

APEX

High Sensitivity Inlet System
for ICP-OES & ICPMS



Elemental Scientific Inc.



Elemental Scientific, Inc.

Elemental Scientific, Inc. (ESI) designs and produces a range of sample introduction systems for the determination of trace element concentrations and isotope ratios in liquid samples when using inductively coupled plasma instrumentation (ICP). ICP-OES and ICP-MS instruments measure most of the elements in the periodic table and are used daily by many laboratories as a routine analytical tool. ESI has many products based upon improving the efficiency and capabilities of the ICP sample introduction system.

ESI has sample introduction systems for a wide range of applications, including semiconductor pure chemicals, environmental, clinical, organic solvents, isotope ratio, and many other types of trace metal determinations.

Custom Products

We welcome the opportunity to manufacture special products and to work with prototype designs. If you require a product not listed in the catalog, please call or email and a representative will be happy to discuss your requirements. to discuss your requirements.

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APEX Sample Inlet System

a high stability, high sensitivity, low-memory desolvating inlet system for ICP-OES & ICP-MS

The Apex is a fully integrated inlet system that connects directly to the ICP torch injector and incorporates ESI's MicroFlow PFA or PolyPro nebulizer technology. The Apex improves sensitivity primarily by increasing both sample transport efficiency and the quality of aerosol introduced to the ICP instrument. Liquid samples are nebulized with the MicroFlow nebulizer into a heated cyclonic spray chamber and Peltier cooled condenser. This gives unsurpassed stability along with enhancements in sensitivity of between 3 – 10 times depending on the volume of sample introduced.



Apex Q Sample Inlet System

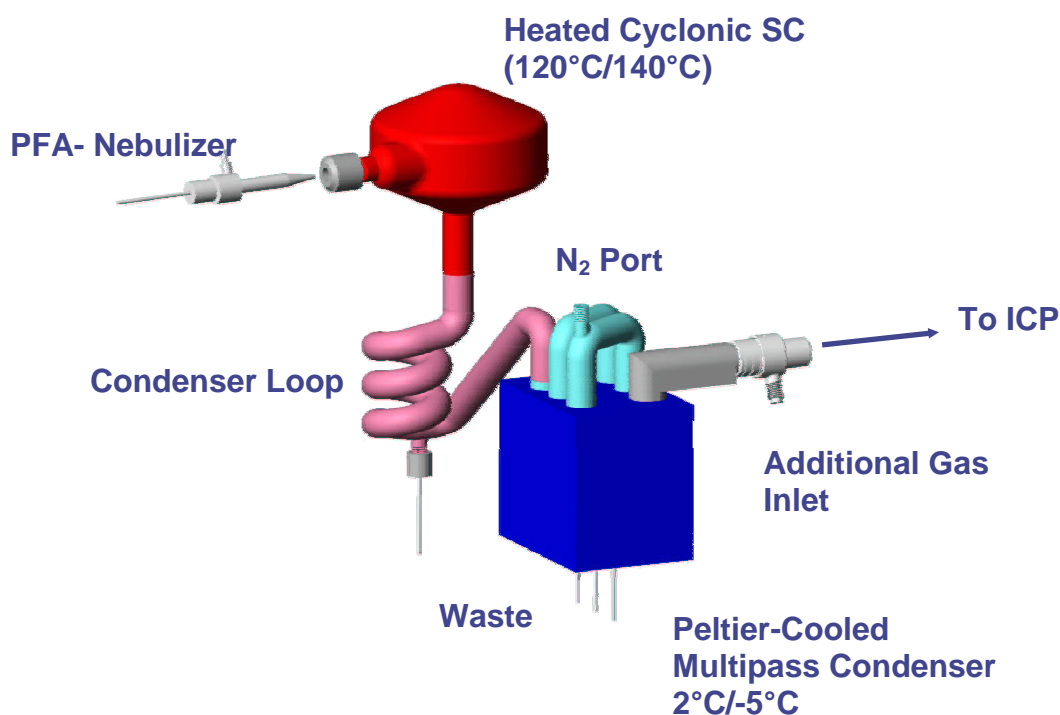
- Unique patent pending flow path design ensures rapid wash out characteristics.
- Utilizes PFA MicroFlow or PolyPro-ST nebulizers to generate sample aerosol.
- Excellent signal stability
- Can operate from 10 μ L/min - 800 μ L/min.
- Available in 4 different platforms with flow paths in Pyrex, quartz, & PFA.
- Can tolerate samples with high TDS.
- Small footprint.
- O-ring free to give low backgrounds.
- Integrated 4 channel peristaltic drain pump
- Can be used with or without membrane desolvation.
- Two optional membrane units available, ACM cooled Nafion[®] membrane and Spiro heated Teflon[®] membrane

Sample Flow Path

The unique patent pending, o-ring free, sample flow path is constructed entirely from 3 different materials to suit every laboratory application and cost needs.

