PRODUCT SPECIFICATION 43281

Thermo Scientific iCAP TQ ICP-MS

Redefining triple quadrupole technology with unique ease of use

Keywords: Ease of use, elemental analysis, interference removal, research, routine, triple quadrupole ICP-MS

Benefits

- Provides accurate data with confidence.
- Removes the complexity from TQ-ICP-MS.
- Decreases method development time.
- Offers scope for new applications.

Harness the power of Triple Quadrupole (TQ) ICP-MS with incredible accuracy and detection limits for the most challenging applications. Improved interference removal allows laboratories to tackle complex samples with ease and deliver data with the confidence of 'right first time' results.

Ease of use is the core concept behind the Thermo Scientific™ iCAP™ TQ ICP-MS, which has been designed for laboratories working in both routine and research applications. The system is based on a platform with an intuitive hardware design that simplifies the user experience. The operator-focused software streamlines workflows and integrates control of peripherals to automate sample handling.

Expand your applications and enhance your laboratory efficiency with a breakthrough TQ-ICP-MS systems, so easy to use that it is accessible to any analyst.

iCAP TQ ICP-MS hardware summary

Sample introduction

The bench height sample introduction system is positioned to facilitate user accessibility to all parts.

Spraychamber

- Peltier cooled high purity quartz or PFA, low-volume, baffled cyclonic or double pass spraychambers, efficiently filter out larger aerosol droplets for improved plasma stability.
- Compatible with all 6 mm OD nebulizers.

Nebulizer

- High performance, concentric nebulizers for optimal sample consumption.
- Optional nebulizers in a range of flow rates, total dissolved solids tolerance and resistance to organics or aggressive mineral acids.

Torch

- Push-in, demountable single piece quartz torch.
- All connectivity (argon gas supplies and plasma ignition) designed into the torch holder, reducing complexity and improving usability.
- Proprietary, screw-in, self-aligning injector for simplicity and reproducibility.
- Multiple injector designs available to allow dry aerosol introduction for bulk quantitation, enhanced sensitivity or improved transient signals.

Peristaltic pump

- Compact, low pulsation, low noise, 12 roller, four channel mini-pump with inert rollers for improved reliability.
- Drain Sensor – Automatic drain flow control – assuring user notification and automated action upon failure of the sample delivery system.

Additional gas modules

- Two additional mass flow controllers (0-250 or 0-1000 mL·min^{-1}) available as options.
- Coupled closely to the sample introduction system with quick fit connectivity.
- Fully software controlled allowing for introduction of gases into the spraychamber (e.g. O_2 for the analysis of organic solvents or Ar for Gas Dilution) or to supply gases for coupled accessories (for example He during Laser Ablation).

Inductively coupled plasma

The iCAP Qnova Series ICP-MS plasma system is designed to rapidly adapt to changing matrices and provide unparalleled robustness even for challenging samples such as highly volatile organic solvents.

RF generator

- Argon ICP ion source with digital, solid state RF generator.
- Dynamic frequency impedance matching the plasma at ~27 MHz.
- Low ion energy spread for optimum ion focusing and transmission, without the need of a grounded shield between torch and load coil.
- Highly stable and robust cold plasma operation.

Load coil

- Water cooled load coil with PTFE coating for improved lifetime and reliable plasma ignition.

Plasma TV

- Remote monitoring of plasma status via integrated camera.

Inert tubing

- Deactivated, inert gas transfer tubing for lower backgrounds.

Interface

Unique, front opening interface provides rapid, simultaneous access to cones and extraction lens, to facilitate routine maintenance and minimize downtime.

Cones

- Optimized sample (1.1 mm diameter orifice) and skimmer (0.5 mm diameter orifice) cone geometries for reduced matrix deposition and maintenance.
- Ni cones as standard; Pt tipped as option for specialized applications.
- Cones are rapidly removed by a single (magnetic) tool.
- Proprietary skimmer insert design reduces memory effects and a range of inserts allows the user to balance the needs of matrix resistance against absolute sensitivity.
  - Robust Interface specifically designed for minimal drift during long-term analysis of high matrix samples.
  - High Matrix Interface for typical sample types provides the optimal balance between sensitivity and tolerance.
  - High Sensitivity Interface provides excellent signal to noise ratio for ultratrace analysis and advanced applications.

