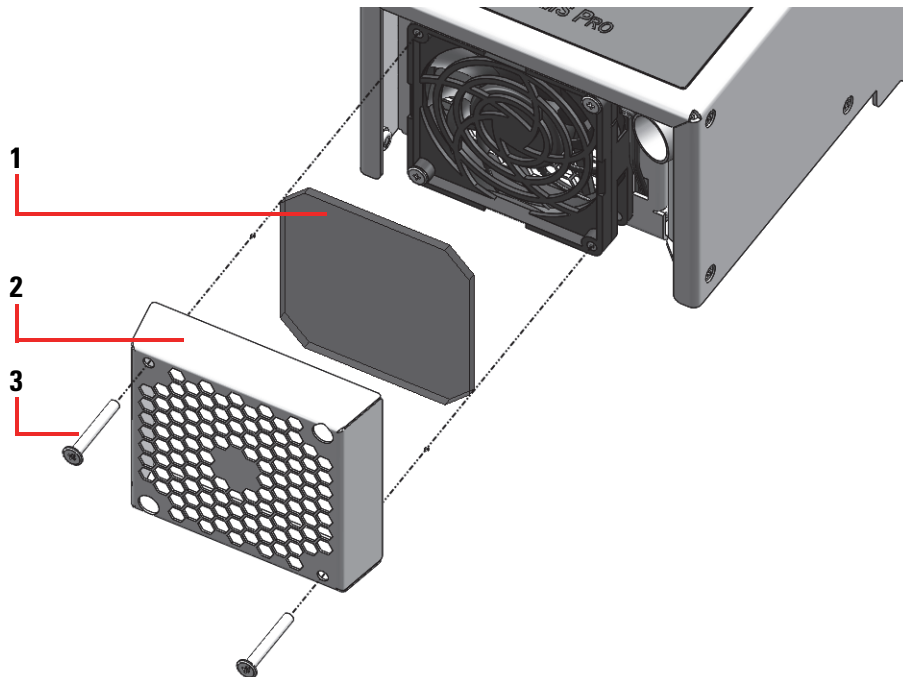
No.	Description	No.	Description
1	Air filter	3	M4×30 mm, low profile, Phillips head screws (2)
2	Fan grill		

4. Reinstall the clean air filter.

To install the FAIMS interface on the MS, see "Install the FAIMS interface on the MS" on page 51.

Clean the drainage system

When the background noise increases beyond an acceptable level, clean the drainage system.

Preconditions

- The FAIMS housing adapter and RF transformer box assembly is removed from the MS.

- FAIMS electrode assembly is removed from the FAIMS housing adapter.

- The upper FAIMS drain is removed from the electrode assembly.

Chemicals
• Liquinox™
• Optima LC/MS grade water
• Optima LC/MS grade methanol
Materials and equipment
Soft toothbrush
Lint-free cloth

For an LC/MS/FAIMS system, the components of the drainage system that require periodic cleaning are as follows:

• The natural PEEK drain insert in the ion source housing (for high-flow applications)
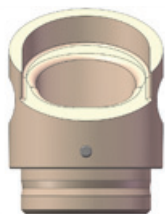
• The drain attached to the electrode assembly (for high-flow applications)
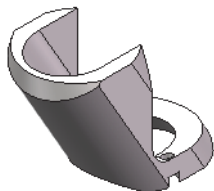
• The drain adapter on the front of the FAIMS housing adapter

> **IMPORTANT** Clean the drain adapter after removing the housing adapter from the mass spectrometer.

❖ **To clean the drainage system**

1. Do the following:

   • To clean the metal drain, brush the drain with a soft toothbrush soaked in a 1% solution of Liquinox in water.

   • To clean the drain insert on the front of the housing adapter, wipe the adapter using a lint-free cloth dampened with an Optima LC/MS grade solvent—100% water, 100% methanol, or a mixture of water and methanol.

- To clean the natural PEEK drain, wipe the drain using a lint-free cloth dampened with an Optima LC/MS grade solvent—100% water, 100% methanol, or a mixture of water and methanol.