The sample is aspirated via a PFA MicroFlow

nebulizer into a heated cyclonic spray chamber to vaporize the entire sample. The excess solvent aerosol is then condensed out by a Peltier cooled condenser. The dry aerosol containing over 90% of the sample analyte passes to the ICP.



Internal sample flow path of the Apex sample inlet system.

The 4 available Apex platforms are:

Apex E - Low cost unit designed primarily for ICP Emission systems. The sample path is made from Pyrex and temperature settings of the heater and chiller are fixed.

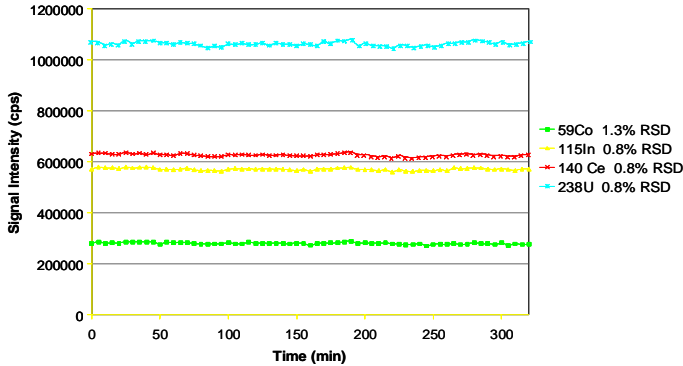
Apex Q - Has an o-ring-free Quartz flow path for high sensitivity and low background for samples that do not contain hydrofluoric acid. The Apex Q gives the fastest rinse-out of any high sensitivity ICP introduction system.

Apex HF - Uses a high-purity PFA Teflon flow path to provide resistance to HydroFluoric acid.

Apex IR - Has a quartz flow path and includes an additional mixing chamber giving the most stable signal, ideal for Isotope Ratio analysis.

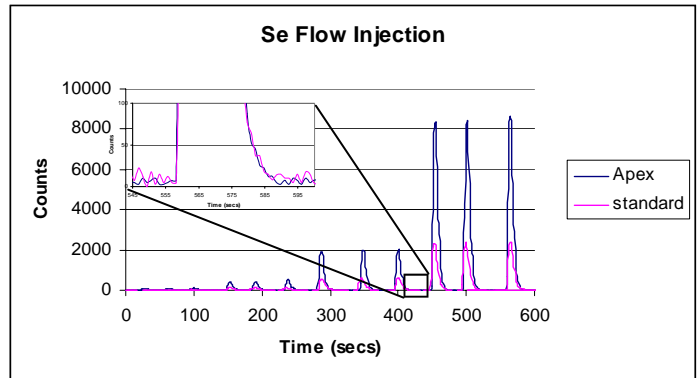
Performance Characteristics

5 Hour Signal Stability 50 ppt



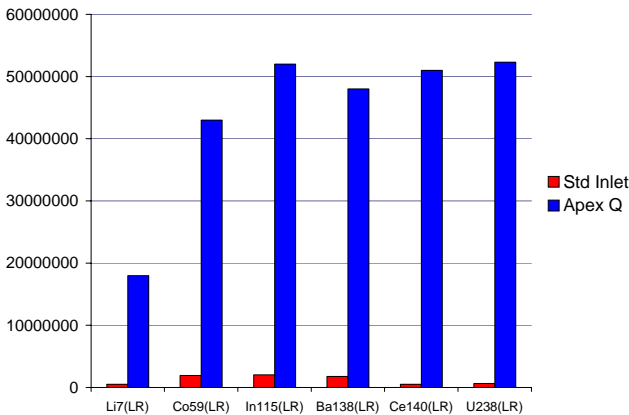
Unsurpassed Stability

Enhanced stability, which can be further improved with the use of the Apex IR or the addition of the ACM to the other Apex platforms.



