



# Agilent 7700 Series ICP-MS

Extraordinary Design.  
Unparalleled Performance.

## Specifications



### Agilent 7700 Series ICP-MS Hardware and Performance Specifications

The 7700 Series quadrupole ICP-MS from Agilent Technologies provides an unmatched combination of high performance and simplicity of operation, redefining the benchmark for ICP-MS.

Comprising three models, the powerful, flexible workhorse 7700x, the semiconductor-configured 7700s, and the simple, streamlined 7700e, the 7700 Series provides unparalleled performance, in the smallest ICP-MS ever manufactured.

#### 7700 Series Technical and Performance Highlights Include:

- New fast frequency-matching RF generator
- New design ion lens, providing increased sensitivity and reduced background
- Unique, 3<sup>rd</sup> generation cell design (ORS<sup>3</sup>) which delivers significantly improved interference removal in helium (He) cell gas mode
- New MassHunter Workstation software provides a common platform with other Agilent MS systems, simplifying cross-platform training.



**Agilent Technologies**

## 7700 Series Overview

### Unparalleled performance

All three 7700 Series models benefit from enhanced plasma stability and tolerance of organic solvents, as a result of the new fast frequency-matching RF generator.

The 7700 Series features higher sensitivity and lower random background than the 7500 Series, due to a redesigned ion lens.

The new ORS<sup>3</sup> provides enhanced interference removal capability in He mode resulting in reliable quantification at lower detection limits, even in complex matrices.

### Enhanced ease of use

One-click Plasma optimization using pre-set conditions is provided on all three models, giving simpler, more reproducible setup from day to day and between operators. Agilent's patented High Matrix Introduction (HMI) capability is standard on the 7700x model, and pre-set plasma conditions for both hot and cool plasma operation are provided with the 7700s.

Expert AutoTuning delivers faster, more consistent tuning, giving reproducible instrument performance, even with multiple operators. Routine maintenance is expedited by one-touch torch positioning and tool-free removal and refitting of the sampling cone.

### Reduced operating costs

Lower exhaust flow rate (especially important in clean rooms) reduces installation and operation costs.

The 7700 uses MassHunter based software, which is consistent across all Agilent MS platforms, thereby simplifying and reducing the cost of staff training.

### Significantly smaller footprint

At only 730 mm wide and weighing 115 kg, the 7700 is easily the world's smallest ICP-MS – saving on valuable bench space, and simplifying lab planning. The footprint of the 7700 is >30% smaller than any other ICP-MS, but performance and usability have been improved. Despite the small cabinet size, the ion path length is actually longer than the 7500, and user maintenance and service access is improved.

### Reduced environmental impact

The 7700 mainframe is extraordinarily light for an ICP-MS (only 138 kg when packed for air-freight), so CO<sub>2</sub> emissions from transportation are reduced.

Stainless steel panels are used throughout the cabinet, reducing the amount of paint required.

Agilent is committed to eliminating toxic compounds from

electronic components, promoting recyclability of plastics, and using recycled packing materials.

## Model Selection Guide

### Agilent 7700x – high-performance, flexible mainframe for reliable high-throughput analysis of complex samples.

The 7700x features the ORS<sup>3</sup> with a single cell gas line for He collision mode, used for most elements in most sample types. He mode simplifies method development and routine analysis by using consistent cell conditions for all interfered elements, regardless of the sample matrix.

He mode performance is improved significantly with the ORS<sup>3</sup>, especially for problematic elements such as P, S, Se, and Fe. This means that reaction gases are no longer needed for common applications outside the semiconductor industry. Eliminating the complexity and uncertainty associated with using reaction gases greatly simplifies operation and improves data quality.

HMI is standard on the 7700x, reducing sample preparation time and costs permitting the direct analysis of % level total dissolved solids (TDS) samples.

The combination of He mode, HMI and pre-set tuning conditions simplifies operation while delivering consistently accurate results and superior performance in routine applications.

