

ICS-3000 System

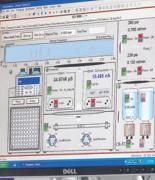
DIONEX

# Productivity

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# Capability









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Passion. Power. Productivity.

# **Innovation** All the Advantages of Modular IC

The ICS-3000 Reagent-Free<sup>™</sup> Ion Chromatography (RFIC<sup>™</sup>) system provides the versatility of a modular system and the convenience of an integrated system. Whatever your needs, from high-throughput routine analyses to trace detection of varied and complex analytes in high-strength matrices, choose the modules that fit your applications, and upgrade your system as your needs change.

#### The Modular System that Delivers Flexibility

The innovative ICS-3000 system increases your productivity and expands your capabilities, combining consistently high performance, intelligent automation, and integrated data management and control. Its modular design makes upgrading your system easy and economical, allowing your laboratory to adapt to changing demands. All ICS-3000 modules give you easy access to components, facilitating reconfiguration and maintenance.

Innovative Modules that Expand Capabilities Innovations in all ICS-3000 modules increase

productivity and improve performance. The EG Eluent Generator is the heart of the RFIC system. It generates eluents electrolytically from water, letting you run gradient IC as easily as isocratic IC, with precise concentration control. Its dual cartridge capacity supports an expanded range of eluent systems, including carbonate/ bicarbonate and new chemistries for hydroxide elution.

Combined with the EG, a single isocratic pump is all you require for gradient IC. And the high-performance pump module can be upgraded easily to a dual configuration, giving you extra versatility and capacity. The dual pump module allows you to use more complex eluent systems or perform a variety of dual IC techniques such as sample preconcentration or matrix elimination. The chemically-inert pump module withstands pH extremes and protects sensitive samples from metal contamination.

The intelligent autosampler can deliver samples to two separate chromatographic systems within the same instrument, either sequentially or simultaneously, and facilitates unique automation capabilities for sample and standard preparation.



The DC Detector/Chromatography Compartment provides precise thermal control and organizes columns, detectors, valves and plumbing for decreased noise and void volume. The optional AM Automation Manager plugs directly into the DC, and increases system flexibility by providing integrated valves for the automation of complex techniques like matrix elimination and two-dimensional IC (2-D IC).

Chromeleon® Chromatography Data System brings all the modules together, automating sample preparation and injection, eluent generation, column switching, and data collection and analysis.



#### **Powerful Features of RFIC Systems**

- Precise, accurate, and effortless eluent management—just add water!
- Superior reproducibility—lab-to-lab, system-to-system, operator-to-operator, year-to-year
- · Convenient and safe, with no acidic or caustic reagents or wastes to handle
- Application versatility through support for single- and dual-component eluents



#### **Dual IC Provides Twice the Productivity**

Dual IC describes varied techniques that utilize two distinct chromatography systems in one instrument. These systems can work in parallel or in series, running sequentially or simultaneously with the same or different samples. With the advent of column switching techniques, sample and solvent switching, and, most importantly, powerful software control, the advantages of dual applications are becoming more and more accessible.

Dual IC:

- Increases productivity
- Expands flexibility
- Enhances sensitivity and selectivity
- Saves time and money

The dual ICS-3000 combines traditional instrument improvements for signal enhancement with valving and automation to increase system capability and adaptability.

#### Single- and Dual-System Solutions

- Full range of configurations to satisfy diverse needs
- Economical single-system configurations for light to moderate workloads
- Powerful dual-system configurations for higher versatility and productivity
- Economical, field-installable upgrades to dual-system configuration

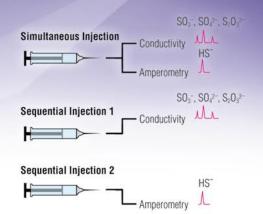
# **Productivity** The Power and Flexibility of Dual IC

The inherent flexibility and precise control of the system make complex applications such as 2-D IC, matrix elimination, preconcentration, and on-line sample pretreatment easier to implement.

