The IonDrive™ Turbo V Source

For Front-End Sensitivity, Robustness and Efficiency

The Turbo V™ ion source has been the gold standard for quantitative and qualitative LC-MS/MS for over 10 years. The key reasons for the success of this ion source is simplicity in source architecture, orthogonal spray design and the strategic application of heated gas to the spray region to aid in the desolvation of analytes. This efficient architecture provides outstanding robustness and sensitivity when analyzing complex biological matrices with minimal maintenance. By merging two orthogonal streams of hot gas in the ESI region, efficient desolvation and hydrodynamic focusing of ions towards the orifice is achieved. For higher flow rate applications, this can translate to significant boosts in sensitivity of over unheated ESI sources. Despite robustness in performance across all modes of operation, additional gains in sensitivity, robustness and consistency have been observed through an upgrade of the heating system in the new IonDrive™ Turbo V source.

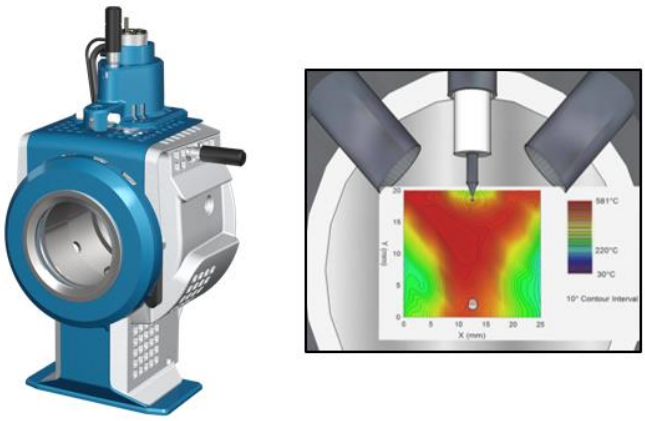


Figure 1. The IonDrive™ Turbo V Source. Expanded view of the ion spray region shows wider diameter heaters generating a wider sweet spot, as a well as greater thermal homogeneity in the desolvation zone. The IonDrive Turbo V source is available on both the TripleTOF® 6600 System and QTRAP® 6500+ LC/MS/MS System.

Key Feature of IonDrive™ Turbo V Source

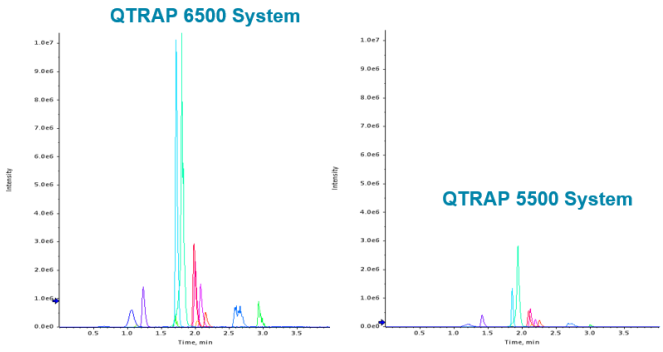
- High sensitivity with enhanced ionization efficiency
  - Greater ion desorption rates from ESI droplets can be achieved on the new IonDrive Turbo V Source using high capacity heaters with a wider sweet spot and enhanced sensitivity
- Extraordinary robustness in performance providing higher productivity
  - The simplistic source architecture and orthogonal spray design with no complex spray path provides uniform temperature distribution and optimized curtain gas flow to improve robustness and ruggedness
- High throughput analysis over wide range of flow rates
  - With functional flow rate ranges from 5ul/min to 3 mL/min, the IonDrive™ Turbo V Source is the perfect match for both micro flow HPLC applications with new low dispersion electrodes and analytical flow UHPLC flow rates, delivering unmatched desolvation and stability for the most demanding applications
- Wider compound class coverage
  - The ability to quickly interchange ionization modes between APCI and ESI enables wider compound class coverage and easy and faster method development
- Simple plug and play ion source design
  - A tool-free source design enables plug and play capability with almost zero maintenance.

Increase in Ionization Efficiency

Electrospray ionization efficiency can be enhanced by 3 key parameters:

- Sample & solvent considerations like chemical nature of the analyte -proton affinity, thermal stability, solvent pH, dielectric constant and surface tension of the solvent
- Charged spray formation effected by flow rate, electric potential, nebulizer gas flow rate, electrode protrusion distance and sprayer bore diameter
- Desolvation conditions like temperature, heater gas flow, nebulizer gas flow and curtain gas flow rates

While the first parameter depends mainly on the sample of interest, both spray formation and desolvation can be optimized within an ion source for enhanced ionization efficiency. By upgrading the traditional Turbo V heaters with a larger-diameter heaters, a wider sweet spot with hotter, larger and a more homogeneous spray region is created. As seen in Figure 1, a uniform temperature distribution and more homogeneous desolvation area is established in the IonDrive™ Turbo V source, increasing ion production using enhanced gas flow dynamics and optimized heater configurations while improving reliability, reproducibility and robustness. This is demonstrated below in Figure 2 and 3.



ANALYTE	Precursor m/z	Product m/z	Signal Gain	S/N Gain
methamphetamine	150.1	91.0	5.6	3.9
clomipramine	315.2	242.1	6.8	2.3
ketoconazole	531.2	489.0	5.2	3.8
ginsenoside Rb2	1101.6	789.5	9.5	2.1
verapamil	455.3	165.1	4.2	2.4
erythromycin	734.5	558.4	12.6	2.8
nigericin	742.5	657.4	10.1	5.6
tylosin	916.5	174.1	4.0	2.2
cyclosporin	1202.8	1184.8	6.8	4.7
lidocaine	235.2	86.1	3.5	1.7

Figure 3. Increase in Sensitivity using IonDrive Turbo V Ion Source. Using the same QTRAP 6500 system, the IonDrive Turbo V source was compared to Turbo V source on a range of compounds. Gains in Signal and S/N were observed for all compounds.