2. Thoroughly rinse the drains with Optima LC/MS grade water.

3. Rinse the drains with Optima LC/MS grade methanol.

4. Use a stream of nitrogen gas (purity: 99.5% or higher) to dry the drains.

Figure 100. Drain insert on the housing adapter
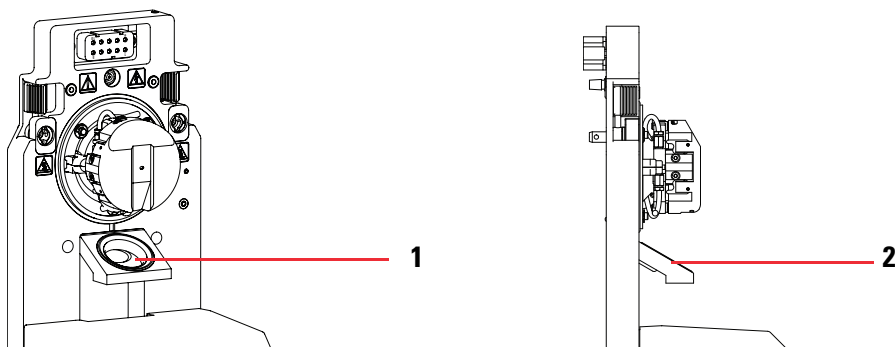
No.	Description	No.	Description
1	Drain insert in the drain extension on the FAIMS housing adapter	2	Drain extension

Fix a gas leak between the MS and the FAIMS interface

If you observe a gas leak after installing the FAIMS interface, follow this procedure to reposition or replace any of the following O-rings—the large O-ring on the front of the housing adapter, the large O-ring on the back of the housing adapter, or the O-ring behind the entrance plate's orifice.

IMPORTANT A misaligned O-ring can cause an error message indicating failure of electrodes to heat up properly.

❖ **To fix a gas leak between the MS and the FAIMS interface**

1. If the ion source housing is installed, do the following:

   a. Place the MS in the Off mode, and wait for the source housing to cool to room temperature.

   CAUTION Hot surface. The external surface of the spray insert, API source housing, MS Ion sweep cone, and entry to the ion transfer tube can be hot enough to burn your skin. Allow the parts to cool to room temperature (approximately 20 to 30 minutes) before you touch them.

b.   Remove the ion source housing from the MS as described in the ion source user guide.

> **Tip** The user guides for the ion sources that are compatible with your MS are available from the Tune window's Options menu. To open any of these user guides, click the **Options** icon, ⚙ ▾ . Then, choose **Instrument Manuals** from the dropdown menu.

2.   Unlock the electrode assembly's locking latches. Then, remove the electrode assembly from the housing adapter.

3.   Unlock the electrode assembly's RF locking latches. Then, remove the electrode set from the assembly. Squeeze the ends of the electrode set as you remove it from the assembly.

4.   Examine the 15.6 mm ID O-ring on the entrance plate behind the electrode set.
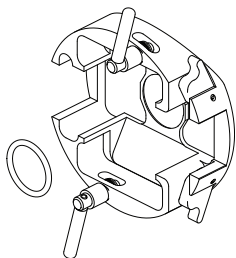
5.   Examine the 41 mm ID O-ring on the front of the housing adapter.
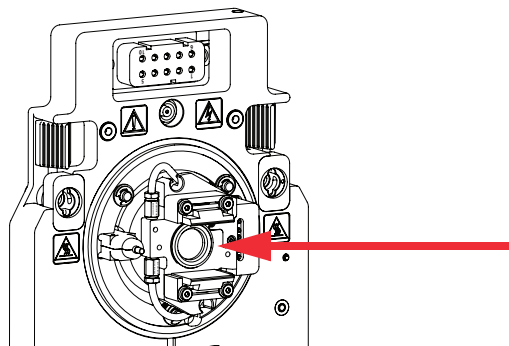
> **Tip** The 41 mm ID O-ring on the front of the housing adapter sometimes sticks to the electrode assembly when you remove the electrode assembly from the housing adapter.
>
> If the O-ring on the front of the housing adapter comes off with the electrode assembly, do the following:
>
> 1.   Make sure that the housing adapter is cool enough to touch. Then, remove it from the MS.
>
> 2.   Let the housing adapter equilibrate at room temperature for at least 20 minutes.
>
> 3.   Seat the O-ring in the groove.

4. Remove the housing adapter from the MS and examine the 40 mm ID O-ring on the back of the housing adapter. See "Remove the FAIMS interface from the MS" on page 154.

5. Install the clean O-rings in their respective grooves or replace the O-rings as necessary.

Related Topics

• Replaceable parts

Install the FAIMS interface on the API source interface

Follow this procedure if you removed only the FAIMS housing adapter and RF transformer box assembly from the MS but left the FAIMS cable attached to the main controller box (MCB).

Preconditions

• The ion source housing is removed from the MS.

• The API source interface is cooled to room temperature.

• The FAIMS interface is removed from the MS.

• The FAIMS electrode assembly is installed on the FAIMS housing adapter.

• For high-flow applications, the top FAIMS drain is installed on the electrode assembly.