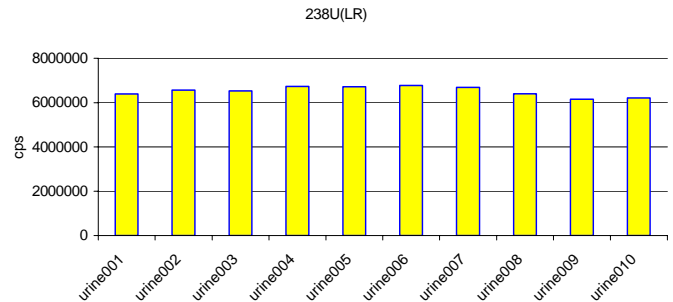
Rapid Rinse Out

The patent pending design of the sample flow path ensures minimal memory effects with rinse-outs comparable if not faster than simple cyclonic systems, even with initial higher count rates.



Enhanced Sensitivity

Improvements in sensitivity that can range from 3x to 15x over standard inlet systems depending on the sample flow rate used. The Apex is over 90% efficient at transporting the sample analyte to the plasma.



Matrix Tolerance

Capable of running with high matrix samples such as 10% Urine, giving 3.2% rsd after 10 x 5 min sample replicates

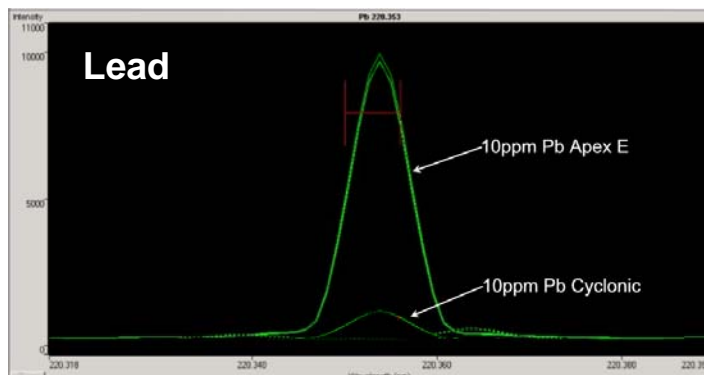
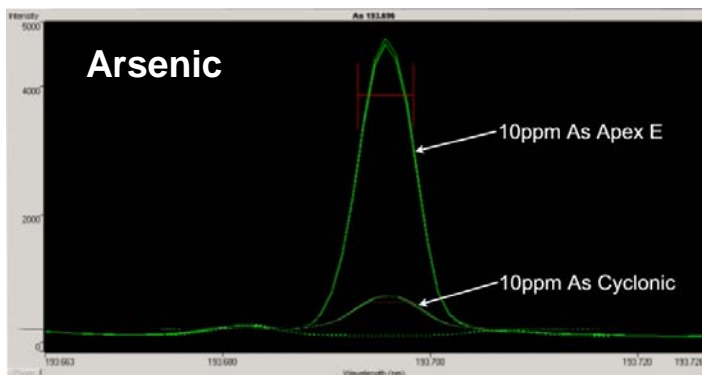
Apex E for ICP-OES



A low cost unit designed primarily for ICP Emission systems. The sample path is made from Pyrex and temperature settings of the heater and chiller are fixed.

ICP-OES detection limits can be improved by up to a factor of 6-10 when operating at 0.8 ml/min using a MicroFlow PFA-ST or PolyPro-ST nebulizer together with the Apex E. Alternatively, the combination of a low flow nebulizer with the Apex E maintains ICP-OES sensitivity while reducing sample consumption by a factor of 5 - 10, improving ICP-OES determinations when the volume of sample is limited.

- Lower cost high performance inlet system
- O-ring free Pyrex flow path
- Flow rates 100 μ L/min—0.8mL/min
- 6—10 fold enhancement in sensitivity
- Simple one switch control