Cooling plate

- Polymer coated cooling plate for enhanced resistance against aggressive solutions.

Extraction lens

- Single extraction lens operated at low voltages for optimum ion extraction and focusing into the ion optics – bayonet mounted for easy handling.

Slide valve

- Fully software controlled to maintain vacuum in the analyzer housing during standby or shutdown: defaults to closed position when plasma is off or in the event of a power failure.

Ion optics

- Unique 90˚ cylindrical ion lens – the RAPID lens: Right Angular Positive Ion Deflection, providing high ion transmission across the entire mass range.
- Open lens stack eliminates lens cleaning maintenance and a completely off-axis design delivers class-leading background noise.
- Electrical connections with gold spring contacts inside the analyzer chamber for improved reliability.

Q1 quadrupole

- High frequency (4 MHz) quadrupole mass analyzer with pre and post filter for isolation of wanted ions.
- User-definable resolution in all TQ modes. Switch between intelligent Mass Selection (iMS) and High Resolution (<1u) mass resolution for optimal performance in all matrices.
- Mass calibration automatically assessed and updated.

Q2 QCell collision/reaction cell (CRC)

- Zero maintenance, small volume collision/reaction cell with proprietary flatapole rods.
- High transmission, low mass cut off, and highly flexible gas usage provides powerful interference removal for a cleaner mass spectrum in all sample types.
- Four gas specific mass flow controllers with dedicated flow ranges deliver H_2, NH_3, O_2 and He in a safe and compliant manner. (Additional 15 CRC gases are supported based on request).

Q3 quadrupole

- Quadrupole mass analyzer driven by a solid state, 2 MHz supply ensures low abundance sensitivity and class leading mass stability.
- User-definable mass resolution accessible in all analysis modes.
- Mass calibration automatically assessed and updated.

Vacuum system

- High vacuum is maintained in the event of a power failure: the rotary and turbo pumps automatically restart as soon as power is restored.
- A stable vacuum, obtained in less than 15 minutes pumping time, enables fast return to service after routine maintenance.

Turbo pump

- Single split flow turbo molecular pump.

Standard interface pump

- External, high performance pump to provide backing to the turbo pump and evacuation of the expansion region for improved sampling from the plasma.
- Supplied with synthetic, chemically stable, temperature resistant rotary pump oil as standard.

Dry interface pump

- An external, oil-free, multi-stage roots pump with frequency converter for minimal particle emission is optional for the iCAP TQ ICP-MS, offering an ECO mode for lower running costs.

Detector

- Long lifetime detector designed for ICP-MS requirements.
- Dwell times of 100 µs in both analog and counting detection modes.
- Linear dynamic detection range: >10 orders of magnitude for a single isotope.
- Automated optimization of operating voltages and cross-calibration. Cross calibration factors can be automatically updated per measurement sequence to increase data quality in total element quantitation.
- Cradle design for ease of detector exchange.

iCAP TQ ICP-MS standard configuration and performance specifications

Configuration	iCAP TQ ICP-MS
Nebulizer (default flow rate)	Glass, concentric (400 µL·min^{-1}, pumped)
Spraychamber	Quartz, cyclonic
Torch	Quartz, demountable, no shield
Injector	Quartz, 2.5 mm ID
Cones/Interface	Nickel, high performance
Plasma Gas Flow Controllers	Three
QCell (Q2) Mass Flow Controllers	Four
Additional Plasma Mass Flow Controllers	Optional (total of two)

