

The Thermo Scientific TSQ Vantage triple quadrupole mass spectrometer consistently delivers the highest precision at the very lowest levels of quantitation.

## Thermo Scientific TSQ Vantage

Triple Stage Quadrupole Mass Spectrometer



- Superior precision with Generation 2 (G2) ion optics
- Easier to use with smarter software
- Simultaneous quantitation and confirmation with QED-MS/MS
- Up to 3000 SRMs definable per run
- Scan speeds: up to 5000 u/s

The Thermo Scientific TSQ Vantage is the top-of-the-line model of the Thermo Scientific triple stage quadrupole (TSQ) mass spectrometer product line.

The TSQ Vantage™ incorporates the sensitive and rugged Thermo Scientific Ion Max source with the newly developed G2 ion optics. In conjunction with our precision hyperbolic quadrupoles, which provide the best transmission and peak shape, our detection technology and ion source results in the most sensitive triple quadrupole instrument available today.

State-of-the-art electronics, comprehensive diagnostics, and easy-to-use Thermo Scientific Xcalibur software give you total instrument control at your fingertips.

With these industry-leading features, the TSQ Vantage defines a new standard of excellence in bioanalytical, environmental, clinical research, and quantitative proteomic analysis.



### Hardware Features

#### Ion Max™ API Source

- Enhanced precision and ruggedness
- Sweep gas reduces chemical noise
- Optimal 60-degree spray angle
- Interchangeable HESI-II and APCI ionization probes
- Removable ion transfer tube provides vent-free maintenance
- High temperature, self-cleaning APCI heater employing state-of-the-art ceramic heater technology
- Dual Desolvation Zone Technology with the HESI-II
- G2 ion optics for improved ion transmission
- X, Y, and Z probe positioning adjustments for all ionization probes
- Automatic source recognition for ease of use and simplified data logging
- Square profile quadrupole ion guide for the highest ion transmission

## Triple Stage Quadrupole

- Dual Thermo Scientific HyperQuad precision hyperbolic quadrupole mass analyzers for ultra performance
- Large 6 mm field radius provides high transmission and superior peak shape
- 90-degree square profile quadrupole rod assembly ion guide with noise-reducing geometry
- Software control and automated optimization of collision energy and gas pressure
- Fully automated system calibration, tuning, and compound optimization

## Vacuum System

- Four-stage differentially pumped vacuum manifold
- Advanced triple inlet turbomolecular pump integrated with vacuum manifold
- Dual rotary vacuum pump configuration

## Detection System

- Off-axis continuous dynode electron multiplier with extended dynamic range
- $\pm 15$  kV post-acceleration conversion dynode
- Digital electronic noise reduction
- System integrated electron multiplier eliminates field emission and microphonic noise

## Integrated Divert Valve

- Fully automated data system control enables switching the solvent front, gradient end point, or any portion of the HPLC run to waste
- Capable of automatic system optimization by loop injections
- User-definable default state of the valve, either "to waste-load" or "to source-inject"

## Integrated Syringe Pump

- Automated infusion and loop injections under full data system control

## Source Options

- HESI-II source compatible with liquid flow rates of 1  $\mu$ L/min to 2 mL/min, without splitting
- APPI/APCI source compatible with liquid flow rates of 50  $\mu$ L/min to 2 mL/min, without splitting
- Metal needle configurations for low-flow or high-flow analysis
- NanoSpray source supports both static and dynamic nanospray experiments, compatible with liquid flow rates of 50 nL/min\* to 50  $\mu$ L/min
- FAIMS reduces noise and matrix interferences, resulting in improved assay robustness and increased assay sensitivity

