Thermo Electron Corporation's new XSeries" ICP-MS (Inductively Coupled Plasma Mass Spectrometer) offers the user more practicality, more productivity and more performance for a wider range of applications than it's predecessor, the already acclaimed X Series ICP-MS.

XSeries¹¹ ICP-MS

More Practicality, More Productivity, More Performance











The XSeries" ICP-MS provides a high entry-level specification with plug and play options enabling the system configurations to be tailored to meet your specific needs.

In addition to being the world's smallest bench top ICP-MS, the standard XSeries" configuration includes ambient temperature externally mounted spray chamber, PlasmaScreen *Plus*, π extraction optics, high performance quadrupole with computer controlled resolution, AutoRange Plus detector, system computer and PlasmaLab software.

Source

ICP source with all solid-state 27.12 MHz RF generator.

Ion Optics with π extraction

Unique Infinity II Ion Lens with lowest background and highest signal to noise ratio of any quadrupole ICP-MS.

The new π Extraction optics used in the XSeries" greatly reduce the Blank Equivalent Concentrations seen in all instrument configurations. This dramatically improves detection limits and, with the new interfaces available, a wider range of applications and a higher level of performance is available to the user.

Analyzer

Off-axis high-performance quadrupole, mass range 2-255 amu.

Detector

Simultaneous analogue/pulse counting electron multiplier >10⁸ dynamic range.

Electronics

Solid-state with high-speed signal processing for transient signal analysis.

Software

PlasmaLab Windows® platform.



Outline Description

Thermo's XSeries"ICP-MS is robust enough for your toughest analytical challenges. It is a powerful, precise measurement tool designed for maximum productivity in a wide cross section of applications. More than just an instrument, the XSeries" is a complete solution that includes proven reliable hardware, fully featured software, on-going methods development, responsive service, and knowledgeable technical support.

Sample Introduction

Open architecture sample introduction system utilizing an externally mounted spray chamber. Includes a standard "Plug-in" self-locating torch mounted to a close-coupled torchbox housed within a compact Faraday cage for RF protection. A viewing window is fitted to the torchbox door providing full UV protection. Plasma gases are efficiently extracted and a vapor shield prevents ingress of corrosive plasma gases into the critical components of the mass spectrometer.

Peristaltic Pump:

Close coupled, computer controlled, variable speed (up to 100 rpm), 3-channel and 12-rollers.

Nebulizer:

Glass concentric nebulizer (0.8ml/min).

Spray Chamber:

Glass single-pass conical spray chamber with fixed impact bead.

Torch:

One-piece quartz torch, 1.5mm injector.

Precision Torch Adjustment:

Full PC control of the horizontal, vertical and plasma sampling-depth positions is included, with all parameters stored in each analytical method.

Precision Gas Control:

3 computer controlled mass flow controllers, for Nebulizer, Coolant and Auxiliary gas flow.

RF Generator

Solid State Technology, crystal controlled with dynamic tuning.

Frequency:

27.12 MHz

Power Range:

PC controlled 100W to 1600W in 10W increments. Optimum power settings defined and stored within each method for different sample types. Automated plasma startup and shutdown under PC control.

Interface

Optimized Plasma Interface:

Provides uniform mass response. A unique, hinged interface front-plate allows easy access to the internal mounting points for the extraction ion lens.

Sample and Skimmer materials:

Ni Standard (Pt tipped optional), replaceable without venting the analyzer chamber.

Slide Valve:

PC controlled slide valve, automatically isolates mass analyzer when power or plasma is off. The slide valve allows the cones and extraction lens to be removed for cleaning without venting the vacuum system.

Ion Optics

Elimination of photons and neutrals:

Chicane Ion Lens with offset analyzer and detector, reduces background noise to <0.5cps.

Infinity II Lens:

Incorporates a high efficiency hexapole ion guide, driven by mass dependent RF voltages to optimize ion transmission across the whole mass range. Interactive or autotune controlled ion focusing with optimized parameters stored in the analytical method.

The Infinity II Lens is fitted in the vacuum chamber using a polarized (asymmetric) hanging mount system to facilitate fast removal and refitting by a service engineer at a preventative maintenance visit.