❖ **To install the FAIMS interface on the API source interface**

1. Turn off the MCB if is not already turned off by toggling the power switch on its back panel to the Off position.

2. Toggle the Electronics switch on the mass spectrometer's right panel to the Service Mode position.

   Figure 101 shows the Electronics switch (a toggle switch) on the right panel of the mass spectrometer in the Service Mode.

Figure 101. Electronics switch for the MS
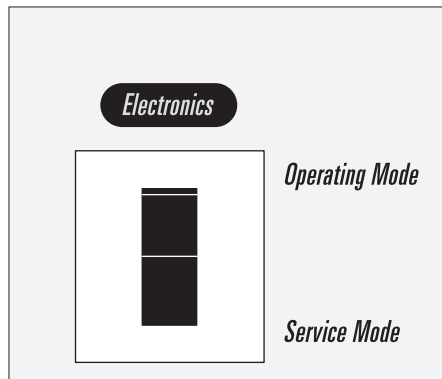
3. Install the FAIMS housing adapter on the API source interface's mounting pins.

4. Close the locking latches on the FAIMS housing adapter to secure the FAIMS interface to the MS.

5. If you disconnected any of the cables or nitrogen lines to the MCB, reconnect them.

6. Set the Electronics switch to the Operating Mode position.

Shut down the LC/MS/FAIMS system for storage

Shut down the LC/MS/FAIMS system when you are not using it for an extended period of time or when you must shut it down for maintenance or service.

None of the maintenance procedures in this guide require a full shut down of the LC/MS/FAIMS system.

❖ **To shut down the MS/FAIMS system**

1. If your system includes an LC pump, turn off the solvent flow to the MS ion source.

2. In the Tune window, place the MS in **Off** mode, ⬤ .

3. Toggle the Electronics switch on the mass spectrometer's right panel to the Service Mode position.

   Placing the Electronics switch in the Service Mode position, turns off the mass spectrometer's front panel LEDs and the power to the non-vacuum system electronics.

4. Turn off the Main Power switch for the MS and the power switch on the back panel of the FAIMS main controller box (MCB).

5. Unplug the MS and MCB power cords from the electrical outlets.

CAUTION Do not disconnect the power cords at the MS or MCB while the other ends are still plugged into the electrical outlets.

6. (Optional) Turn off the LC instruments, the gas supply to the mass spectrometer at its tank, and the data system computer.

Note For routine or preventive system maintenance, you do not need to turn off the LC instruments, gas supply, and data system.

To restart the LC/MS system after a complete shutdown refer to hardware manual for the mass spectrometer. Then, turn on the power switch on the back panel of the FAIMS main controller box to restart the FAIMS interface.

Upgrade a FAIMS Pro interface for high-flow applications

The FAIMS Pro interface as purchased is compatible only with solvent flow rates from 100 to 1000 nL/min. To use the FAIMS Pro interface for high-flow applications, you must order the FAIMS Pro to High-Flow Kit, and then replace the drain ring in the housing adapter with the drain insert in the kit.

The new drain ring ensures efficient drainage from the ion source regardless of whether the MS is in the Standby, On, or Off mode and regardless of whether the spray voltage and gases are sufficient to produce a spray plume while the solvent flow from the liquid chromatography (LC) system is turned on. The new drain ring even prevents solvent pooling in the drainage system when a run time error turns off the MS or the FAIMS interface, but it does not turn off the solvent flow from the LC system.

To install the new drain insert, follow these topics in the order listed:

1. Remove the FAIMS Pro drain insert

2. Install the new drain ring on the FAIMS housing adapter

Remove the FAIMS Pro drain insert

Required tools

- Small flathead screwdriver

- Large flathead screwdriver

❖ **To remove the old drain ring from the FAIMS Pro interface**

1. If the FAIMS Pro interface is installed on the MS, remove it from the MS as described in "Remove the FAIMS interface from the MS" on page 154.

2. Place the housing adapter module on a flat surface with the electrode assembly facing up.

3. Using the small flathead screwdriver, gently pry the drain ring away from the drain extension at several points around the drain ring's circumference. If necessary, twist the screwdriver to apply lateral force to separate the drain ring from the housing adapter.

Figure 102. Using a small flathead screwdriver to loosen the drain ring

4. Insert the large flathead screwdriver into the gap between the drain ring and housing adapter to pry the drain ring up and away from the housing adapter.