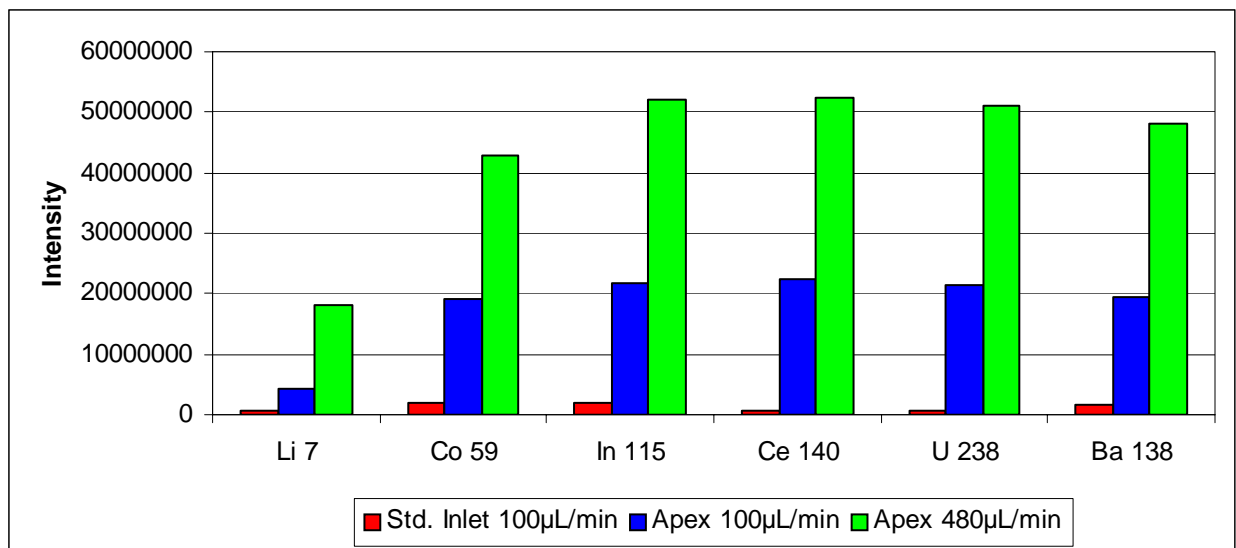


Wavelength scans from a radial ICP-OES of 10ppm solution of Arsenic and Lead introduced with both standard cyclonic spray chamber and the Apex E sample inlet system.

Apex Q - Quartz Inlet System

Features an o-ring-free Quartz flow path for high sensitivity and low background for samples that do not contain hydrofluoric acid. The Apex Q sample path design, ensures rapid rinse-out of any high sensitivity ICP introduction system.

- Improves sensitivity 3—10 fold depending on flow rate
- Flow rates from 20—600 μ L/min
- Dual preset temperature settings for heater (105°C/140°C) and cooler (-5°C/2°C)
- Capable of processing volatile samples
- Tolerates high dissolved solids
- Nitrogen addition control
- Rapid rinse out



The Apex Q is over 90% efficient at transporting the sample analyte to the plasma.

Apex IR for Isotope Ratio Analysis



Developed for Isotope Ratio analysis, the Apex IR has a quartz flow path and includes an additional mixing chamber that further homogenizes and stabilizes the sample aerosol stream, resulting in a more stable signal from the ICP-MS.

- Improves sensitivity 3—10 fold depending on sample flow rate
- Enhanced stability
- O-ring free Quartz sample flow path
- Flow rates from 20—600 μ L/min
- Nitrogen addition control
- Retrofit to Apex Q version

Sr Ratios (NBS 987)	Standard Error (abs.) $\times 10^{-6}$		
	SIS/PFA-50	Apex IR/PFA-100	
	200 ppb	10 ppb	100 ppb
$^{84}\text{Sr}/^{86}\text{Sr}^*$	15.3	25.8	2.8
$^{87}\text{Sr}/^{86}\text{Sr}^*$	3.9	7.8	2.7
$^{88}\text{Sr}/^{86}\text{Sr}$	123	111	49.8

*Ratio normalized to $^{88}\text{Sr}/^{86}\text{Sr}$
Thermo Neptune

Apex HF for Hydrofluoric Acid Resistance

Uses a high-purity o-ring free PFA Teflon flow path to provide resistance to Hydrofluoric acid. The Apex HF is recommended for many geochemistry and semiconductor applications where samples containing HF are analyzed.

- Improves sensitivity 3—7 fold depending on flow rate
- Supplied with PFA MicroFlow nebulizers for minimum spiking and rapid rinse out
- Minimal static effects
- HF resistant PFA Teflon sample flow path
- Flow rates from 20—400 μ L/min
- Nitrogen addition control



Sensitivity comparison (1 μ g/L) Apex HF vs. Crossflow Nebulizer Elan DRC II

	Mg (24)	In (115)	Ba (138)	Ce (140)	Pb (208)
CrossFlow	10091	27470	26366	21499	12885
Apex HF	207329	265083	302756	246960	183914

The Apex HF is over 90% efficient at introducing analyte to the plasma, resulting in dramatic improvements in sensitivity.