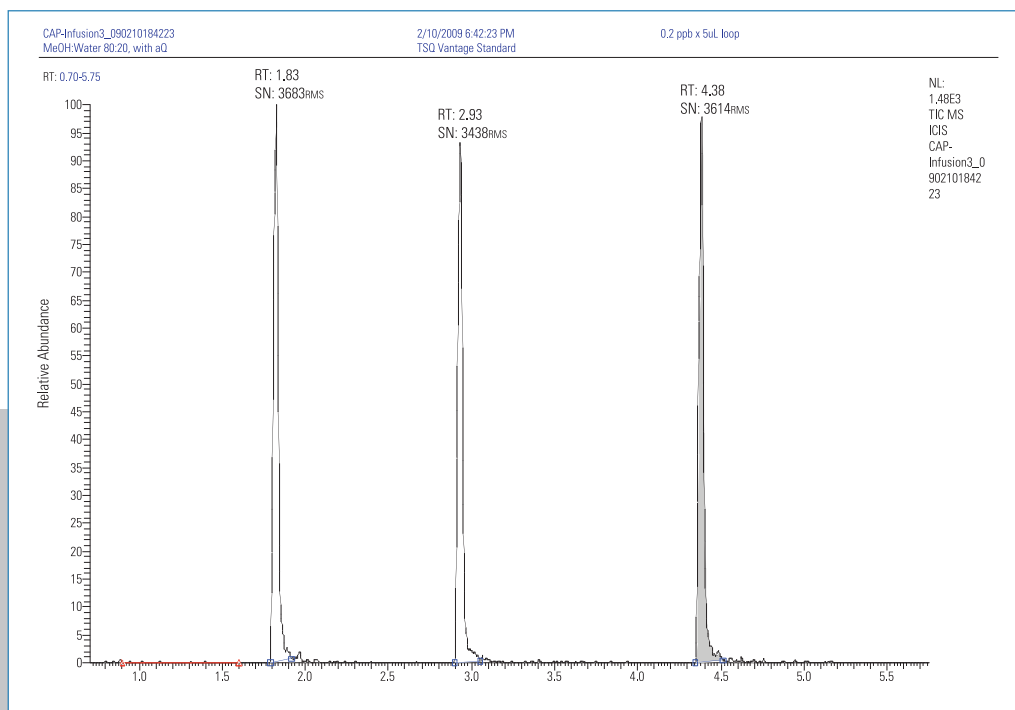
\*Lower limit depends on gauge of needle used.

## Scan Functions

- Highly sensitive full-scan MS in Q1 or Q3
- Selected Ion Monitoring (SIM) in Q1 or Q3
- Timed Selected Reaction Monitoring (SRM) for the most demanding bioanalytical and proteomics assays. Up to 3000 SRMs definable.
- Product Ion Scanning
- Precursor Ion Scanning
- Neutral Loss Scanning
- H-SRM
- Reverse Energy Ramp MS/MS spectra (RER) gives information-rich MS/MS spectra for solid compound identification

## Advanced Experiments with Data-Dependent Acquisition Mode

- Available from all scan types
- Thermo Scientific Dynamic Exclusion allows acquisition of MS<sup>n</sup> spectra from lower intensity ion species
- Polarity switching capabilities
- AutoSIM
- AutoLock feature for accurate mass systems
- Quantitation-Enhanced Data-Dependent MS/MS (QED-MS/MS) for simultaneous compound confirmation and quantitation



Typical TSQ Vantage sensitivity for 1 pg chloramphenicol injected on a Thermo Scientific Hypersil GOLD aQ 20 X 2.1 mm 1.9  $\mu$ m particle packed column at a flow rate of 500  $\mu$ L/min 20:80 water/methanol. Operating in negative ion mode monitoring the transition 321.0 $\rightarrow$ 152.1. Three consecutive injections on the column are visible and showing excellent s/n of better than 3400.

## System Control

- Powerful embedded computer system with Motorola PowerPC® processor
- Integrated Serial Peripheral Interconnect (SPI) bus for reliable electronic communications between system modules
- Dedicated SHARC® digital signal processor (DSP) for dedicated instrument control
- Fast 100BASE-T Ethernet port for PC-to-instrument communications

## Data Acquisition

- Real-time, high-speed, digital signal processing with dedicated SHARC digital signal processor (DSP)
- High-speed analog-to-digital converter (ADC) with 195 kHz sampling rate
- Adjustable scan speeds to 5000 u/s
- High-resolution centroiding

## Data System

### Instrument Control—Xcalibur™ Software

- Xcalibur processing and instrument control software
- Data system control of all instrument parameters
- Superior comprehensive instrument diagnostics
- Automated optimization of all instrument parameters including gas pressures and collision energy within an experiment
- Direct control of multiple vendor LC systems and autosampler configurations through Xcalibur data system software
- High performance PC with Intel® Pentium® microprocessor and Microsoft® Windows® operating system
- 19-inch viewable ultra-sharp flat screen display monitor