### Agilent 7700s – unparalleled semiconductor analysis.

The Agilent 7700s mainframe provides ultra-high performance, for semiconductor analysis and clean-room operation. It is unique in offering the ultimate in detection power and interference removal capability, with all industry standard analytical methods (no gas, collision, reaction modes AND cool plasma), provided in a single instrument.

Additional flexibility is provided with a H<sub>2</sub> reaction gas line, and a 5<sup>th</sup> carrier gas line. The extra carrier gas line is used for Ar/O<sub>2</sub> gas addition for organic solvent analysis, or He carrier gas for laser ablation.

The 7700s also uses pre-set plasma conditions and autotuning to simplify operation for all typical semiconductor applications.

### Agilent 7700e – streamlined for routine analysis.

The new Agilent 7700e offers a simplified user interface and standardized hardware configuration for many common applications. It includes the ORS<sup>3</sup> with He cell gas line, and core software functionality for a highly automated system, which is ideal where flexibility is not required in routine use.

An upgrade path ensures that the 7700e can address advanced applications, should the need arise.

## Specifications

### Sample Introduction System

The standard sample introduction system includes an efficient, low-flow concentric nebulizer, a temperature-controlled spray chamber and a high precision, 10-roller peristaltic pump. All components are optimized for high throughput routine analyses of samples with TDS up to 0.2% (2000 ppm).

#### Nebulizer

Low flow concentric nebulizers (glass on the 7700x and 7700e and PFA fluoropolymer on the 7700s) are standard and operate at ~ 0.2 mL/min for reduced sample consumption and minimized matrix effects.

**Spray Chamber:** Quartz, low-volume, Scott-type double-pass spray chamber, provides improved removal of larger aerosol droplets, compared to cyclonic or impact-bead designs. Standard Peltier-cooling provides stable operation and eliminates the need for a separate external cooling water supply.

- Controlled temperature range: -5 °C to +20 °C with instrument cooling water at 15 to 30 °C. (Fixed at 2 °C on 7700e)

**Peristaltic Pump:** Low-pulsation, high-precision 10-roller peristaltic pump, with 3 channels for precise delivery of sample and internal standard (ISTD), plus spray chamber drain.

#### High Matrix Introduction (HMI) Capability

Agilent's unique, patented HMI Aerosol Dilution technology, standard on the 7700x, extends the TDS range to percent level, while eliminating the added costs, time and potential errors of conventional liquid dilution.

### Plasma

**RF generator:** The new high power-transfer efficiency, maintenance-free solid state digital drive 27 MHz RF generator with variable-frequency impedance matching provides significantly improved plasma stability with changes in sample matrix, including the introduction of high flow rates of volatile organic solvents.

- RF power range: 500 W to 1600 W, in steps of 10 W.

**Torch:** Easy-mount, one-piece quartz torch with 2.5 mm internal diameter (id) injector. The wide torch injector promotes efficient decomposition of the sample matrix, minimizing interferences and reducing routine interface cleaning.

**Torch position:** Stepper-motor controlled in three axes (horizontal, vertical and sampling depth) in 0.1 mm steps. Expert AutoTuning delivers quick and reliable optimization following maintenance.

- Horizontal and vertical position: ±2 mm
- Sampling depth: 3 to 28 mm

**ShieldTorch System:** Agilent's unique Shield Torch System (STS) precisely controls ion energy – essential to achieve high performance in He cell mode and cool plasma operation.

### Interface

**Sampling cone:** 1 mm diameter orifice, Ni-tipped (7700x and 7700e) or Pt-tipped (7700s) with Cu base. Easy access to the interface region for routine maintenance; no tools are required for removal or refitting of sampling cone. The large cone-retaining ring insures reliable thermal contact and reproducible fitting, even with different operators, giving dependable long-term performance.

**Skimmer cone:** 0.4 mm diameter orifice, Ni (7700x and 7700e) or Pt-tipped (7700s). Precisely controlled skimmer tip temperature ensures minimal matrix condensation, providing good tolerance to high matrix samples. Small skimmer orifice reduces matrix contamination of the high vacuum region, reducing maintenance.