Figure 103. Using a large flathead screwdriver to pry the drain ring away from the housing adapter
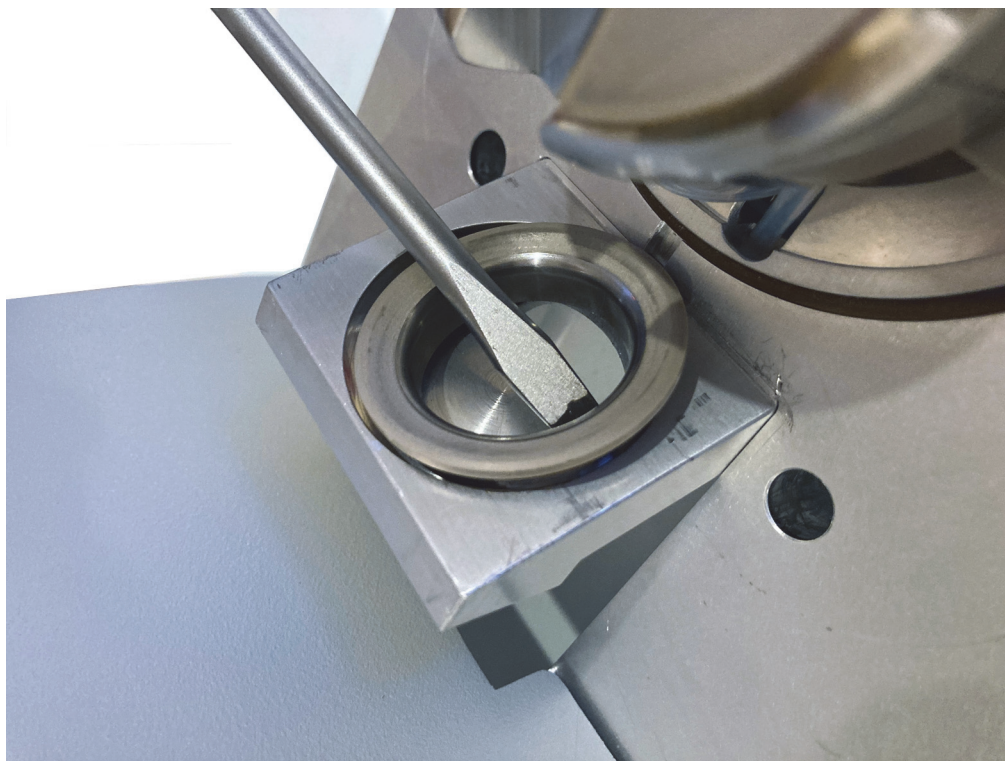
Install the new drain ring on the FAIMS housing adapter

Required parts

- Drain ring in the FAIMS Pro to High-Flow Kit

- O-ring for the drain ring

❖ **To install the new drain ring on the FAIMS housing adapter**

1. Place the O-ring (provided in the upgrade kit) on the bottom of the new drain ring.

Figure 104. Bottom of the new drain and the O-ring
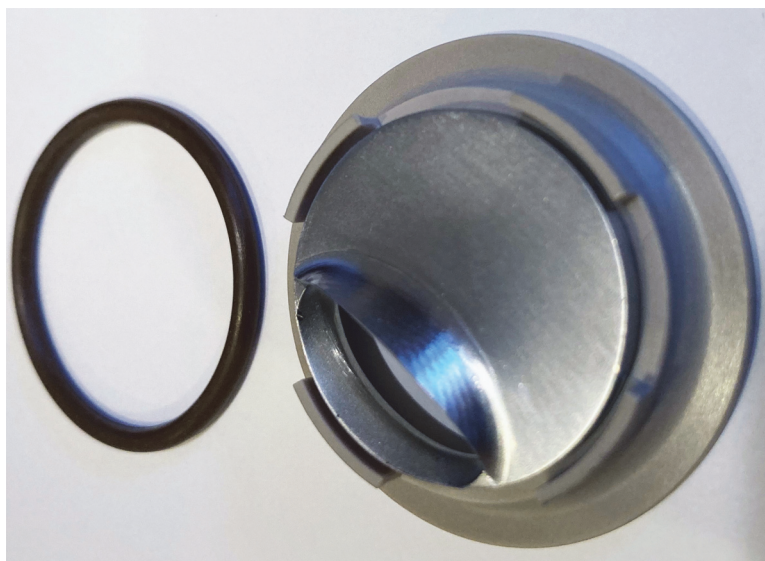
Figure 105. O-ring installed on drain ring
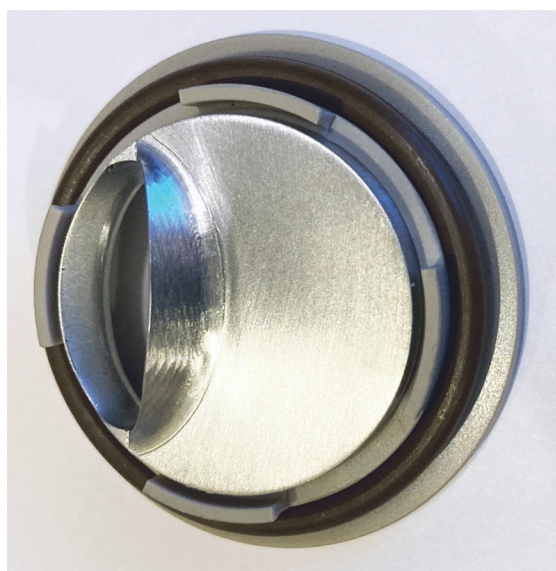
2. Align the drain ring with the housing adapter such that the bottom side with the O-ring faces the RF box of the FAIMS Pro interface and the oval drain hole matches the oval hole on the housing adapter.