SQ mode		
Sensitivity (kcps/µg·L^{-1})[a]	^{7}Li	65
	^{59}Co	150
	^{115}In	300
	^{238}U	330
Detection Limits (ng·L^{-1})[b]	^{9}Be	<0.5
	^{115}In	<0.1
	^{209}Bi	<0.1
Oxides (%)[a]	CeO/Ce	<2.0
Doubly Charged (%)[a]	Ce^{++}/Ce^{+}	<4.0
Background (cps)[a]	*m/z* 4.5	<1.0
Stability (%RSD)	10 mins[a]	<2.0
	2 hrs[b]	<3.0
Isotope Ratio Precision (%RSD)[b]	^{107}Ag/^{109}Ag	<0.1
SQ-KED mode		
Sensitivity (kcps/µg·L^{-1})[a]	^{59}Co	40
Background (cps)[a]	*m/z* 4.5	<0.5
Detection Limits (ng·L^{-1})[b]	^{9}Be	<0.5
	^{115}In	<0.1
	^{209}Bi	<0.1
TQ mode		
Detection Limits (ng·L^{-1})[b]	^{32}S (as SO^{+})	<50
	^{31}P (as PO^{+})	<15
	^{78}Se	<1
Isotope Ratio Precision (%RSD)[b]	^{107}Ag/^{109}Ag	<0.1

[a]Demonstrated on installation. Note that installation specifications are only conducted with the default sample introduction components listed in the Table above.
[b]Typical values, dependent on cleanliness of chemicals.


User-friendly torch assembly with automatic gas coupling and self-aligning injector.


Quick-connect sample introduction system.


Easy interface access with drop-down door.

iCAP TQ ICP-MS hardware specifications

Sample introduction	
Access	Bench height, externally mounted, torch axis parallel to bench, minimized distances
Peristaltic Pump	Software controlled 12 roller 4 channel mini-pump, inert rollers, low noise and pulsation
	Three-stop flared PVC pump tubing as standard
Nebulizer	Concentric glass, PFA microflow and high TDS options
Spraychamber	Baffled cyclonic, high purity quartz; PFA cyclonic and double pass options; peltier cooled
	Compatibility with all 6 mm OD nebulizers
Peltier Cooler	Software control in range –10 ˚C to +20 ˚C
Injector	Screw-in, self-aligning
	No o-rings required
	Multiple internal diameters and injector materials available
	Multiple injector designs available to allow dry aerosol introduction for bulk quantitation, enhanced sensitivity or improved transient signals
Plasma ion source	
Torch	Push-in, single piece, quartz
	Automatic gas coupling
	Horizontal and vertical position: +/- 2 mm, 0.02 mm step width
	Sampling depth: 3-15 mm, 0.025 mm step width
RF Generator	Digital, solid state RF generator, ~27 MHz
	Dynamic frequency matching
	RF power range: 400 W to 1600 W
	No plasma shield required
Load Coil	Water-cooled, PTFE coated, silver-sheathed, copper load coil
Ar Gas Flow Controllers	Three channels: coolant, auxiliary, nebulizer
Additional Gas Flow Controllers	Capacity for two additional MFCs for gas dilution, oxygen addition, laser ablation etc.
Plasma TV	HD camera for remote monitoring of plasma status
Vacuum system	
Configuration	Three stage, differential pumping
Vacuum Pumps	Split-flow turbo molecular pump
	External backing rotary pump (common to interface)
Pump Down Time	<15 min after maintenance (<$1 \cdot 10^{-6}$ mbar)