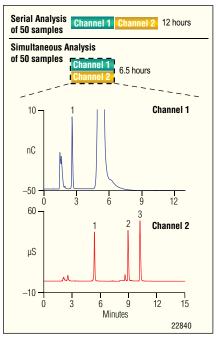
Increase productivity with simultaneous or sequential injection. These techniques use only one autosampler in a dual system to increase throughput in your laboratory. For example, you can detect anions and cations from one injection using only one autosampler.

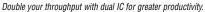
The ICS-3000 system provides an effective platform for both standard techniques and multiple valve switching applications such as 2-D IC. The close proximity of the valves to the columns and detector cells in the DC provides a low-dispersion platform for multidimensional sample preparation and analysis schemes. 2-D IC is a dual-column technique to enhance sensitivity and selectivity. This technique involves loading a sample and matrix on one column in the first dimension, then transferring a fraction of interest onto a second column that further resolves the analytes. By using a 4-mm column in the first dimension and a different 2-mm column in the second dimension, 2-D IC improves selectivity and enhances the signal. This approach also allows the potential to combine two different chemistries in two dimensions, enabling a selectivity not possible using only a single chemistry dimension.

With the ICS-3000, dual IC is easy to achieve. Upgrading from a single to a dual system is a breeze due to the system design. The ICS-3000 can expand as your lab expands, and allows you to perform techniques you always wanted to try but found too cumbersome with other systems. With the ICS-3000, you get more information per sample, increased selectivity, and lower detection limits in an economical design and a singlesystem footprint.



Flexibility—combine or separate analytical techniques.











Whether you need a simple analyzer for occasional IC analysis, a rugged workhorse that maximizes sample throughput, or a high-performance system that handles the most challenging applications, the modular ICS-3000 will satisfy your needs, now and into the future. Choose from a range of high-performance modules to customize a system around your current requirements, and simply add or reconfigure modules if your requirements change.

#### Take Advantage of New RFIC System Capabilities

If you have already used an RFIC system, you know the convenience and performance benefits of its three electrolytic technologies: eluent generation, impurity trapping, and suppression. Now, with the dual eluent generator of an ICS-3000 RFIC system, you can enjoy those benefits with a wider range of applications, including those requiring two-component eluents like carbonate/bicarbonate.

#### Choose a Dual Pump for Greater Versatility

With the optional ICS-3000 dual pump module, you get more than the quietest, most accurate IC eluent delivery ever. You get two complete pumping systems that can operate together or independently, both in one module. Use your second pump for sample preparation, column cleaning or conditioning, reagent delivery, or simply as a spare that you can bring on-line at any time.

#### Use a Dual System for Maximum Productivity

Upgrading your ICS-3000 to a dual system is easy and economical, especially if you already have a dual pump module. Simply add an injection valve, a detector, and columns, and you have two complete chromatography systems in one, for twice the productivity. Run the same application on both systems to double sample throughput. Use your second channel to simultaneously run a secondary or confirmatory analysis on each sample. You can even run two completely independent applications asynchronously on different sets of samples. And you can do all this using one autosampler and no additional bench space.



#### **AS Autosampler**

- Delivers samples to two systems, simultaneously or sequentially
- Offers unique sample preparation capabilities













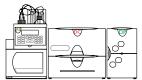
#### EG Eluent Generator

- Generates high-purity eluents for single or dual systems
- Supports dual-component eluents such as carbonate/ bicarbonate
- Supports gradient-compatible eluents such as KOH, NaOH, and MSA

#### ICS-3000 Conductivity or Electrochemical System Configurations



Basic system



Single system with dual pump

### SP/DP Pump

Primary pump

- Delivers precise, accurate flow and gradient proportioning
- Automatically rinses seals and monitors their performance

#### Optional secondary pump

- Enables easy upgrade to a complete dual RFIC system
- Adds versatility for singlesystem configurations



Single RFIC system with dual pump

Dual RFIC system

#### DC Detector/Chromatography Module

- Maintains highly stable temperatures for optimal IC performance
- · Provides convenient access to all flow paths while minimizing dead volumes
- Supports single-system and dual-system configurations
- Offers a variety of electrochemical detection capabilities
- Simplifies complex applications with optional AM Automation Manager