Quadrupole/Mass Analyser

RF Generator:

Solid state, 2.0 MHz

Vacuum System:

Three-stage pumping configuration with advanced split-flow turbomolecular pumping for extremely high gas throughput. "Topentry" vacuum-chamber with simple access to analyzer components.

Vacuum Chamber Electrical Connections:

All connections within the vacuum chamber utilize gold spring contacts fixed into the chamber lid, reducing wiring and minimizing RF leakage ensuring good electrical contact at all times.

Stable Vacuum:

15 minutes from atmosphere

Analyser Pressure:

<6 x 10⁻⁸ mbar (Slide Valve Closed) <2 x 10⁻⁶ mbar (Slide Valve Open)

Quadrupole Configuration:

230mm x 12mm rods utilizing an easy access polarized hanging mount system.

Quadrupole Material:

Molybdenum plus high purity alumina ceramic

RF Pre-filter:

Yes

Quad Settle Time:

Dynamically set from a minimum of 100 µsecs

Mass range:

2 - 255amu Scanned at >12000 amu/sec.

Detection

AutoRange Plus:

Incorporates a two-section discrete dynode electron multiplier operating simultaneously in both pulse counting and analog modes. Advanced analog to digital signal conversion electronics with a unique novel within-detector transformer system provide fast analog data collection and increased signal to noise, improving detector stability for long-term use.

The detector is housed in a unique, plug-in cradle, enabling simple replacement by the user without the need to connect any wires or plugs.

Measurement Range:

>8 orders of magnitude.

Protection:

Full software protection in all modes of analysis, with auto reset.

Data Acquisition

Multichannel Analyzer:

65,000 channels.

Sweep accumulation:

Multiple buffer data acquisition allows uninterrupted fast data acquisition.

Minimum Dwell Time:

100 $\mu secs$ for both pulse counting and analog detector modes.

Acquisition Modes:

Peak Jumping, Scanning, Split Scanning, Mixed Peak Jumping and Scanning in same acquisition and Time Resolved Analysis (TRA) using integral software.

Instrument Control Electronics

Instrument Communications:

RS232C serial communications

Embedded PC control:

Industrial model PC with 128Mb onboard RAM and Solid State "Disk-on-a-chip" nonvolatile memory. The embedded PC uses Thermo's XSeries" ICP-MS control code running on a state-of-the-art QNX® Neutrino® real-time operating system. Data acquisition and instrument control uses a custom designed PCI card.

Distributed Control Electronics:

Separate electronic control boards with their own fail-safe control logic are mounted close to the hardware items they control reducing cabling to a minimum.

All internal communications for the distributed electronics use the industrial quality highly robust Centralized Area Network (CAN) protocol.

PlasmaLab Desktop PC

Supplied with all XSeries" ICP-MS instruments, it provides fully automatic control of the spectrometer and appropriate accessories under Microsoft Windows®' XP operating system.

The software features a re-designed user interface using a range of tools to make setting up even complex analyses very fast and easy with advanced automatic optimization algorithms. All raw data, results and parameters are stored in a single database for each experiment giving easy access to all information. Comprehensive reporting facilities are provided, and data can be transferred to other applications for consolidation with other data. Comprehensive QC facilities provide confidence in results quality and conformance with legislative requirements. PlasmaLab software is available in several languages.

Techconnect Remote Diagnostics

Standard with all XSeries" ICP-MS instruments the real-time remote diagnostics and assistance package allows Thermo's applications and support staff to operate a user's computer and software as if it were local, to speed up and simplify troubleshooting, provide expert analytical method development advice or for quick transfer of data or programs. Requires a V90/V92 56K Modem (supplied) with a direct dial telephone line, or a TCP/IP address accessible through a fire wall.

Manuals

The XSeries" is supplied with a comprehensive Getting Started Guide and extensive online, context sensitive Help/Software Reference Guide. Together with a comprehensive Consumables Catalog and an Instrument Maintenance log book.