Figure 106. Oval drain hole in the drain extension on the front of the housing adapter
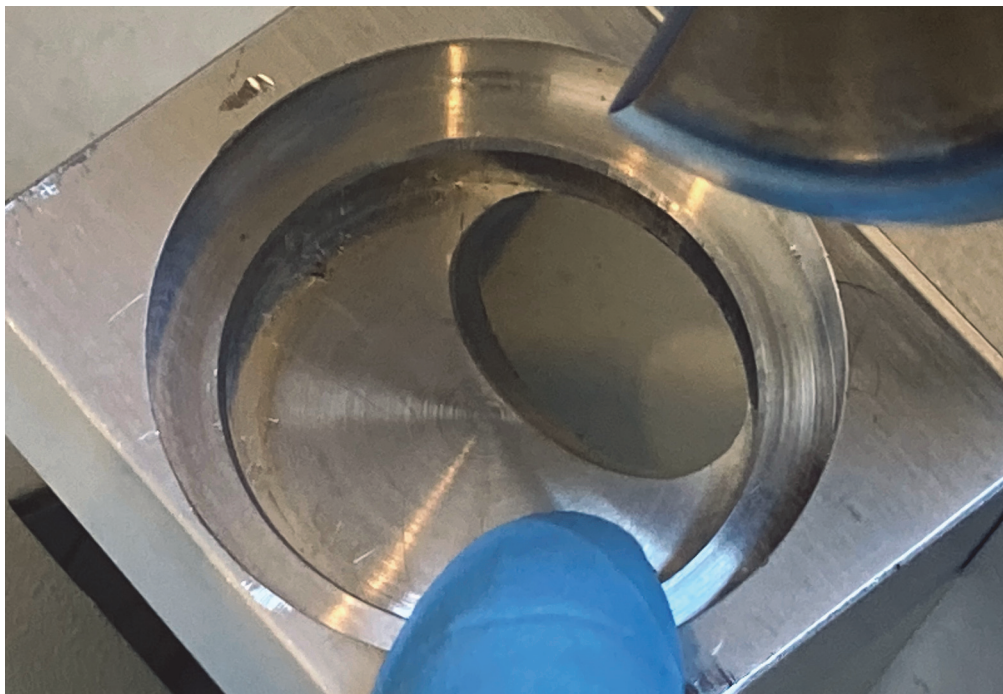
Figure 107. New drain insert above the drain extension
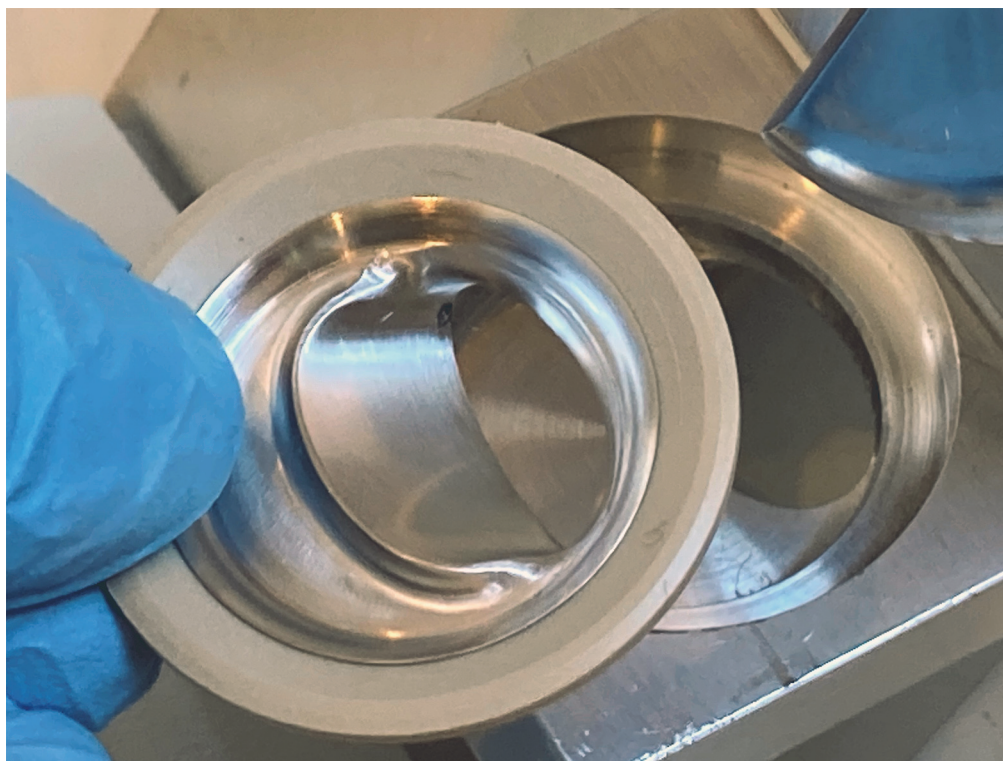
3. Push the drain ring in place until it sits flush with the top of the drain extension.

