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## *ICS 3000 Ion Chromatography System*

### **Performance Specifications**

The ICS-3000 Ion Chromatography System provides an impressive combination of increased productivity, expanded capabilities, and improved performance. Innovations in all modules provide up to an order of magnitude improvement in performance—the foundation of the system. Modular versatility, functional integration, and superior performance culminate in the most advanced ion chromatography system on the market.

- Modular design allows versatility in configuring a wide variety of applications
- Performance improvements up to an order of magnitude in flow rate accuracy, eluent generator electronics stability, and conductivity cell temperature control increase retention time reproducibility, baseline stability, and sensitivity
- New hydroxide and carbonate Reagent-Free™ Ion Chromatography (RFIC™) consumables offer the greatest flexibility of any RFIC system
- Dual-system capability (within the same footprint) maximizes throughput
- Integrated DC Detector/Chromatography module with precisely controlled temperature zones maintains baseline stability and increases application flexibility
- AM Automation Manager simplifies and automates complex applications including sample preparation, preconcentration, matrix elimination and postcolumn reagent addition
- New innovative ED Electrochemical Detector capabilities improve and expand applications: multiwaveforms in a single run; post-run 3-D data processing; new cell design
- Innovative touchscreen TabletStation, mounted on a movable arm, unifies and simplifies system control and operation

#### **Modular Design**

The modular ICS-3000 meets a wide and ever-increasing range of application needs. From an entry-level IC for routine, dedicated analysis to a high-throughput, dual RFIC system, the ICS-3000 is truly designed for versatility and productivity. The system can be upgraded to a dual system configuration—without taking up more valuable laboratory bench space.

#### **Performance Enhancements**

Significant performance enhancements make the ICS-3000 the most reproducible, stable, and sensitive ion chromatography system available today. Significant improvement in flow rate accuracy, eluent generator electronics stability, and conductivity cell temperature control increase baseline stability and enhance sensitivity. Each module offers new innovations for increased performance and help your lab become more productive.

## **Unique System Control**

Instead of individual module front panels, the ICS-3000 gives you one centralized control panel. A new touchscreen TabletStation with Chromeleon® Xpress provides a centralized panel so that all module control parameters, status, calibration, and diagnostics are easily and readily available. A convenient home screen shows overall system status while individual module tabs provide quick access to individual module functions and detailed status and diagnostics. The movable arm allows the user to move the TabletStation to the best position for use and viewing of status and chromatograms.

## **MODULAR CAPABILITIES AND PERFORMANCE**

### **DP Dual and SP Single Pump**

The DP Dual Pump and SP Single Pump are each available in multiple configurations based on application requirements. Both formats can be configured for gradient or isocratic eluent delivery. A SP pump-based system can be field-upgraded to a DP pump, depending on your needs. Pump assemblies slide out for easy access and serviceability. The pumps feature a variable-speed, serial-piston design to deliver consistent flow rates and quiet detector baselines. Compared to previous systems, the pump has a tenfold improvement in flow rate accuracy and precision. The pumps are designed to support flow rates from 0.001 to 10 mL/min.

### **EG Eluent Generator**

The EG Eluent Generator module provides the latest advances for RFIC systems in a dual-system format. Improved electronics provide an extremely stable baseline and precise gradient generation. You can generate highpurity eluents on-line, and run gradient separations as easily as isocratic. RFIC systems combine “Just Add Water” eluent generation, eluent purification, and electrolytic suppression technologies. RFIC systems eliminate variability and potential contamination compared to systems with manually prepared eluents, and provide superior performance, higher sensitivity, improved resolution, and excellent reproducibility. The EG can be configured for a single system or for dual-system support, along with an expanded set of eluent chemistry options for carbonate and hydroxide applications for anion analysis.

### **DC Detector/Chromatography**

The DC Detector/Chromatography module houses and organizes chromatography components such as valves and columns, as well as conductivity and electrochemical detectors and cells. The module keeps plumbing organized and minimizes connection lengths to reduce delay volumes and improve peak efficiencies. The DC is separated into three sections for automation, detection, and separation. The DC offers up to five separate temperatures that can be maintained simultaneously (separation section, detection section, two conductivity detector cells, and postcolumn reaction coils). This extremely flexible and precise temperature control increases stability and enhances sensitivity. Further increasing stability is a tenfold improvement in conductivity detector temperature control and a fivefold improvement in column temperature control.

### **CD Conductivity and ED Electrochemical Detectors**

The CD and ED detectors install inside the DC compartment, minimizing tubing lengths and providing optimum thermal stability. The detectors are easy to install snap-in devices and can be configured in series for dual detection or as separate detectors for a dual system—all in the same enclosure.

The ED features a new cell design with an improved reference electrode. The cell is also more rugged due to an improved handle design that provides uniform torque on the working electrode. Multiple waveforms optimize detection conditions for individual analytes and signal measurements can be collected as a complete three-dimensional data set for post-run analysis and characterization of different compound classes.