The Basic XSeries¹¹

The XSeries" ICP-MS is designed for demanding applications requiring exceptional matrix tolerance and extreme productivity. As such it is configured with the following tailored system components.

Xt Interface

The interface has been designed to give very low matrix-based polyatomic species under very controlled conditions to allow easy correction with simply derived equations. With the Xt interface it is now possible to measure to over 200mg/l sodium in the same mass scan as ng/l levels of ultra-trace analytes without the use of a sensitivity attenuating CCT mode. **Sampling Aperture:** 1.1mm **Skimmer Aperture:** 0.75mm

PlasmaScreen Plus

With normal plasma RF powers (1400w) PlasmaScreen *Plus* enhances sensitivity without compromising the <0.5 cps background seen in the standard XSeries" performance.

PlasmaScreen *Plus* utilizes a high quality metal screen encapsulated by quartz tubes to protect the screen from corrosive gases. Simple "Plug-In" connector design ensures long-term reliable operation.

Optional XSeries¹¹ **Components**

Peltier Controller

To meet the needs of individual laboratories' applications, or the ability to handle organic matrices efficiently, the spray chamber can be jacketed in a unique and efficient Peltier (thermo-electric) block that allows for precise temperature control. Users may select individual temperature settings that may be required for different applications.

Nickel Xs Interface

Provides high sensitivity uniform mass response, whilst retaining the incredibly low background characteristics. Sampling Aperture: 1.1mm Skimmer Aperture: 0.7mm

Platinum Xs Interface

For ultratrace analysis of high purity matrices, "cool plasma" technology remains an excellent technique chosen by many users. PlasmaScreen *Plus* offers excellent performance, significantly reducing or eliminating many of the traditionally troublesome interferences which affect the determination of Li, Na, K, Ca, and Fe even down to sub-ppt levels.

The Xs^{*} mode also allows the determination of Group I/II elements and transition metals to ppt levels at high RF powers using the 3rd Generation CCT to attenuate interferences, enhancing the ICP-MS data for more difficult semi-conductor matrices.

Inert Spray Chamber

Comprises second generation, inert, highpurity, polypropylene, single-pass conical spray chamber with impact bead, suitable for use with aqueous, organic and HF solutions.

Additional Gas Kit

An additional computer controlled mass flow controller to provide make-up gas capability with high performance low flow nebulizers and/or mixed gas plasmas for solution or LA-ICP-MS applications. The 0-500ml/min mass flow controller gives high precision flows into the dedicated port of the inert spray chamber end cap. (Requires inert sample introduction system for solution applications).











Collision Cell Technology

Third generation collision cell technology, incorporating 2 computer controlled mass flow controllers for interactive or fully automated optimization. The new π Extraction optics control the energy of the ions entering the collision cell so they are optimized for both kinetic energy discrimination or reaction chemistry. The new third generation CCT allows energy discrimination that efficiently eliminates matrix and argon-based spectral interferences using simple reaction gases, minimizing unwanted reactions in the cell without complex electronics. **Gas Purity:** H₂/He 99.996%

Flow rate: 0.1-10ml/min Regulated pressure: 30 – 50 mBar Required: High quality 2 stage regulator

Organics Kit

The analysis of organic solvents is accomplished by utilizing the Organics Kit. Comprising of computer controlled 0-500ml/min mass flow controller for oxygen addition, together with an inert spray chamber with O_2 port, a 0.1ml/min glass concentric nebuliser and organic solvent compatible pump tubing.

Speciation Kits

XSeries" ICP-MS can be coupled to either HPLC or GC systems to allow speciation of elements for a wide variety of matrices. The XSeries" coupling kits include all the necessary parts to allow a completely automated system with analyte transfer without degrading the quality of the chromatography and full, two way communication between the ICP-MS and Chromatograph. The GC-ICP-MS kit includes a unique dual sample inlet system so liquid sample introduction can be used alongside the gaseous inlet for tuning, internal standardization and a more robust plasma.

XSeries^{*II***} ICP-MS Accessories**

CETAC ASX-520 Autosampler

Random access, large capacity, x-y movement autosampler with up to 370 maximum position capability, dependent on rack configuration.