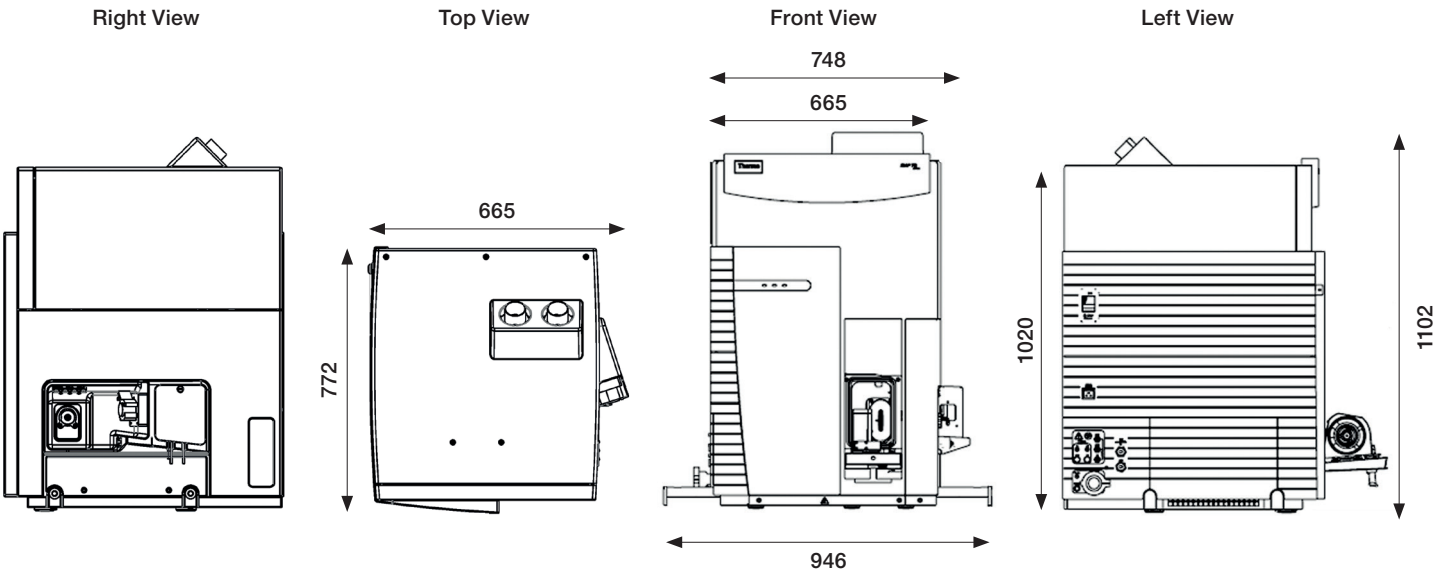
Interface	
Access	Bench height, easy access from drop-down door
Sample Cone	Ni or Pt-tipped, 1.1 mm diameter orifice
Skimmer Cone	Ni or Pt-tipped, 0.5 mm diameter orifice; insert or cold plasma versions available
Skimmer Inserts	High sensitivity insert as standard; Robust and High Matrix interface option supplied
Extraction Lens	Low voltage, easy access, conical; single as standard, dual for cold plasma
Injector	Multiple injector designs available to allow dry aerosol introduction for bulk quantitation, enhanced sensitivity or improved transient signals
Slide Valve	Software controlled, power failure interlock
Ion optics	
RAPID Lens	90˚ ion lens at a single, fixed voltage
Electrical Connections	Cable free, fixed position, spring mounted gold contacts
Q1 quadrupole	
Frequency	4 MHz
Mass Range	2-240 u
Resolution	User definable in all TQ modes. Switch between intelligent Mass Resolution (iMS) and High Resolution (<1u) mass resolution for optimal performance in all matrices.*
Q2 QCell CRC	
QCell	Non-consumable, zero maintenance
	Automatic low mass cut off
Standard MFCs	He – max. flow 12 mL·min^{-1} H_2 – max. flow 15 mL·min^{-1} O_2, NH_3 – max. flow 1.2 mL·min^{-1} Other CRC gases supported based on request
Q3 quadrupole	
Frequency	2 MHz
Mass Range	2-290 u
Scan Speed	>3700 u/s; Li to U with 40 interval masses
Mass Stability	<± 0.025 u per day
Resolution	User-definable across all modes
Mass analyzer	
Abundance Sensitivity in TQ Mode	<0.005 ppm
Ion detection system	
Detector	Dual mode discrete dynode electron multiplier
	Simultaneous pulse/analog over four orders of magnitude
	Cradle design for simplified exchange
Minimum Dwell Time	100 µs in pulse and analog
Dynamic Range	>10 orders of magnitude (<1 - >$5 \cdot 10^9$ cps)

*Available using Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ Software v2.10 and higher.