# **Performance** Reach Your Laboratory's Potential with Dual Pump and Eluent Generation Technology

#### **Discover the Optimal Metal-Free Pump**

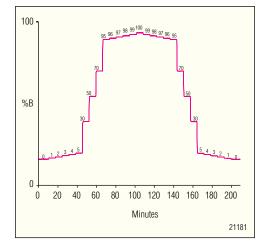
High-performance IC requires a highperformance pump made of chemically inert materials, and you won't find one better than the pump module of the ICS-3000. The metal-free pump provides the precise flow delivery and gradient proportioning that define excellent pump performance. The static mixer ensures that only homogeneous blends reach your column, even when poorly miscible liquids are combined. The result? Chromatography data that is highly accurate and reproducible.

#### Extend Capabilities with Optional Second Pump

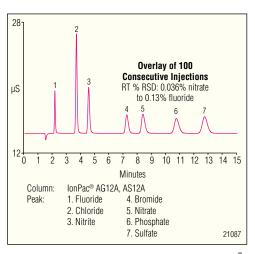
Get even more from your ICS-3000 pump by opting for the DP Dual Pump module. If you run only one chromatography system, you can use the second high-performance dual-piston pump to preconcentrate samples or deliver post-column reagents. Or use the second pump for offline tasks like cleaning columns, and switch it inline to continue operation during maintenance of your primary pump. If you need to process more samples or run a second analysis, you can easily set up a second complete chromatography system. Just add an injection valve, an economical detector, and columns.

#### **Increase Reliability and Monitor Performance**

The ICS-3000 pump's exclusive piston seal wash system regularly rinses piston and seal parts that are exposed to air. This prevents build-up of abrasive salt crystals from evaporation of eluent solutions or buffers, greatly extending piston seal life. The system also monitors the amount of eluent that seeps past the piston seals, and notifies you when the seepage rate indicates that seals are due for replacement. Thus, you get maximum life out of each set of seals, and ample notice to replace worn seals before they affect your chromatography.



The SP and DP pumps deliver exceptionally smooth proportioning and precise gradients with low void volumes.



Chromatogram showing a seven-anion separation on a 4-mm  $lonPac^{\otimes}$ AS12A column using the ICS-3000 and carbonate eluent generation. The DP and EG combine to give you consistent eluent for dependable and reliable results, day-to-day, month-to-month, lab-to-lab.





The SP (single) and DP (dual) pumps deliver outstanding accuracy and precision for consistent peak retention times.





The EG Eluent Generator delivers consistent eluent for reliable results, day to day, month to month, and lab to lab.



#### Make Your Job Easier and Get Better Results

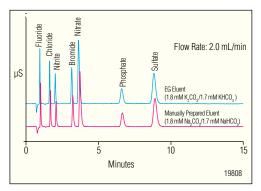
The ICS-3000 EG Eluent Generator is the heart of your RFIC system. With the EG, you no longer have to spend time and effort mixing eluents, because the EG automatically transforms deionized water into high-quality eluent on demand, at the exact concentration needed for your application. This not only makes IC extraordinarily convenient, it also eliminates the variability that occurs with manually prepared eluents. You get reproducible results week-to-week, month-to-month, lab-to-lab.

#### Tap Into the Power of Gradient Ion Chromatography

Your eluent generator does more than increase convenience and improve reproducibility; it also provides the eluent purity and precise control needed to run gradient IC. With a concentration gradient, you can elute strongly retained analytes faster without compromising the separation of weakly retained analytes. Even for target analytes that can be separated under isocratic conditions, the peak focusing effect of gradient elution makes all your analyte peaks taller, sharper, and more symmetric than peaks eluted using isocratic conditions. Thus, gradient elution can deliver better resolution, higher sensitivity, and lower detection limits. And with an RFIC system, gradient elution is as easy to use as isocratic elution. You simply define the gradient profile, and the eluent generator creates it for you, using only deionized water.