### Ion Lens

The redesigned extraction and off-axis ion lens of the 7700 insures optimum ion transmission and low backgrounds across the entire mass range.

The lens is in front of the gate valve, allowing easy access for scheduled cleaning, without venting the vacuum system.

**Extraction lens:** Positioned behind the skimmer cone, the extraction lens focuses ions of all masses as they enter the intermediate vacuum stage. The lens design gives the characteristic "flat" mass response of the 7700, and operates at fixed voltage for simple, reliable tuning.

**Off-axis Omega lens:** Protects the ORS<sup>3</sup> cell and high vacuum region from contamination, by separating neutral species and photons from the ion beam. This contributes to the minimal mass bias and low background noise.

## Octopole Reaction System

The 7700 Series incorporates a new, 3<sup>rd</sup> generation cell, the ORS<sup>3</sup>, which provides superior interference removal in He mode. The ORS<sup>3</sup> is longer and narrower than the 7500 Series ORS cell, and operates at higher frequency, higher cell gas pressure and higher kinetic energy discrimination (KED) bias voltage. This delivers improved performance in He mode, eliminating the need for reactive cell gases for all applications except semiconductor.

**ORS<sup>3</sup>:** Consisting of a thermally stabilized cell with a 12 MHz octopole ion guide operated with fixed RF amplitude for the full mass range. Permits fast analysis with uniform conditions, for signal stability and consistent interference removal. An octopole provides both high ion transmission and superior ion focusing, minimizing ion scattering at the high cell pressures required for effective KED.

**He cell mode as standard:** The combination of the ShieldTorch and the octopole-based cell, both unique to the 7700, enables efficient removal of interferences using an inert cell gas (He) and KED. He mode provides several critical advantages compared to reactive cell gases:

- He mode is effective for all polyatomic interferences, not just reactive polyatomics. This means that the same He mode method can be applied to variable and unknown sample matrices. No reactive cell gas offers such method consistency and ease of use.
- Since He is inert, no new interferences are produced, so reliable results are obtained regardless of the matrix.
- Unlike a reactive cell gas, He does not react with any analytes, so consistent and predictable sensitivity is maintained.

He mode is suitable for all analytes (no gas mode can be used for uninterfered analytes) and can be used reliably for completely unknown sample matrices – a unique capability of the 7700. The use of He cell gas also eliminates safety issues related to reactive gases such as H<sub>2</sub>, H<sub>2</sub> mixes or NH<sub>3</sub>.

**Cell gas control:** The 7700x and 7700e have a single He cell gas controller, while the 7700s adds a second (reaction) gas line. Other cell gases are available for research applications, for example, H<sub>2</sub> option (standard on the 7700s), and Xe or NH<sub>3</sub>.

If multiple cell gases are used in a method, cell gas switch over time is only about 5 seconds (45 sec on the 7700e), due to the low internal volume of the octopole-based cell.

## Mass Analyzer

**Quadrupole mass spectrometer:** The 7700 uses a high-frequency (~3 MHz) quadrupole with true hyperbolic rod profile, unique in ICP-MS. A hyperbolic profile quadrupole provides superior ion transmission, resolution and abundance sensitivity at standard settings, thereby eliminating the need for multiple resolution settings to separate adjacent peaks.

- Mass range: 2 – 260 amu
- Mass scan speed:
  - Slew rate (Li to U, no intervening peaks): 56.6 million amu/s
  - Scan speed (Li to U, plus data collection at 40 intervening masses): > 3000 amu/s
- Mass resolution:
  - Variable from < 0.3 amu to > 1.0 amu
- Typical mass calibration stability
  - < 0.05 amu per day; < 0.1 amu per 6 months
- Abundance Sensitivity (at Cs):
  - Low Mass side:  $5 \times 10^{-7}$
  - High Mass side:  $1 \times 10^{-7}$

**Detector:** Unique, auto-switching, dual-mode discrete dynode electron multiplier detector provides a full 9 orders dynamic range with standard hardware and operating conditions.