Figure 108. Installed drain ring

Note To use the upgraded FAIMS Pro interface for high-flow applications, do the following:

- Install the FAIMS drain on the electrode assembly as described in "Connect the top FAIMS drain to the electrode assembly when using the OptaMax ion source" on page 48.

- Remove the metal drain insert from the OptaMax NG ion source as described in "Remove the metal drain insert from the ion source housing" on page 61. Then, install the natural PEEK drain insert in the OptaMax NG ion source as described in "Install the ion source drain insert that is compatible with the FAIMS interface" on page 63

Replaceable parts

This chapter describes the replaceable parts and the FAIMS Pro to FAIMS Pro Duo upgrade kit that you can purchase from Thermo Fisher Scientific. It also describes the power cord specifications for the FAIMS interface.

See the following topics:

- Consumable parts

- FAIMS Pro to High-Flow Kit

- FAIMS Installation Kit

- Power cord

Note The FAIMS interface ships with an installation kit and a power cord. Use the provided part numbers when ordering replacement parts.

Consumable parts

Fuse, miniature cartridge, 5 × 20 mm, time-lag, low-breaking capacity,
2 A 250 V (for the MCB AC inlet) 00006-09105
O-ring, Viton 884, 41 mm ID, 1.78 mm W (1-5/8 in. ID, 1/16 in. width
(back of the housing adapter) 00107-01-00019

FAIMS Pro to High-Flow Kit

To expand the flow rate range of the FAIMS Pro interface, order the The FAIMS Pro to High-Flow Kit (OPTON-20068).

Note To upgrade a legacy FAIMS Pro interface for high-flow applications on a Tribrid MS, you also need to purchase the OptaMax NG ion source (OPTON-32100)

Table 20. FAIMS Pro to High-Flow Kit (OPTON-20068) parts

Part description		Purpose	Part number
Drain, electrode assembly, FAIMS		Connects to the entrance plate of the FAIMS entrance plate and electrode assembly to provide additional drainage	98100-20074
Screws, two, Endries, M2.5 by 8 mm long, socket cap head		Secure the high-flow drain to the entrance plate of the FAIMS electrode assembly	00619-01-00040
Drain, insulator, FAIMS		Connects to the OptaMax NG ion source housing to provide additional drainage	98100-20073 rev B
Drain ring, housing adapter, FAIMS Pro Duo		25% glass-filled natural PEEK 31 mm wide at the upper lip Fits into the drain port of the drain extension on the front of the FAIMS housing adapter	98100-20078
O-ring		31.42 mm ID, 2.62 mm width, Parker No. 2-124 Provides a seal between the drain ring and the drain extension on the front of the housing adapter	00107-01-00205

FAIMS Installation Kit

The FAIMS Installation Kit ships with the FAIMS Pro interface and the FAIMS Pro Duo interface.

Table 21. FAIMS Installation Kit (Sheet 1 of 2)