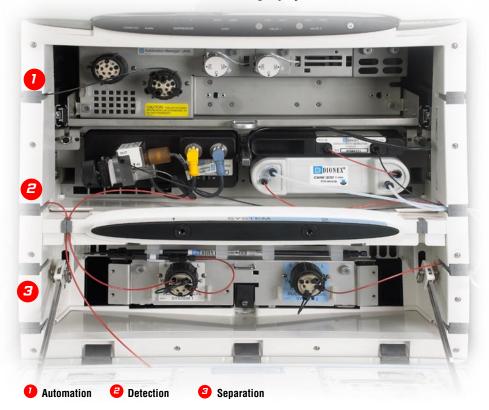
#### **Enjoy the Benefits of Eluent Generation**

Now you can get the convenience and reproducibility of on-line eluent generation without having to change your methodology. The dual-cartridge capability of the ICS-3000 EG supports two-component eluent systems, such as carbonate/bicarbonate, broadening your options. Of course, you can decide at any time to switch to chemistries that are compatible with gradients—all you need to do is change EluGen® cartridges.



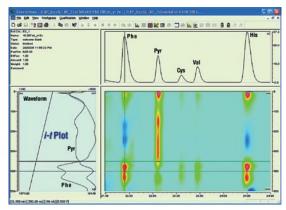
Chromatogram showing the separation of common anions on a 4-mm lonPac AS4A-SC column using  $K_2CO_3/KHCO_3$  eluent generation. The ICS-3000 produces high-purity carbonate/bicarbonate eluent at a precisely controlled concentration, eliminating the labor and variability of manual eluent preparation.





**Detector/Chromatography Module** 

The Ideal Environment for Your Chromatography The DC Detector/Chromatography module is a high-performance environmental chamber that precisely controls temperatures of valves, columns, suppressors, and detectors. Precise temperature control eliminates drift and minimizes noise, significantly improving sensitivity and stability. And you don't have to sacrifice convenience to gain outstanding performance. The DC gives you immediate access to all components of the flow path from the front of the instrument.

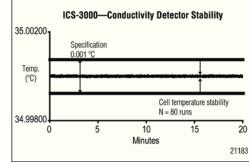


Learn more about your analytes with 3-D amperometry, an exciting new detection technology available only from Dionex.

> Innovative, self-contained conductivity (above) and electrochemical (below) detectors easily snap into the DC module, which precisely controls their temperature and virtually eliminates baseline drift.

New ED cell design features a new one-piece reference electrode and a torque control knob that ensures consistent pressure and cell volume.

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Advanced electronics and design have resulted in a highly temperaturestable conductivity detector that delivers consistent peak areas from run to run.



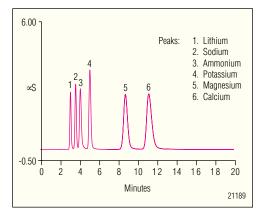
#### **Enjoy Performance and Convenience**

Behind the DC's clamshell doors you'll find more design features that enhance performance and convenience. The lower compartment organizes columns and valves, and equilibrates eluent to the correct temperature before it reaches the column. The upper compartment, which can maintain a different temperature, organizes detection components in its lower section and automation components in its upper section. Thoughtfully designed mounts and connectors not only make component installation and removal fast and easy, but also keep tubing and cable lengths short to minimize dead volumes. Applications requiring precolumn or postcolumn techniques are easier than ever, because Chromeleon software coordinates the additional valves, heaters, and other devices included with the optional Automation Manager.

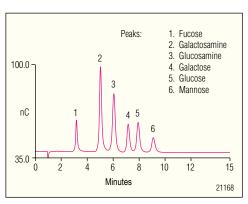
#### Get Better Results and Expand Your Capabilities

The ICS-3000 goes beyond stabilizing detector cell temperatures—it stabilizes the detector electronics too. The novel CD Conductivity Detector and ED Electrochemical Detector are compact, self-contained units that simply snap into place inside the protective environment of the DC module. You can quickly swap them out for servicing or to change applications.