## Optional Thermo Scientific Application-Specific Software

- LCQUAN™ quantitation software supports 21 CFR Part 11 compliance
- Watson LIMS™—highly specialized protocol-driven Laboratory Information Management System designed to support DMPK/Bioanalytical studies in drug development
- Galileo LIMS™—fully integrated system for *in vitro* ADME experiments in a single client-server application
- QuickQuan™—high-throughput, automated quantitation software for early drug discovery
- QuickCalc™ software powered by Gubbs Inc. GMSU—quantitation and reporting solution for high-throughput ADME laboratories
- MetWorks™—automated metabolite identification, component detection and predicted fragmentation in one intuitive workplace
- Mass Frontier™—spectral interpretation and classification software for the identification of unknowns
- TraceFinder™—simplifies method development and routine analysis in food safety and environmental laboratories

## System Specifications

### Sensitivity

#### Electrospray (HESI) at Unit Resolution

A 5 µL injection of a 100 fg/µL (0.3250 fmol/µL) reserpine solution on a Hypersil GOLD aQ™ 20 X 2.1 mm 1.9 µm particle packed column at a flow rate of 500 µL/min 30:70:0.1 water/Acetonitrile/Formic acid will produce a minimum signal-to-noise ratio of 500:1 for the transition of the protonated molecule at  $m/z$  609.3 to the fragment ion at  $m/z$  195.1 when operated in selected reaction monitoring mode (SRM) with Q1 and Q3 resolution set to 0.7 Da FWHM.

#### Heated Electrospray (HESI) at High Resolution

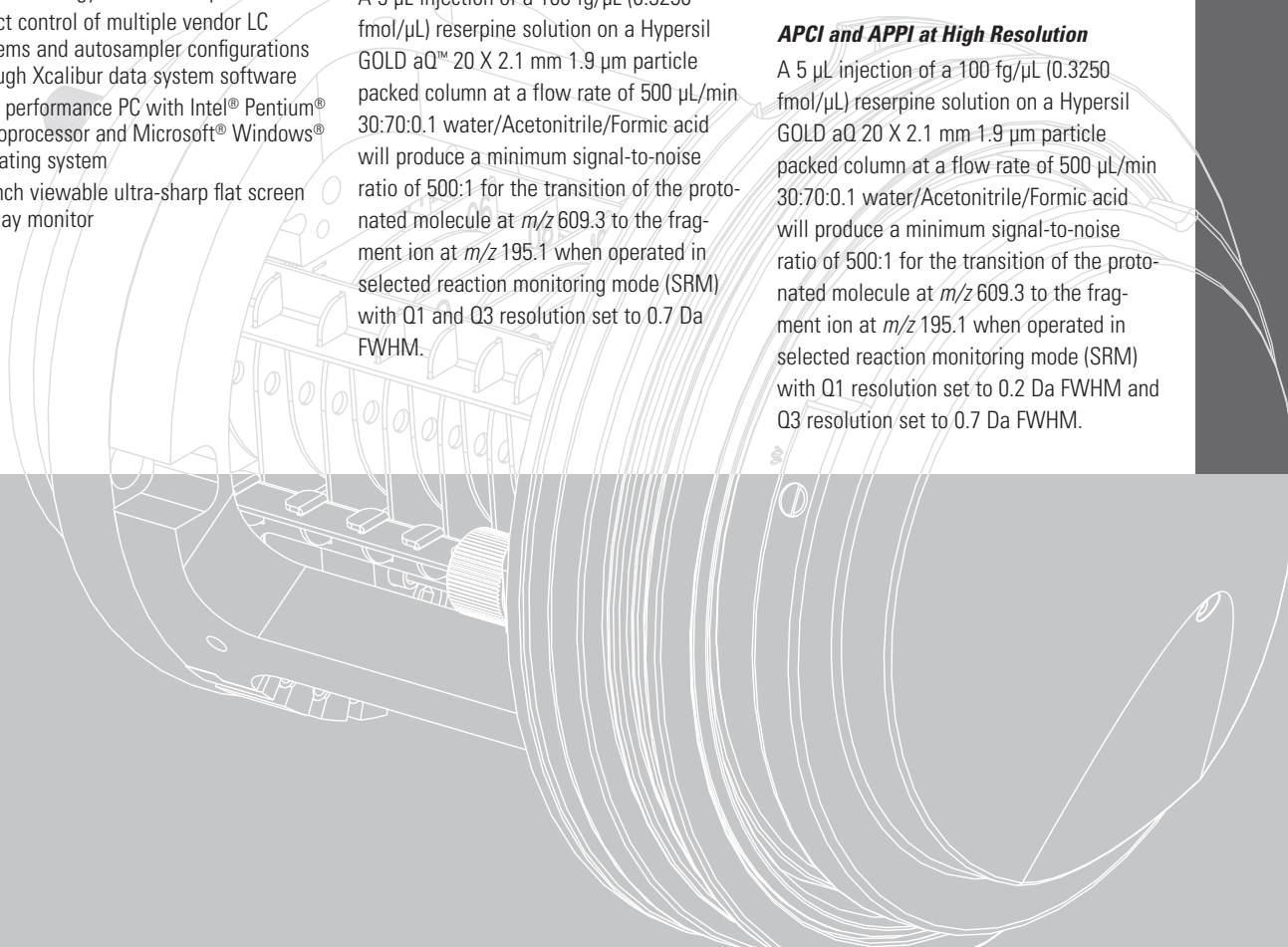
A 5 µL injection of a 100 fg/µL (0.3250 fmol/µL) reserpine solution on a Hypersil GOLD aQ 20 X 2.1 mm 1.9 µm particle packed column at a flow rate of 500 µL/min 30:70:0.1 water/Acetonitrile/Formic acid will produce a minimum signal-to-noise ratio of 500:1 for the transition of the protonated molecule at  $m/z$  609.3 to the fragment ion at  $m/z$  195.1 when operated in selected reaction monitoring mode (SRM) with Q1 resolution set to 0.2 Da FWHM and Q3 resolution set to 0.7 Da FWHM.