Part description	Purpose	Part number
Cable, patch cord, Cat 5E, 7 ft length	Connects the main controller box to the Ethernet switch for the LC/MS system	N/A
Tubing, ultrapure PFA, 0.25 in. OD, 0.062 in. wall thickness, 15 ft length	Connects the laboratory nitrogen supply to the FAIMS main controller box (MCB)	00101-50100
Fitting, tube, union, push to connect fittings, for 1/4 in. OD tubing and 6 mm OD tubing, nylon (Parker Legris number 3106 06 56)	Replacement push to connect fitting for the gas lines	00101-01-00180
Fitting, union, tube, TEE to connect three tube of equal or different diameters at a 90 degree angle, push to connect fittings	Connects the laboratory nitrogen supply to Nitrogen In port on the left panel of the MS and the Nitrogen In port on the back panel of the MCB	00101-01-00021
O-ring (1), Parker number 2-030, 1 5/8 in. ID, 1 3/4 in. OD, 1/16 in. width, Viton 884	O-ring on the back of the housing adapter	00107-01-00019
O-rings (2), Parker number 2-016, 15.61 mm ID, 1.78 mm. cross-section width, Viton, V0884-75	O-ring on the front of the housing adapter	00107-01-00188
O-rings (3), Parker number 2-004, 178 mm ID by 178 mm W, VITON, V884-75	Replacement O-ring for the FAIMS housing adapter	00107-01-00057
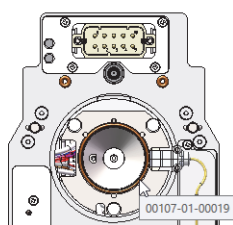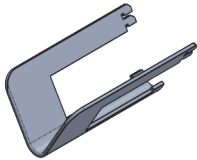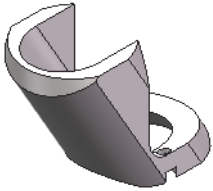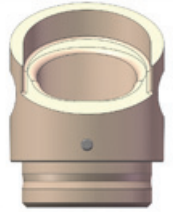
Table 21. FAIMS Installation Kit (Sheet 2 of 2)

Part description	Purpose	Part number
Assembly, bushing with O-ring for the FAIMS electrode assembly	Replacement bushing and O-ring for the electrode assembly	
Cable support, FAIMS MCB	Supports the FAIMS cable that hangs off the back of the MCB and prevents the electrical wires inside the cable from pulling away from the connector (due to gravity) and fraying	98100-10014
Drain, electrode assembly, FAIMS	For high-flow applications, this drain connects to the electrode assembly and directs excess solvent into the drainage system	98100-20074
Screws, two, Endries, M2.5 by 8 mm long, socket cap head	Secure the high-flow drain to the entrance plate of the FAIMS electrode assembly	00619-01-00040
Drain, FAIMS, insulator	Provides additional drainage for the OptaMax NG ion source	98100-20073

Power cord

Country or territory[a]	Receptacle type	Plug type	Plug rating	Cord length
North America (P/N 6003-0160)	C13	NEMA 5-15, nonpolarized	125 Vac, 10 A	2.3 m (7.5 ft)
International[b] (various part numbers)	C13	Various	250 Vac, 10 A	2.5 m (8.2 ft)

[a] Part number is provided for Thermo Fisher Scientific field service use only.

[b] "International" designation is for countries or territories that do not use the North American plug configuration.

Specifications, laboratory requirements, and gas consumption

This chapter describes the specifications and laboratory requirements for the FAIMS interface. It also provides information about the nitrogen gas consumption for the FAIMS interface.

See the following topics:

- Specifications for the FAIMS interface
- Laboratory requirements for the FAIMS interface
- Nitrogen gas consumption

Specifications for the FAIMS interface

Table 22 lists the specifications for the FAIMS Pro and FAIMS Pro Duo interfaces.

Table 22. FAIMS interface specifications

Parameter	Specification
Dimensions (width × height × depth)	
Housing adapter and RF transformer box	14 × 39.6 × 14.8 cm (5.5 × 15.6 × 5.8 in.)
Main controller box (MCB)	31.9 × 6.1 × 48 cm (12.6 × 2.4 × 18.9 in.)
Weight	
Housing adapter, RF transformer box, cable assembly, and electrode assembly	3.5 kg (7.7 lb)
Main control box (MCB)	2.7 kg (6 lb)

Laboratory requirements for the FAIMS interface

Table 23 lists the laboratory requirements for the FAIMS Pro and FAIMS Pro Duo interfaces.

Table 23. FAIMS Pro Interface specifications

Parameter	Specification
Electrical requirements	
Input rating	100–240 Vac, 50/60 Hz, 2.0 A
Input fuse (MCB AC inlet filter/fuse holder)	Miniature cartridge, 5 × 20 mm, 250 Vac, 2 A, time-lag, low-breaking capacity
Transient overvoltages	Category II
Electrical outlet (wall receptacle)	• North America and other countries with the same configuration: NEMA 5-15 (120Vac, minimum 5 A, 50/60 Hz) • Other locations outside North America: various plug types (230 Vac, minimum 5 A, 50/60 Hz)
Environmental requirements	
Relative humidity	40–80%, noncondensing
Temperature	• Operating range: 15–27 °C (59–81 °F) • Optimum operating range: 18–21 °C (64–70 °F) • Ambient temperature fluctuations: Less than 1 °C or 2 °F over a one-hour period
Heat output (power)	180 VA (614 BTU/h)
Gas supply requirements	
Nitrogen	• High-purity (99.5%) • 690 ±138 kPa (100 ±20 psi) • Tubing, Teflon™ PFA, 1/4 in. (6.35 mm) OD, 0.062 in. (1.57 mm) thick, 4.6 m (15 ft) long (gas supply tank)
Maximum gas consumption flow rate	• Nanoflow applications up to 18.2 L/min • High-flow applications with the OptaMax NG ion source up to 28 L/min of FAIMS nitrogen

Nitrogen gas consumption

For nanoflow applications, you can use the FAIMS Pro interface or the FAIMS Pro Duo interface. For high-flow applications with the OptaMax NG ion source, you can use only the FAIMS Pro Duo interface or an upgraded FAIMS Pro interface.