Membrane Desolvation

The Apex high efficiency sample inlet system has within it Peltier desolvation. Many applications require the removal of further solvent and matrix components of a sample than the Apex alone is capable of. Membrane desolvation can be used to increase the aerosol drying capability of the Apex system. Two membrane units are available for use with any Apex sample introduction system.

ACM

- Cooled Micro-Porous Nafion[®] membrane.
- Desolvation of small polar solvents.
- Allows analysis of volatile Species, no loss of analytes.
- Use Ar or N₂ as sweep gas.
- Obtain CeO⁺:Ce⁺ ratio of approximately 0.06%.

Spiro TMD

- Heated Macro-Porous Teflon[®] membrane.
- Desolvation of Aqueous & Organic Solutions.
- Run samples with high TDS.
- Can be used without the Apex for stand alone desolvation.
- Obtain CeO⁺:Ce⁺ ratio of approximately 0.03%.



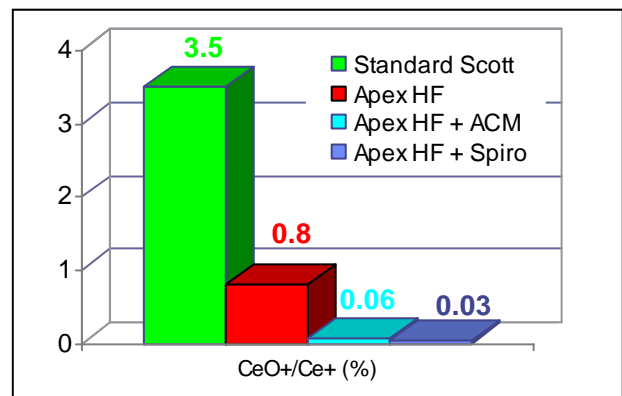
ACM Module cooled membrane desolvation unit



Spiro TMD heated membrane desolvation module



Membrane desolvation modules attach quickly and easily to the Apex outlet

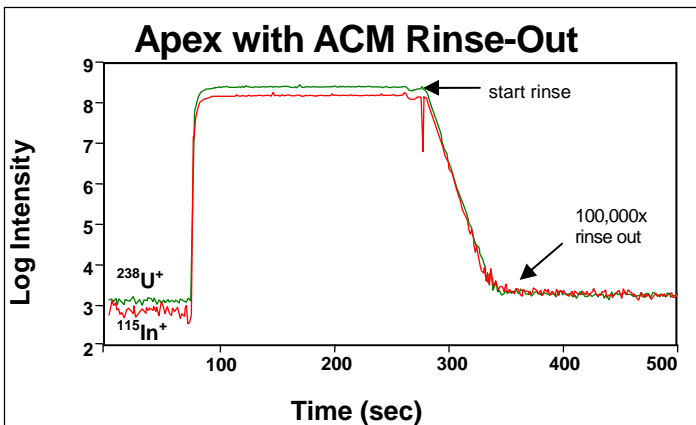


Percentage Cerium Oxide formation for sample inlet systems on Thermo Element2.

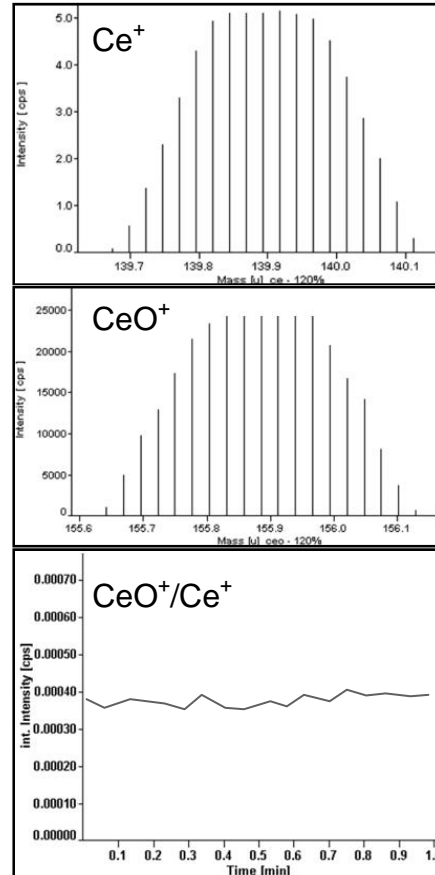
Which Membrane?

ACM Module

- Aqueous solutions and small polar organic solvents only
- Simple to use, sweep gas does not affect ICP tuning
- Lower running costs, Nitrogen can be used as the sweep gas.
- Can be used to analyzed volatile analytes such as Hg, B etc.