Site requirements and dimensions

Environmental		
Temperature	Range	15-35 ˚C
	Rate of Change	<2 ˚C·h^{-1}
Humidity	Range	20-80% (non-condensing)
Utilities		
Electrical	Supply	200-240 V AC, 50/60 Hz single phase
	Power	Apparent: 3000 VA; Effective: 2200 W
Cooling Water	Supply Temperature	20 to 30 °C, optimum at 21 °C
	Supply Rate	>5.5 L·min^{-1}
	Pressure	0.25 - 0.6 MPa (2.5 - 6 bar; 36 - 86 psi)
Argon Gas Supply	Purity	>99.996%
	Typical Flow Rate	16 L·min^{-1}
	Pressure	0.55 - 0.6 MPa (5.5 - 6.0 bar; 82.5 - 90 psi)
Cell Gas Supply	Purity	>99.999%
	Flow Rate	Max. flow rate tailored to gas
	Pressure	0.1 - 0.15 MPa (1 - 1.5 bar; 15 - 22.5 psi)
Plasma Exhaust	Port Dimensions	60.3 mm (recommended 63 mm ID ducting)
	Flow Rate (63 mm ID ducting)	6 - 8 m·s^{-1} (67 - 90 m^3·h^{-1}; 39.4 - 53.0 cfm)
Heat Exhaust	Port Dimensions	60.3 mm (recommended 63 mm ID ducting)
	Flow Rate (63 mm ID ducting)	4 - 6 m·s^{-1} (45 - 67 m^3·h^{-1}; 26.5 - 39.4 cfm)

Dimensions of the iCAP TQ ICP-MS (mm)



Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ (ISDS) Software

With centralized control and simplified workflows, Qtegra ISDS Software delivers quality and drives productivity. The platform, common to other Thermo Scientific ICP techniques, is intuitive and easy to use for routine, high-throughput analyses, yet offers all the flexibility required for the most demanding applications.

Languages supported

English (default). Support for additional languages (for example Simplified Chinese and Japanese) is available through the use of specific Language Packs.

Integrated control of peripherals

The unique architecture in Qtegra ISDS Software allows for the control of peripheral devices via plug-ins, ensuring full implementation of all features within a single window.

Regulatory compliance

Qtegra ISDS Software provides full functionality to support FDA 21 CFR Part 11 compliance. Features such as audit trails, access control, e-signatures and secured data enable full confidence in FDA or GMP/GLP compliant environments.

Supplied PC specifications

- Intel® i7 Quad Core CPU
- 16 GB RAM
- 512 GB SSD Drive
- 64 bit Microsoft™ Windows™ 10 Operating System

Supported operating systems

- Windows 10 Professional and Enterprise (32 & 64 bit)

Licensing

1 instrument seat and 3 desktop seats are provided with each software license.

iCAP TQ ICP-MS accessories

Autodilution systems

Automated prescriptive and intelligent dilution are the most flexible approaches for handling highly varied and complex samples. Fully inert autodilution systems provide accurate and dynamic dilution of samples and facilitate unattended operation. Qtegra ISDS Software triggers the re-analysis of high matrix or over range samples for a completely automated and hands-free workflow.

Autosamplers

A wide range of Teledyne CETAC Technologies and Elemental Scientific autosamplers are supported. From small, fully-enclosed units that reduce contamination of high purity samples, to large multi-rack systems in high-throughput laboratories.

Argon gas dilution

On-line gas dilution delivers a significant improvement in plasma robustness for the analysis of high matrix samples. Argon humidifier is included.

Laser ablation

Laser ablation systems are directly supported via dedicated plug-ins within the Qtegra ISDS Software. With both powerful data evaluation (trQuant) and flexible data export, the iCAP TQ ICP-MS is a truly routine laser ablation analysis solution.