Note For information about upgrading the FAIMS Pro interface, see "Upgrade a FAIMS Pro interface for high-flow applications" on page 163.

Note The carrier gas is always on and flowing at a low level when the MS is in Off, Standby, or Service mode. The user can increase the Total Carrier Gas flow rate during operation from the default flow rate.

See the following topics:

- Gas consumption by the FAIMS interface for nanoflow applications
- Gas consumption by the FAIMS interface for high-flow applications
- Total nitrogen gas consumption for an LC/FAIMS/ MS system by solvent flow rate

Gas consumption by the FAIMS interface for nanoflow applications

These conditions apply for Table 24:

- The MS is either scanning or is in Standby mode.
- The FAIMS interface is attached to the MS and powered on.
- The EASY-Spray or Nanospray Flex ion source is in use.

Table 24. FAIMS interface gas consumption for nanoflow application

	High-capacity ion transfer tube (elongated bore)		Standard capacity ion transfer tube (round bore)	
	Standard Resolution	**High Resolution**[a]	**Standard Resolution**	**High Resolution**[a]
Cooling gas (L/min)	5	10	5	10
Carrier gas default (L/min)	4.6	4.6	1.2	1.2
Carrier gas range (L/min)	3.5–7.7	3.5–7.7	0.7–4.3	0.7–4.3
Total (L/min)	**8.5–12.7**	**13.5–17.7**	**5.7–9.3**	**10.7–14.3**

[a] High resolution mode is defined as an inner electrode temperature of 80 °C and an outer electrode temperature of 100 °C.

Gas consumption by the FAIMS interface for high-flow applications

For high-flow applications with the OptaMax NG ion source (H-ESI or APCI), the flow rate of the FAIMS cooling gas depends on the vaporizer temperature, the ion transfer tube type, and the resolution mode. The default setting and range for the carrier gas depend on the ion transfer tube type.

Table 25 lists the gas consumption for high-flow applications, by the vaporizer temperature, ion transfer tube type, and FAIMS resolution mode.

Table 25. FAIMS interface gas consumption for high-flow applications with the OptaMax NG ion source

	Temperature (°C)	High-capacity ion transfer tube (elongated bore)		Standard capacity ion transfer tube (round bore)	
		Standard Resolution	High Resolution	Standard Resolution	High Resolution
Cooling gas (L/min)	Up to 100 °C	6	11	6	11
	150 °C	7	12.25	7	12.25
	200 °C	8	13.25	8	13.25
	250 °C	9.25	14.5	9.25	14.5
	300 °C	10.25	15.5	10.25	15.5
	350 °C	11.5	16.75	11.5	16.75
	400 °C	12.5	17.75	12.5	17.75
	450 °C	13.75	19	13.75	19
	500 °C	14.5	20	14.5	20
	550 °C	16	20	16	20
Carrier gas default (L/min)	n/a	4.6	4.6	1.2	1.2
Carrier gas range (L/min)	n/a	3.5–7.7	3.5–7.7	0.7–4.3	0.7–4.3
Total	**n/a**	**9.5–13.7**	**14.5–27.7**	**6.7–20.3**	**11.7–24.3**

Total nitrogen gas consumption for an LC/FAIMS/ MS system by solvent flow rate

Table 26 provides an example of the total nitrogen gas consumption for an LC/FAIMS/TSQ Altis MS system. The calculated values, in L/min, are based on the default ion source conditions for the specified solvent flow rates and include the source gases and the FAIMS gases.

The gas consumption increases as the solvent flow rate increases and is higher for the high resolution mode than the standard resolution mode.

Table 26. Calculated nitrogen gas consumption for an LC/FAIMS/TSQ Altis MS system

Solvent flow rate (μL/min)	Total Gas Consumption (L/min)	
	FAIMS in standard resolution mode	FAIMS in high resolution mode
50	19.9	25.1
100	25.6	31.3
250	30.7	35.9
400	30.7	35.9
800	35.3	40.6
1000	35.3	40.6

Index

W