Configuration: 1 x 10-position standards rack, 4 x 60 position sample-racks. Supplied with a PTFE probe, 10 standard bottles and 240 x 14ml polypropylene sample tubes. Pumped wash facility. RS232C cable. Rinse and drain vessels. Rack capacity can be doubled using the CETAC ERX 8 option.

CETAC ASX-100 Micro Autosampler

Random access, carousel, micro volume autosampler with total 36 to 180 maximum position capability, dependant on rack configuration.

Configuration: 1 x 12-position standardsrack, 1 x 24 position sample-rack and PTFE probe. RS232C cable.

ID100 Autodilutor

A multi-piston pump constructed from inert materials, capable of performing dilutions in excess of 50:1. Under full software control the system can be programmed to intelligently dilute samples in a variety of user selectable modes.

PrepLab: Sampling Station

PrepLab Sampling Station with RS232 control - The PrepLab is an integrated liquid sample handling system for ICP-MS controlled through PlasmaLab Windows® software. It comprises two computer controlled variable speed peristaltic pumps, two pinch valves and a twin six port injection valve. The kit contains pre-written protocols and easy to follow schematics. The RS232 PrepLab can be used with any autosampler or as a stand alone unit.

Requires at least one of the following PrepLab application packs for operation:-

PrepLab Lunchbox

PrepLab Continuous Hydride Generation Pack PrepLab Segmented Hydride Generation Pack PrepLab On-Line dilution pack PrepLab On-Line Internal Standard Addition Pack with Microdilution PrepLab On-Line Standard Addition Pack Solid Phase Chelation (SPC)

Stand alone Hydride Generation Kit

A kit comprising the plumbing components and membrane gas-liquid separator required for continuous flow hydride generation without the need for PrepLab.

On-line Internal Standards Kit

Enables internal standards to be added to the sample on-line. Kit comprises of an inert Y-piece and all associated tubing and adaptors.

Productivity Packs

EPA Productivity Packs

Provides everything required to establish the 6020, 6020A, ILM05.3 and 200.8 protocols in the laboratory.

Calibration solutions, QA/QC solutions, interference check solutions are available.

Tailored PlasmaLab method templates and autotune/performance reports.

Full documentation to assist in the preparation of the laboratory SOP.

On-line Internal Standard addition kit (4600431).

EPA Productivity Pack Implementation Assistance

Only available in conjunction with 4600541 and 4600542. On-site assistance with the implementation of the EPA Productivity Packs. Duration 4 days to include training implementation and use of the supplied methodologies plus specific advice to assist in tailoring the method to the laboratory requirements.

MicroProbe UP Laser Ablation

The **MicroProbe UP** is a compact laser ablation sampling device designed for bulk and micro-sampling analysis with the XSeries" ICP-MS. The laser ablation system consists of a high power Nd:YAG 266 or 213 nm flat beam profile UV laser providing variable energy of up to 6mJ at the sample surface. **MicroProbe UP 266** laser features include built-in energy meter, high precision (<0.2µm per step) x, y, z, sample stages, fast changeover sample cell suitable for bulk and thin section samples, high resolution optical viewing on the PC screen with zoom capability, high intensity sample illumination and seven on-board microprocessors to optimize overall performance. The complete system is designed and built to conform to the international safety standard IEC-825-1 (class I laser product). **MicroProbe UP 213** laser dramatically improves energy coupling with materials that do not efficiently absorb 266nm light leading to cleaner ablation pits and a finer aerosol of particles. The greater coupling efficiency has also been linked to reduced fractionation effects. The flat beam profile maintained in the 213nm laser ablation system gives performance similar to the use of excimer lasers without the inherent problems of dealing with toxic gases.