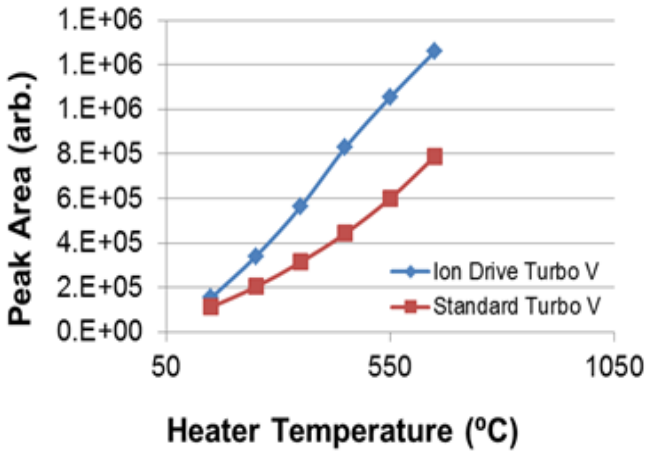


Figure 2: Comparing Peak Areas Between Sources. Measured peak area for Lidocaine using the Turbo V (red) and IonDrive Turbo V (blue) sources. All instrumental variables held constant other than swapping sources on a QTRAP 6500 System.

Extended Robustness for Higher Productivity

Multi-day robustness was evaluated by using 1,500 consecutive injections of methamphetamine and amphetamine in plasma in a continuously running batch lasting 3 days. The optimized curtain gas geometry and the IonDrive QJet result in rugged performance for analysis of samples in biological matrices. No divert valve was used. The relative standard deviation for all 1500 injections was < 3.5% for raw peak areas and < 2.9% for analyte to internal standard ratios, as show in Figure 4.

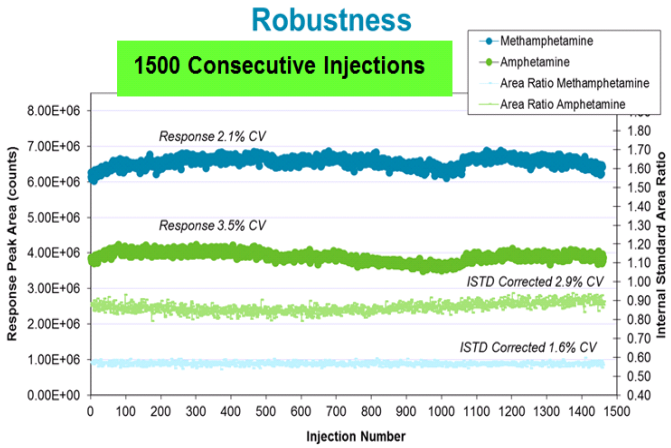


Figure 4. Robustness of IonDrive Source. 1500 consec4tive injections of methamphetamine and amphetamine in protein precipitated rat plasma (no divert valve) continuously over 3 days. The peak area counts and peak area ratio for both compounds were stable with % CV <3.5.

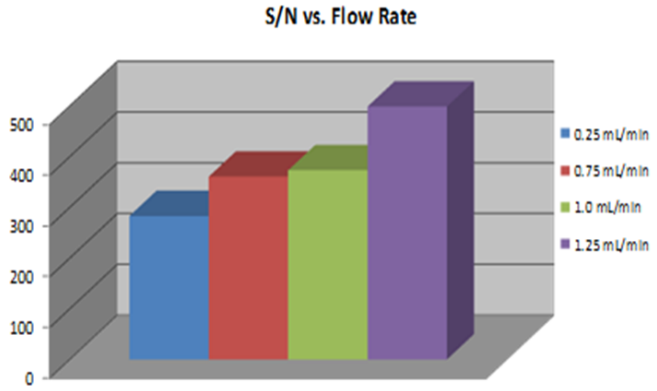


Figure 5. Use of Higher Flow Rates on the IonDrive Turbo V Source. Using the IonDrive Turbo V source on the QTRAP 6500+ system with a fused core LC column allow for use of higher flow rates, with no decrease in sensitivity observed. The S/N ratio for a mixture of 7 compounds (ametryn, atrazine, prometon, prometryn, propazine, simazine, terbutryn) was examined at different flow rates ranging from 0.25 ml/min to 1.25 ml/min under similar LC conditions. The S/N does not suffer at the cost of higher LC flow rates, and even improves.

Efficiency over a Wide Range of Flow Rates

Higher desolvation capacity in the spray region also enables the use of LC methods with higher flow rates, which reduces run times and increases sample throughput. This enables researchers to take full advantage of the new fused core columns, which operate most efficiently at high flow rates. Both the LC peak area and S/N ratio measured with the IonDrive Turbo V source on the QTRAP 6500 System maintain full performance, and can even improve, at higher LC flow rates (Figure 5).

Conclusion

By establishing uniform heat distribution in the spray region of the source, the IonDrive Turbo V allows higher levels of sensitivity, robustness and throughput to be achieved.

- Uncompromised performance from microflow to high mL/min flow ranges can be attained.
- The unique geometry of the SCIEX Turbo V family of sources provides unmatched sensitivity and robustness that is well known by scientists.
- The hotter and more stable desolvation area established by the IonDrive Turbo V source allows for superior performance at high LC flow rates.

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