#### Atmospheric Pressure Chemical Ionization (APCI) and Atmospheric Pressure Photoionization (APPI) at Unit Resolution

A 5 µL injection of a 100 fg/µL (0.3250 fmol/µL) reserpine solution on a Hypersil GOLD aQ 20 X 2.1 mm 1.9 µm particle packed column at a flow rate of 500 µL/min 30:70:0.1 water/Acetonitrile/Formic acid will produce a minimum signal-to-noise ratio of 500:1 for the transition of the protonated molecule at  $m/z$  609.3 to the fragment ion at  $m/z$  195.1 when operated in selected reaction monitoring mode (SRM) with Q1 and Q3 resolution set to 0.7 Da FWHM.

#### APCI and APPI at High Resolution

A 5 µL injection of a 100 fg/µL (0.3250 fmol/µL) reserpine solution on a Hypersil GOLD aQ 20 X 2.1 mm 1.9 µm particle packed column at a flow rate of 500 µL/min 30:70:0.1 water/Acetonitrile/Formic acid will produce a minimum signal-to-noise ratio of 500:1 for the transition of the protonated molecule at  $m/z$  609.3 to the fragment ion at  $m/z$  195.1 when operated in selected reaction monitoring mode (SRM) with Q1 resolution set to 0.2 Da FWHM and Q3 resolution set to 0.7 Da FWHM.



## Performance Specifications

### Mass Range

- $m/z$  10-1500 daltons (Da) (TSQ Vantage and TSQ Vantage AM)
- $m/z$  10-3000 Da (TSQ Vantage EMR)

### Resolution

- 7500 (FWHM) at  $m/z$  508 of polytyrosine
- Resolution is continuously adjustable to better than 0.1 Da peak width (FWHM) across the entire mass range

### Mass Stability

#### TSQ Vantage/TSQ Vantage EMR

- Mass assignment will be within  $\pm 0.050$  Da over a 24-hour period. The laboratory room temperature must be maintained between 15-27°C (59-81°F). The optimum temperature of operation is between 18-21°C (65-70°F). The room temperature may not change by more than 5°C (9°F) during this period.

#### TSQ Vantage AM

- Mass assignment will be within  $\pm 0.025$  Da over a 24-hour period. The laboratory room temperature must be maintained between 15-27°C (59-81°F). The optimum temperature of operation is between 18-21°C (65-70°F). The rate of change in temperature may not exceed 2°C per hour (3.6°F/hr) and not by more than 5°C (9°F) during this period.