The CD Conductivity Detector handles any IC application, from single-column methods with high background matrices to determinations of trace contaminants in high-purity water. Industry-leading suppressor technology provides low noise and high pressure tolerance for sensitive suppressed conductivity determinations using isocratic or gradient separations. The ED Electrochemical Detector brings exciting capabilities to amperometry, such as waveform switching, to achieve optimal detection of different analytes in the same chromatogram. You can run cyclic voltammetry experiments right in the chromatography cell to develop an optimal waveform for each analyte. And with Chromeleon software, you can capture amperometric measurements as a rich 3-D data set that reveals subtle differences not visible in a single chromatogram. Threedimensional amperometry also enables postrun adjustment of integration periods, so you can optimize them without having to reinject samples.



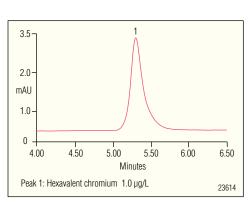
Switch between microbore and standard-bore applications, such as this separation of common cations on a 2-mm IonPac CS12A column, without changing anything more than columns, tubing, and flow rate.



The ED Electrochemical Detector enables very sensitive detection of electroactive species such as carbohydrates, amino acids, catecholamines, and many inorganic compounds, as shown in this separation of six monosaccharides.

Corrosion Resista Metal-Free For IC and Biological Samples

The ICS-3000 is the optimal liquid chromatography system for IC and biomolecule analysis. With a 100% metal-free system (autosampler, pump, flow path, and detector), the ICS-3000 is able to overcome the limitations of traditional stainless steel or other metal chromatography systems affected by corrosive mobile phases. Metal flow paths can cause denaturation or absorption effects with some analytes, resulting in poor chromatography. The complete PEEK™ flow path of the ICS-3000 system eliminates the possibility of system corrosion.



The VWD Variable Wavelength Detector allows sensitive, specific detection in the ultraviolet and visible range.



#### **Enhanced UV-Vis Detection**

The VWD variable wavelength detector can be used for a variety of applications that require UV or visible detection. The VWD allows monitoring of up to four separate wavelengths at the same time. In addition, precise thermal stabilization of both the eluent and the lamp housing minimizes noise and drift in the baseline.

The VWD's dual beam detection method reduces noise, increases signal-to-noise ratio, and ensures excellent linearity. The VWD utilizes high quality deuterium and tungsten lamps to cover wavelengths from 180–900 nm. Moreover, integrated chip technology identifies detector cell and lamp properties and tracks lamp usage. System wellness and predictive performance features of Chromeleon software monitor lamp intensity and usage, and can provide warning when limits are exceeded.

#### **Maximized Absorbance Information**

The PDA provides all the advanced features that you expect from photodiode array detection. With its range-extending dual lamp configuration, the PDA provides three-dimensional information for accurate assessment of peak identity, purity, and quantitation in a single run. The Dionex PDA uses dual extended-life lamps for superior intensity and improved signal handling. Advanced logic for the lamp power-up sequence allows the user to set the start-up parameters for both lamps. Faster spectrum calibration allows the PDA to operate on short notice. With exceptional thermal stability and calibration management, rapid analysis is just moments away.

#### Large Temperature Range, Ultrahigh Precision

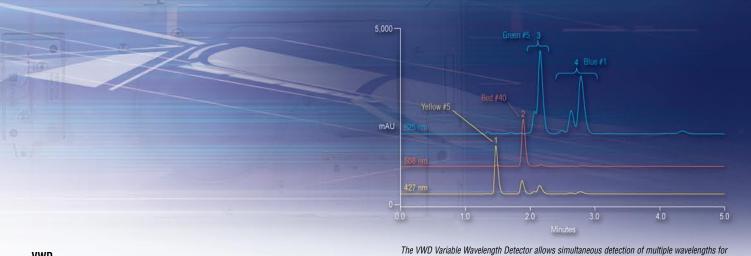
The TC Thermal Compartment module maintains very precise temperatures while allowing a large temperature range from 5 to 85 °C. Optional eluent temperature stabilizers help bring the eluent to oven and column temperature, to ensure more precise separations. The ICS-3000 TC comes configured with single or dual valves. Dual valve configurations can maximize productivity by implementing simultaneous or sequential injection or column switching techniques. In addition, the integrated column chip technology helps the user track important information regarding the operating conditions to which the column has been exposed, number of injections, and expiration date. A complete record of the column's history always accompanies the column.