Configuration Guide

Description	Part Number	Description F	art Number
XSeries" ICP-MS	4600517	Cetac Aridus (50Hz)	1202803
Major Options		Cetac Aridus (60Hz)	1202802
Performance Paltier Cooled Spray Chamber	4600201	General Accessories	
PlacmaScroop Pluc	4000291 STANDARD	Conical Inert Spray Chamber	4600295
		ESI Full Inert Sample Intro Kit	4600363
	31ANDAND 4600250	- Nobuliaera	4000000
π Extraction Ontics	4000233 STANDARD		4000050
	STANDARD	Burgener miramist	4600356
Additional Gas Mass Flow Controller	4600290	Burgener Arimist	4600495
	4600298	Concentric Polymeric (0.8ml/min)	1600139
Air-cooled Chiller (required)	4000200	PFA50 Low Flow Neb	1600165
(50Hz)	4600506	PFA100 Low Flow Neb	1600342
(60Hz)	4600369	PFA20	1600427
Nickel Xs Interface	4600539	Torches/Injectors	
Platinum Xs Interface	4600540	2mm wide here tareh	26011/7
Platinum sample cone Xs/Xt	3601289		3001147
Data Station		- HF resistant inert demountable torch (requires inert injector)	3601146
PlasmaLab PC + 17" TFT Monitor	STANDARD	Pt Injector	4600140
High Performance DeskJet Printer	2203826	Allumina Injector	4600138
Laser Printer	1200958	Sapphire Injector	4600139
External Trigger Board	4600261	Productivity Packs	
Bar Code Reader	2600113	EPA 6020, 6020A, ILM05.3d Productivity Pack	4600541
Autosamplers		EPA 6020, 6020A, ILM05.3d Solutions Pack	4600432
CETAC ASX-520 - 50/60Hz	4202467	EPA 6020, 6020A Ha Solutions Pack	4600465
CETAC ERX 8 Extended Sample Racks options	1600654	= EDA 200.0 Draductivity Deals	4000543
CETAC ASX-100 (100/115V)	1202531		4000042
CETAC ASX-100 (220V)	1600007	EPA 200.8 Solutions Pack	4600545
CETAC ASX-100 (240V)	1600008	EPA Implementation Assistance	1600608
Sample Introduction Systems		Speciation Kits	
ID100 Autodilutor	4600395	LC-ICP-MS	4600485
PrepLab	4600186	GC-ICP-MS	4600503
PrepLab Lunchbox	4201960	Training Backages	
PrepLab Segmented Hydride Generation	4201984	Finiting Factory S	1600317
PrepLab Continuous Hydride Generation Pack	4201985	Eastery based basis appretate source for the VS price// /2 Dave)	1000514
PrepLab On-line Dilution	4201986		1000532
PrepLab Internal Standard Addition	4201987	Factory based basic operators course for the XSeries" with CCI (3.5 Days)	1600533
PrepLab Standard Addition	4201988	Factory based MicroProbe UP operators course (1.5 Days)	1600534
PrepLab Solid Phase Chelation	4202264	On-site basic operators course for the XSeries" CCT for up to 4 people (3.5 Days	;) 1600536
Stand alone Hydride kit	4600152	 On-site MicroProbe UP operators course for up to 4 people (1.5 Days) 	1600537
Un-line Internal Standards Kit	4600431	Factory based, advanced environmental applications course (1.5 Days)	1600538
Laser Ablation Systems	4000000	Factory based, advanced clinical applications course (1.5 Days)	1600539
IVIICTOPTODE UP 200	4600328	Factory based, advanced geological applications course (1.5 Days)	1600540
	4000331		10005-0
Laser Interface Software	1600246	ractory based, advanced nuclear applications course (1.5 Days)	1000041

Applications of the XSeries" ICP-MS

Many application notes are already available detailing the usefulness of the X Series ICP-MS in key areas. All of these applications are possible with the XSeries" ICP-MS with the extra benefits highlighted below.

General Hardware, Software and Accessories

All of the main hardware and software capabilities are available with the XSeries". The improved Blank Equivalent Concentrations, higher signal to backgrounds, 3rd Generation CCT and Xt and Xs interfaces will also offer a considerable improvement over the data shown in these notes for organic solvent analysis and laser ablation applications.

Environmental analysis

The improved matrix tolerance capabilities of the XSeries" ICP-MS and the 3rd Generation CCT will improve the quality and long term robustness of the data such that improvements in environmental analysis will be seen.