### Mass Accuracy—TSQ Vantage AM

Infusion of a mixture of polyethylene glycols (PEGs) of average molecular weights 200, 400, 600, and 1000 at 50 pmol/ $\mu$ L produces 27 ammoniated PEG ions from 124 to 1268 Da. Accurate mass data is generated on each of the 25 ions from 168 to 1224 Da using the neighboring peaks as internal lock masses. The mass of each ion is determined from the average of up to 100 scans and the error between the expected mass and the measured mass is expressed in mmu and ppm. The root mean square (RMS) average is computed from the errors of the 25 individual ions. The RMS error will be less than or equal to 5 ppm.

## Installation Requirements

### Power

- One 230 Vac  $\pm 10\%$ , 50/60 Hz at 16 A minimum
- Four 120 Vac  $+6-10\%$ , 50/60 Hz at 20 A or four 230 Vac  $\pm 10\%$ , 50/60 Hz at 13 A
- Earth ground hardwired to main panel
- Free from voltage variations above or below the recommended operating range

### Gas

- Collision gas: 99.995% pure Argon
- Collision gas supply pressure: 135  $\pm$  70 kPa (20  $\pm$  10 psig)
- Sheath/aux/sweep gas: 99% pure Nitrogen
- Sheath/aux/sweep gas supply pressure: 690  $\pm$  140 kPa (100  $\pm$  20 psig)
- Maximum sheath gas consumption: ~ 20 L/min

### Environment

- Functional temperature range: 15°C to 27°C (59°F to 81°F)
- Optimal temperature range: 18°C to 21°C (65°F to 70°F)
- TSQ Vantage heat output: 2,300 W (8,000 Btu/h)

- Total system heat output: 4,420 W (15,380 Btu/h)
- Particulate matter: < 3,500,000 particles per cubic meter of air (< 100,000 particles of > 5  $\mu$ m diameter per cubic foot of air)
- Relative humidity: 20% to 80%, without condensation
- Floors must be free of vibration

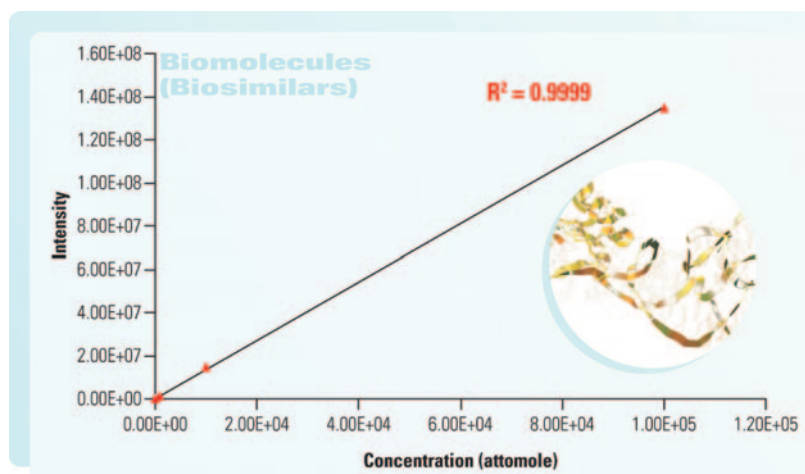
## Dimensions

- TSQ Vantage: 61  $\times$  56  $\times$  79 cm (h  $\times$  w  $\times$  d)
- Liquid chromatograph\*: 73  $\times$  36  $\times$  50 cm (h  $\times$  w  $\times$  d)
- Minitower computer: 48  $\times$  18  $\times$  43 cm (h  $\times$  w  $\times$  d)
- Monitor: 41  $\times$  41  $\times$  43 cm (h  $\times$  w  $\times$  d)
- Forepumps (each): 30  $\times$  20  $\times$  64 cm (h  $\times$  w  $\times$  d)
- Laser printer: 20  $\times$  41  $\times$  46 cm (h  $\times$  w  $\times$  d)

## Weight

- TSQ Vantage: 118 kg
- Liquid chromatograph\*: 62 kg
- Minitower computer: 14 kg
- Monitor: 5 kg
- Forepumps (each): 34 kg
- Laser printer: 7 kg

\*Values are based on the Thermo Scientific Accela system. Other LC systems will vary.



Linear dynamic range of four orders of magnitude for the peptide quantitation experiment. Horse heart myoglobin (0.01fmol-100fmol) was spiked into E. coli tryptic digest. The TSQ Vantage successfully quantified horse heart myoglobin using the targeted SRM-triggered QED-MS/MS scan to simultaneously quantify and confirm the ALELFR tryptic fragment in this complex mixture.

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