#### MSQ Plus<sup>™</sup> for Increased Confidence in Results

Combine IC separations with the MSQ Plus detector for positive identification of the analytes in your samples. With IC and MS together, you can determine ionic and polar compounds that other techniques can't quantitate. The chromatographic separation isolates analytes from interferences, while the mass spectrometer provides structural information for each analyte. You can determine parameters such as oxidation state speciation, molecular mass identification, isotope ratios, and fragmentation patterns while avoiding coelution and background interferences.

MS dette spe

MSQ Plus mass spectrometric detector for optimal sensitivity, specificity, and limits of detection.



#### VWD

- Monitoring of up to four wavelengths simultaneously provides superior analysis of complex mixtures.
- Broad detection range, 180-900 nm, enables detection of more compounds.
- Expanded linear range delivers accurate detection of concentrated and dilute samples.
- Excellent signal-to-noise ratio improves minimum detection limits.

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#### PDA

- Dual lamp configuration provides full optical range detection.
- Extended lamp lifetime increases reliability.

applications such as complex food dyes, congeners, and isomers.

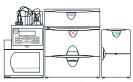
• Full 3-D scanning capabilities provide more information about each sample.



Basic optical system



Dual system PDA and CD/ED



System with UV-VIS and CD/ED

The ICS-3000 system combines with the highly sensitive ICS-Series detectors for complete and trouble-free analysis of biomolecules.

### TC

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 Increased flexibility with single or dual valves supports complex applications.

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- Expanded temperature range allows a wide variety of applications.
- Integrated column chip technology tracks column history for greater reliability.

## Automation Versatile Solutions to Simplify Your Applications

The Automation Manager provides integrated valve control, minimal tubing length, and consistent temperature control for greater sensitivity and robustness with complex applications. Chromeleon's graphical user interface makes programming easy.

#### **Automation for Complex Applications**

Analytical problems sometimes require complex solutions, but complex doesn't have to mean difficult. With the AM Automation Manager, you can easily perform special techniques like high-volume or high-pressure sample preconcentration, matrix elimination, column flushing, heart-cutting, and post-column treatments. The Automation Manager neatly organizes valves, concentrators, reactors, and plumbing in the top section of the DC module, protecting these accessories from laboratory temperature variations and eliminating clutter. And you no longer need cumbersome relay or TTL connection. The Automation Manager works seamlessly with Chromeleon software to orchestrate the devices, so control is easier, timing is more accurate, and communications are more reliable.

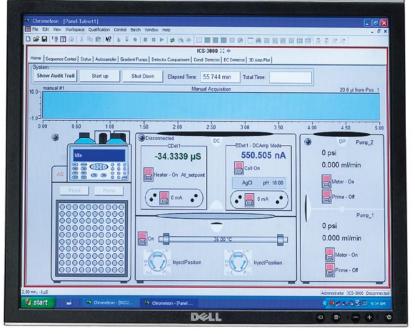
#### **Control for Your System and Data**

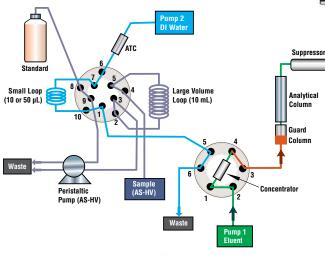
To operate most modular systems, you have to learn the front panels of various modules, then try to coordinate them through your chromatography software. But the ICS-3000 is different. Powerful Chromeleon software integrates system control and data handling into your instrument, providing a convenient command center. Run with direct control, or set up a sequence of samples and methods for your system to run automatically overnight. It's easy and convenient.



For data analysis, Chromeleon software gives you all the power and versatility of the world's most complete chromatography management system. If your lab requires third-party software for data analysis, Chromeleon Xpress provides complete ICS-3000 system control, and affords an easy upgrade path to Chromeleon.







The valves of the AM, in combination with Chromeleon software, allow you to automate tasks such as standard dilution and sample preconcentration.