Fast signal acquisition is delivered by a proprietary analog amplifier, which operates at the same short integration time (100  $\mu$ s) in both pulse and analog mode.

- Minimum dwell time: 100  $\mu$ s
- Dynamic Range: 9 orders

## Vacuum System

The Agilent 7700 uses a three-stage differential vacuum system with a single, split-flow turbo molecular pump and single external rotary pump for fast pump-down and simple maintenance. The typical analyzer stage operating vacuum is  $3 \times 10^{-6}$  mbar or lower in no gas mode. Unique AutoRecover mode returns the 7700 to standby (pumping) state when electrical power is resumed after a power failure, saving valuable time by automatically restarting the vacuum system following an overnight power failure.

The rotary pump is external to the cabinet, and can therefore be located conveniently in the laboratory. Alternatively, the pump can be placed outside the laboratory, which may require the extended 3 m vacuum hose option. The rotary pump hose on the Agilent 7700s is chemically inert for superior resistance to highly corrosive acids.

## Software

Agilent's ICP-MS MassHunter Workstation software provides comprehensive functionality and ease-of-use features for the 7700 Series. With simplified Expert AutoTuning, extensive use of pre-set methods and powerful context sensitive help, even novice operators will quickly be producing reliable and consistent results. The core version of MassHunter (standard on the 7700e) includes:

- Simple intuitive interface for system configuration, instrument control, maintenance and diagnostics, and performance reports. Batch and Queue control of automated startup tasks, method settings, acquisition parameters and sequencing. Batch-at-a Glance data table with real-time update, including all sample data, ISTD/QC signal trend and calibration curves.
- Built-in outlier flags and LabQC charting.
- Fast, simple data report layout and export to Microsoft® Excel (included with MassHunter Workstation software), or export to LIMS for final reporting. The full version of MassHunter (standard on the 7700x and 7700s, optional on the 7700e) adds advanced and flexible tuning, acquisition and data processing tools, including full manual tuning, transient signal acquisition, isotopic analysis and Quick Scan.

The MassHunter software platform is common to all Agilent MS systems (ICP-MS, LC/MS and GC/MS), which reduces training costs.

## Optional Software

The full version of ICP-MS MassHunter can be further extended through a range of software options:

- **User Access Control** - provides multi-level user logon control for enhanced security and auditing capabilities. This includes three levels of access authority, records of user name, operating system lock and more.  
  
ICP-MS MassHunter with User Access Control, combined with Agilent's OpenLab Enterprise Content Manager (ECM), satisfies compliance requirements of US FDA 21 CFR part 11.
- **Chromatographic Software** provides integrated method setup and direct run control for common Agilent LC and GC modules, together with fully integrated chromatographic data analysis for LC-or GC-ICP-MS applications. Permits automatic sequence recalibrations, retention time and ion ratio updates, compound independent calibration, snapshot, automated report generation and more.

- **Intelligent Sequencing** provides comprehensive, configurable QA/QC functionality for automatic QA/QC checks and actions during unattended operation. Includes templates for QC reports for standard methods such as US EPA 6020 and 200.8.

## Accessories and Peripherals

Agilent offers a full range of configurable accessories and peripherals for the 7700 Series, including:

- **Mira Mist Parallel-Path Nebulizer (Teflon or PEEK):** Suitable for samples containing suspended particulates.
- **Agilent Integrated Autosampler (I-AS):** A compact, fully integrated autosampler with cover and pumped rinse station. Ideal for ultra-trace analysis and small sample volumes (0.5 mL). Includes flexible rack configurations offering maximum capacity of 89 vials, plus 3 rinse vials.
- **Integrated Sample Introduction System for Discrete Sampling (ISIS-DS):** Delivers reduced matrix loading and improved productivity in high-throughput laboratories. ISIS can also be configured for low-pressure chromatography, hydride generation, and more.
- **Inert (HF-resistant) Kit:** O-ring-free, PFA sample introduction kit provides lowest contamination levels in the determination of sub-ppt level impurities in high-purity reagents. The kit includes a demountable torch with platinum or sapphire injector and the option of a side-arm connector for the addition of O<sub>2</sub>/Ar for organic solvents.
- **Organic Solvent Introduction Kit:** Includes sample introduction parts required for the direct analysis of volatile organic solvents (requires additional hardware options).
- **LC-ICP-MS Speciation Kits:** Includes all necessary tubing, connectors and cables for seamless interfacing of an Agilent LC to the 7700. Pre-configured kits are available, with column, connectors and methodology for the turn-key analysis of As species in urine and waters.
- **GC-ICP-MS Interface:** Connects an Agilent 7890 GC to the 7700. The unique, fully heated inert Sulfinert lined transfer line and torch with heated injector eliminates cold spots, enabling routine analysis of labile and high boiling point compounds. Transfer line and injector can be independently heated to 300 °C.
- **Laser Ablation:** The 7700 Series can be integrated with any commercially available laser ablation system for the direct analysis of solid samples. With its high sensitivity, fast simultaneous detector and 9 orders dynamic range, the 7700 is ideally suited to measuring signals from laser ablation.

## **Support and Training**

Agilent is renowned for providing expert applications and service support. Agilent has a global network of factory-trained ICP-MS specialists ready to provide support with hardware, software, or applications wherever you are located. Services include:

- Preventive maintenance (PM) to deliver consistent operation and minimize downtime
- Troubleshooting, maintenance and repair
- Software support services
- Compliance services including IQ and OQ of both ICP-MS hardware and software (full version only)
- Comprehensive warranty extension and service contracts, including peripherals and coupled LC/GC systems
- Classroom training and on-site training delivered by experts

### **The Agilent Value Promise – 10 years of guaranteed value.**

In addition to providing continuous product development, we offer something else unique to the industry: our 10-year value guarantee. The Agilent Value Promise guarantees you at least 10 years of instrument use from the date of purchase, or we will credit you with the residual value of the system toward an upgraded model. Not only does Agilent offer a safe initial purchase, we ensure your investment value long-term.

### **The Agilent Service Guarantee**

Should your instrument require service while covered by an Agilent service agreement, Agilent guarantees repair or we will replace your instrument for free. No other manufacturer or service provider offers this level of commitment to keeping your laboratory running at maximum productivity.

## Guaranteed Performance

For each specification, the actual instrument factory test data or Certificate of Guaranteed Performance is included with every Agilent 7700 Series ICP-MS instrument.

Specification		7700e	7700x	7700s
Sensitivity (Mcps/ppm)	Li (7)	20	50	50
	Co (59)			30 (cool plasma)
	Y (89)	80	160	240
	Tl (205)	40	80	120
Background on-mass (cps)	No gas (9 amu)	<5	<2	<3
	He cell gas (9 amu)	<2	<0.5	<0.5
Oxide ratio (%)	CeO/Ce	<2	<1.5	<3
Doubly-charged ratio (%)	Ce <sup>2+</sup> /Ce	<3	<3	<6
No gas mode detection limits (ppt)	Be (9)	1.5	0.5	0.5
	Fe (56)			3 (cool plasma)
	In (115)	0.5	0.1	0.1
	Bi (209)	0.5	0.1	0.1
He mode detection limits (ppt) *	As (75)	20	20	
	Se (78)	40	40	
H <sub>2</sub> mode detection limits (ppt)	Fe (56)			3 **
	Se (78)			1
Short-term stability (%RSD)	20 min	<3	<3	<3
Long-term stability (%RSD)	2 hours	<4	<4	<4
Isotope ratio precision (%RSD)	Ag (107)/Ag (109)		<0.1	<0.1 ***

\* He mode detection limits for As and Se are performed in a matrix of 1% HNO<sub>3</sub>, 2% HCl and 100 ppm Ca, demonstrating the effective removal of both ArCl and CaCl. All other tests are performed in a matrix of 1% HNO<sub>3</sub>.

\*\*The same H<sub>2</sub> mode specification applies to the 7700x when fitted with the optional H<sub>2</sub> cell gas line

\*\*\*The same isotope ratio precision specification applies to the 7700e when the software is upgraded to Full version

All detection limits 3 sigma.