Speciation

Seamless integration of a range of IC, LC and GC systems for speciation analysis of elements in a variety of sample matrices and applications is delivered via the Thermo Scientific ChromControl Plug-in, powered via SII, the Thermo Scientific Chromeleon™ CDS Software device control interface. Comprehensive data acquisition and processing features in the tQuant evaluation module simplify the identification and quantification of critical trace elemental species.

Nanoparticle characterization

Accurately and reliably characterize nanoparticles from single particle ICP-MS analysis utilizing the Thermo Scientific npQuant Plug-in for Qtegra ISDS Software.

Organics kit

Organic solvents can be analyzed routinely with the organics kit comprising a 1.0 mm ID quartz injector, a 50 $\mu L \cdot min^{-1}$ PFA microflow nebulizer and organic solvent resistant waste pump tubing.

Acid resistant kit

For the analysis of aggressive sample matrices (e.g. HF or H_2SO_4), this kit contains a PFA cyclonic spraychamber, a 2.0 mm ID sapphire injector and Pt tipped cones.

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How does triple quadrupole technology work?

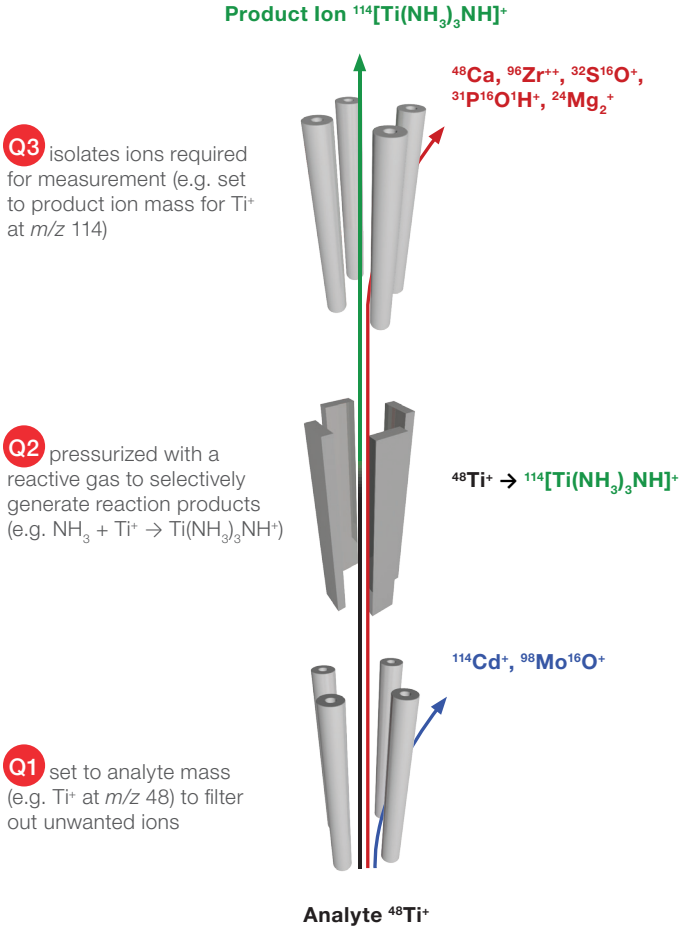
Advanced interference removal with triple quadrupole technology is enabled through the combination of two mass filters, Q1 and Q3 that isolate ions and a Q2 CRC, situated between Q1 and Q3 that generates specific reaction products. This technology can be used in several ways to achieve the most effective interference removal:

SQ mode: Routine single quadrupole operation for multi-elemental analysis in standard mode (no cell gas) or collision cell with Helium and kinetic energy discrimination.

TQ on mass mode: Triple quadrupole on mass mode for detection of the analyte with no change in the analyte mass. The reactive gas is used to selectively eliminate the interference at the analyte mass.

TQ mass shift mode: Triple quadrupole mass shift mode for detection of the analyte as a product ion at a different mass compared to the original ion. The reactive gas is used to selectively shift the analyte to a mass range that does not overlap with the interference.

TQ mass shift mode



Find out more at **thermofisher.com/TQ-ICP-MS**

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