Biomedical analysis

The improved matrix tolerance capabilities of the XSeries" ICP-MS, lower Blank Equivalent Conentrations and the 3rd Generation CCT will improve the quality and of the data such that improvements in Biomedical analysis will be seen.

Speciation ICP-MS

The LC and GC speciation coupling kits both work with the XSeries" and the improved Blank Equivalent Concentrations with both the Xt and Xs interfaces will improve the data already seen in the current applications.

Description	Part Number
X Series ICP-MS: Xt Matrix Tolerant Interface	TN40705_E
X Series ICP-MS: Designed, Manufactured and	PS40673_E
Supported for Maximum Reliability	
X Series ICP-MS: Enhanced Collision Cell Technology	PS40346_E
X Series ICP-MS: Productivity Enhancements	PS40373_E
X Series ICP-MS: Rapid Stabilisation Reduces Operating Costs	PS40591_E
PlasmaLab Brochure	BR_E0355
PlasmaLab Software for X Series ICP-MS: PICO Technology	SN40354_E
PlasmaLab Software for X Series ICP-MS: Quality Control	SN40356_E
PlasmaLab Software for X Series ICP-MS: External Triggers Option	SN40357_E
PlasmaLab Software for X Series ICP-MS: XML	SN40607_E
Reporting and Data Transfer	
PlasmaLab Software for X Series ICP-MS: Performance	SN40590_E
Reports & Autotune	
X Series ICP-MS: Organics Matrix Kit	BR40466_E
X Series ICP-MS: ID100	BR40589_E
PrepLab: Integrated Liquid Handling System	SN40359_E
PrepLab: Seawater - Solid Phase Chelation	AN40363_E
LA-ICP-MS Analysis of Steel	AN_E0605
Microprobe: Universal Platform Laser Ablation System UP-213	S467TB
Microprobe: Universal Platform Laser Ablation System UP-266	S468TB
Microprobe: 213nm Laser Fluid Inclusion	S273AN
Environmental analysis	
X Series ICP-MS: EPA Methods Productivitiy Pack	SN40618_E
X Series ICP-MS: Rapid Payback Analysis for Environmental analysis	PS40375_E
X Series ICP-MS: US EPA Method ILM052D using the X Series ICP-MS	AN_E0620
X Series ICP-MS: US EPA SW-846 Method 6020A using the X Series ICP-MS	AN_E0619
X Series ICP-MS: Using automated collision cell ICP-MS with	AN_E0640
rapid in sample switching to achieve ultimate performance in Enviro Analysis	
X Series ICP-MS: Routine Trace Metal Analysis (DWI-NS30)	AN40350_E
X Series ICP-MS: Strategies for rapid throughput in Environmental Analysis	AN40371_E
Biomedical analysis	
X Series ICP-MS: Clinical Apps Note 1 - As & Cr in Urine	AN_E0601
X Series ICP-MS: Clinical Apps Note 2 - Cu, Zn & Se in Serum	AN_E0604
X Series ICP-MS: Clinical Apps Note 3 - Hg in Urine	AN_E0612
X Series ICP-MS: Clinical Apps Note 4 - Al in water,	AN_E0639
dialysis fluids & serum samples	
X Series ICP-MS: Clinical Apps Note 5 - Trace Element	AN_E0649
X Series ICP-MS: Clinical Anns Note 6 - Uranium in Urine	AN40680 F
ICP-MS versus dual flame/furnace AAS: An elemental	PS40693 F
analysis cost study for biomedical laboratories	1040030_L
Speciation ICP-MS	
X Series ICP-MS: HPLC Elemental Speciation Analysis	SN40634_E
X Series ICP-MS: GC Elemental Speciation Analysis	PS40674_E
X Series ICP-MS: Determination of Organo-As species	AN40653_E
in Seaweed using HPLC-ICP-MS	
X Series ICP-MS: Determination of Organo-Tin species using GC-ICP-MS	AN40698_E
X Series ICP-MS: Determination of As species in Urine	AN40720_E
X Series ICP-MS: Determination of MMHg in Fish using GC-ICP-MS	AN40721 E

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