## Site Requirements and Safety

### Dimensions

Mainframe	Width	730 mm (main cabinet, excluding peripump)
	Depth	620 mm (main cabinet, excluding power cord)
	Height	595 mm (main cabinet, excluding exhaust chimney)
	Weight	115 kg
Largest shipping container	Width	980 mm
	Depth	980 mm
	Height	850 mm
	Weight	138 kg

### Environmental

Operating temperature	Range	15–30 °C
	Rate of change	<2 °C/hr (max. change 5 °C)
Operating humidity	Range	20% to 80% (non condensing)

### Utility

Electricity supply	Voltage Current	Single Phase, 200-240 V, 50/60 Hz 30A
Cooling water	Inlet temperature	15-40 °C
	Minimum flow rate	5 L/min
	Inlet pressure	230–400 kPa (33–58 psi)
Argon gas supply	Minimum purity	99.99%
	Maximum flow rate	20 L/min
	Supply pressure	500–700 kPa (71–100 psi)
Cell gas supply	Minimum purity	99.999%
	Maximum flow rate	12 mL/min for He and 10 mL/min for H <sub>2</sub>
	Supply pressure	90-130 kPa (13–18.8 psi) for He and 20-60 kPa (2.9–8.7 psi) for H <sub>2</sub>
Exhaust duct	Vent Type	Single vent, 150 mm diameter
	Flow rate	5–7 m <sup>3</sup> /min.

### Regulatory Compliance

Safety	IEC 61010-1:2001 / EN 61010-1:2001, CAN/CSA C22.2 No.61010-1-04,UL No.61010-1
EMC	IEC 61326-1:2005 / EN61326-1:2006, ICES-001:2006, AS/NZS CISPR 11:2004
ISO	Manufactured at an ISO 9001 and ISO 14001 certified facility



## Standard Mainframe Configurations

	7700e	7700x	7700s
MassHunter Workstation software version	Core	Full	Full
Nebulizer (concentric)	MicroMist (borosilicate glass)	MicroMist (borosilicate glass)	MicroFlow (PFA)
Spray chamber (Scott double-pass)	Quartz	Quartz	Quartz
Torch id (with ShieldTorch System)	Quartz, 2.5 mm id Injector	Quartz, 2.5 mm id Injector	Quartz, 2.5 mm Injector
High Matrix Introduction (HMI) capability	Not available <sup>1</sup>	Included	Optional <sup>2</sup>
Interface cones	Ni	Ni	Pt
Plasma Mass Flow Controllers (Ar)	3	4	4
Option Gas Line for alternative carrier gas, such as Ar/O <sub>2</sub> for organics, or He for laser	Not available <sup>1</sup>	Option	Included
He (collision) cell gas line	Included	Included	Included
H <sub>2</sub> (reaction) cell gas line	Not available <sup>1</sup>	Option	Included
3rd cell gas line (low- or high-flow rate options)	Not available <sup>1</sup>	Option	Option

Note<sup>1</sup> Configurations that are shown as “not available” for the 7700e require an upgrade to the full version of MassHunter 7700 Workstation software; some additional hardware upgrades may also be required. Following these upgrades, the same hardware options are available for the 7700e as those offered for the 7700x.

Note<sup>2</sup> To add HMI capability to the 7700s requires the following parts to be ordered:  
 Nebulizer: MicroMist (G3266-65003) or Mira Mist (G3161-80000 or G3161-80001)  
 Ni Sampling cone: 7700x type (G3280-67040) – (or use 7700s Pt Sampling cone)  
 Ni Skimmer cone: 7700x type (G3280-67041)  
 Ion lens: 7700x type (G3280-67039 – includes stainless steel skimmer base (G1833-65591))

## For More Information

Visit [www.agilent.com/chem/icpms](http://www.agilent.com/chem/icpms).

Or call 1-800-227-9770 (in the U.S. and Canada) for a free information pack.

In other countries, please call your local Agilent representative or your Agilent Authorized Distributor.

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