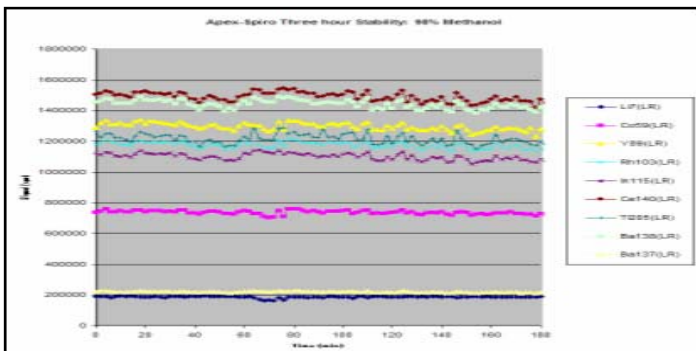
Rinse out of five orders of magnitude using ESI Apex-ACM High Sensitivity Desolvation System



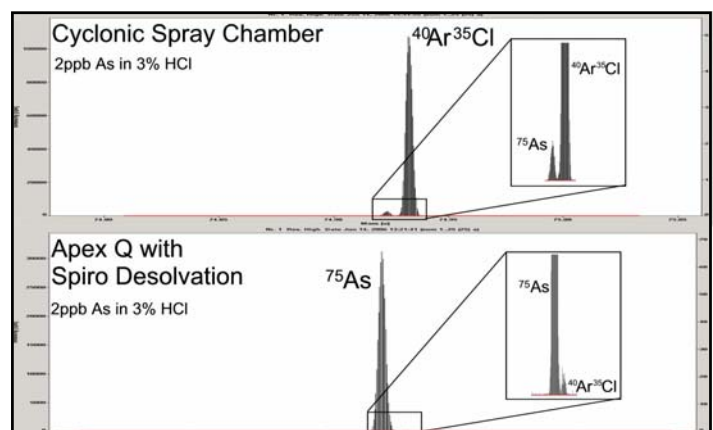
Reduced oxide formation using ACM Microporous Membrane Desolvator with Finnigan Element2 ICPMS. Membrane temperature = -5°C

Spiro TMD Module

- Aqueous and organic solutions can be desolvated, ideal for HPLC applications.
- Sweep gas does affect ICP tuning, therefore must use Argon.
- Removes all volatile species, i.e. SiF₆ from semiconductor industry samples.
- Add membrane desolvation to standard



3 hour stability study running 98% Methanol through an Apex Q with Spiro TMD desolvation.



High resolution scan of Spiro TMD desolvation unit used with the Apex Q, dramatically reduces matrix interferences.

Technical Specifications

APEX	Standard Nebulizers	PFA-100, PFA-ST (PolyPro-ST supplied with Apex E) Other nebulizers may be specified
	Nebulizer Gas Flow Rate	0.6—1.1 L/min
	Sample Uptake Rate	10-800 µL/min
	Operating Environment	Temperature 15°C – 30°C Humidity 35 – 85% RH Non-condensing
	Heater Settings	1 = 100°C; 2 = 140°C (Apex E preset to 140°C)
	Chiller Settings	1 = -3°C; 2 = +2°C (Apex E preset to +2°C)
	Drain Pump	4 channel Peristaltic Pump (included)
	Power Requirements	12V DC power supply (included) 100-240VAC, 3.2A (included) Input delivering VDC, 10A to instrument
	Dimensions (h x w x d)	23cm (9") x 12.1cm (5.75") x 24.1cm (9.5")
	Weight	3.2kg (7lbs)
ACM	Chiller Setting	+3°C
	Power Requirements	12V DC power supply (included) 100-240VAC, 3.2A (included) Input delivering VDC, 10A to instrument
	Dimensions (h x w x d)	14cm (5.5") x 12.7cm (5") x 8.3cm (3.25")
	Weight	1.7kg (3.75lbs)
SPIRO	Heater Setting	160°C
	Power Requirements	12V DC power supply (included) 100-240VAC, 3.2A (included) Input delivering VDC, 10A to instrument
	Dimensions (h x w x d)	15.2cm (6") x 15.2cm (6") x 17.1cm (6.75")
	Weight	1.7kg (3.75lbs)

Ordering Information

ES-4300-0000	Apex Q
ES-4400-0000	Apex HF
ES-4500-0000	Apex IR
ES-4800-0000	Apex E
ES-4599-3000	Spiro TMD Module
ES-4599-2000	ACM Module

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