The user friendly Chromeleon control panels show system status and allow you to access system modules with easy tab-page control.



The optional AM Automation Manager simplifies automation of complex applications. It plugs into the top section of the DC module, which instantly recognizes the accessories, enables their control, and keeps their temperature stable.

Autosamplers

## Autosamplers Deliver Accuracy and Ease of Use

#### **AS: Precision for Advanced IC Techniques**

When there is no room for compromise and you need sample automation, the AS boasts an impressive set of features to meet the demands of any lab.

- PEEK injection needle
- Simultaneous and sequential injections
- Full loop, partial loop, limited sample-partial loop
- Concentration and matrix elimination

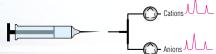


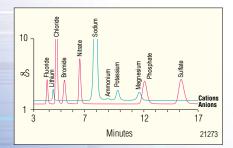
#### Save Time and Money with Intelligent Sample Handling

The AS Autosampler delivers sample handling solutions that no other autosampler can. Your samples are protected from contamination by its metal-free flow path and chemically-inert vials. The solid-state cooling option preserves heat-sensitive samples.

With Chromeleon software and the AM Automation Manager, you can easily automate sample pretreatments, such as preconcentration or matrix elimination. You can save time by enabling sample overlap, which prepares the next sample while the current one is undergoing analysis.

To increase throughput, you no longer need to buy a second autosampler or use additional bench space. The AS delivers samples to two separate chromatography systems within the same ICS-3000 instrument, either simultaneously or sequentially. Use the simultaneous option to perform two different analyses (such as anions and cations) on every sample. Use the sequential option to double throughput for a single application, or to efficiently process separate sets of samples for two different applications. Never before has an autosampler given you so much functionality.





One AS Autosampler can inject a sample into two separate channels of the dual ICS-3000 system simultaneously. This capability allows the ICS-3000 to double your throughput, as in this simultaneous analysis of anions and cations in tap water.

#### AS-HV: The Solution for High Volume Samples

When higher sample volumes are required for trace analysis, matrix elimination, or automated sample preparation, the AS-HV delivers with ease of use, reliability, and flexibility.

- Rapid, precise arm motion speeds sampling time to maximize efficiency
- Sample volumes up to 250 mL with Nalgene® bottles or low-contaminant tissue culture flasks

#### AS-DV: The Solution for Standard IC Autosampling

With dedicated full-loop and concentrator loading, the AS-DV is the optimal device for standard IC analysis. Chromeleon control, random access, and optional automated sample preparation and filtration make routine IC analysis seem effortless.

- Full loop and concentrator loading
- Random access and multiple injection with variable volume
- 5.0 and 0.5 mL polymeric vials with optional filter caps
- Optional 6-port or 10-port valve for automated sample preparation or sample injection

All Dionex Autosamplers have completely non-metallic PEEK-based flow paths. In addition, all samplers are fully supported with Chromeleon control and up-to-date qualification protocols.



Consumables

Complement Your System with Dionex Chemistries

### The ICS-3000 is the recipient of many prestigious instrumentation awards.











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Dionex's goal is to provide you with solutions to your ion analysis challenges, rather than just selling

you an instrument.

To meet that goal, we offer a complete line of training, service, and consulting products, installation and warranty service, and comprehensive support agreements.

#### What's Included with Your System?

The ICS-3000 is a complete package. Not only does it include all modules and accessories, but also complete installation and initial training to allow you to immediately start productive work. Systems come with a comprehensive set of ready-to-use guides, software, and templates.

#### Getting the Most from Your System

Dionex offers a variety of hardware and software training courses to help you get the most from your ICS-3000. Whether you need basic training for new operators or advanced training to further the skills of experienced operators, we have training courses to meet your needs. Courses are held regularly at Dionex facilities, and can also be held at your site. Our experienced staff is available to customize programs to your needs.

#### If You Need Help

It's reassuring to know that Dionex offers one of the most extensive and professional service and support organizations in the chromatography industry. Local support is close at hand, guick to respond, and provides effective solutions. For minor problems and questions, Dionex offers toll-free technical support, for rapid and competent assistance over the telephone.