## Optical Detectors

The ICS-3000 can be configured with any variety of optical detectors available. Unlike the CD and ED, the optical detectors are configured as separate modules outside the DC.

## M Automation Manager

The AM Automation Manager option can be configured in the upper compartment of the DC module. The AM includes options for two high pressure rotary valves and two low pressure solenoid valves for automated sample preparation, preconcentration, matrix elimination, and postcolumn reagent addition. Components are recognized, configured, and controlled through Chromeleon, providing complete automation for even the most complex applications.

## AS Autosampler

The new AS Autosampler can be configured for simultaneous or sequential sample delivery. Configured for simultaneous delivery, sample is delivered through a splitter to two injection valves for dual full-loop injections. With this configuration you can perform two separate analyses on one sample (e.g., anions and cations). Configured for sequential delivery, valves are configured to divert the sample stream to the appropriate injection valve for loading. The new AS also provides sample preparation options and variable sample size loading for preconcentration on various trap columns.

## Module Features

### DP Dual and SP Single Pump

The DP and SP Pumps are each available in isocratic or gradient configurations. The pumps support standard-bore and microbore applications. Gradient configurations provide low-pressure mixing of up to four mobile phases per pump at precisely controlled proportions and flow rates.

### DP and SP Features

- Variable-speed, serial dual-piston design delivers consistent flow rates and quiet detector baselines
- Pump flow components are chemically inert, made with high-quality PEEK heads and fittings, inert polymer seals, and sapphire pistons
- Quaternary proportioning and a low-volume mixer deliver reproducible eluent mixtures
- Linear, concave, and/or convex gradients are possible
- Vacuum degas provides sealed, in-line degassing for flow reproducibility and protection of eluent from contamination and degradation
- Automated integral piston seal wash prolongs seal lifetime by preventing eluent crystallization on the seal surfaces
- The pump assemblies slide out for easy access and serviceability
- User-selectable pressure limits automatically stop pump flow in the event of leaks, flow restrictions, or depleted eluent reservoirs
- User-configurable alarm features in Chromeleon allow additional responses to status or alarm conditions
- Front panel indicates the status of power, pump flow, priming, connectivity (Chromeleon Control), and Alarms

## Benefits of Dual Pump Configurations

Dual configurations provide independent pumping capabilities in the same module and same space-saving footprint. An SP can be field-upgraded to a DP. Configure a DP-based system according to one of the following scenarios:

- Configure the system for dual applications, either running simultaneously or independently:
  - Anion and cation separations

- Two different anion or two different cation separations
  - Use the second pump for:
- Sample preconcentration or matrix elimination
- Postcolumn reagent delivery for postcolumn reaction (PCR) applications
- External water and chemical regenerant delivery
- A backup pump for the primary application
- Consumables cleanup or start-up preparation; preventing primary system downtime for reconfiguration

| DP and SP Pump Specifications      |  |
|------------------------------------|--|
| Available Configurations           | SP Isocratic<br>SP Gradient<br>DP Isocratic/Gradient<br>DP Gradient/Gradient   |
| Applicability                      | Gradient and Isocratic separations with 1–9-mm columns   |
| Construction                       | Chemically inert, metal-free PEEK pump heads and flow path, compatible with aqueous eluents of pH 0–1 and reversed-phase eluents.                  |
| Type                               | Serial dual-piston, constant stroke  |
| Control Modes                      | Remote by Chromeleon software through USB; Stand-alone through standard Chromeleon Xpress control  |
| Pressure Limit Alarms              | Programmable upper and lower limits  |
| Flow Rate Range                    | 0.001–10 mL/min  |
| Flow Precision                     | ±0.1% at 1 mL/min  |
| Pressure Range                     | 50–5000 psi  |
| Pressure Ripple                    | 1% (typical)   |
| Gradient Proportioning Accuracy    | ±0.5% at mL/min  |
| Gradient Proportioning Precision ± | ±0.5% at mL/min  |
| Number of Solvents                 | Isocratic: one solvent, Gradient: four solvents  |
| Gradient Mixer Delay Volume        | 2-mm GM < 90 µL<br>3–9-mm GM3 < 500 µL   |
| Vacuum Degassing                   | SP Isocratic: one channel, (optional)<br>SP Gradient: four channels, built-in<br>DP Isocratic/Gradient, built-in<br>DP Gradient/Gradient, built-in |



|                                   |   |
|-----------------------------------|---|
| Wetted Parts                      | PEEK, sapphire, ruby, ceramics, UHMW polyethylene, PCTFE, PTFE  |
| Leak Detection                    | Optical sensor, (no calibration required)   |
| Computer Connection               | Through USB device connector;<br>with USB hub (three) connectors  |
| I/O Interfaces,<br>Inputs/Outputs | Four programmable relays; motorized<br>switching-valve port; analog output for<br>system pressure<br>Three digital inputs for Start, Stop, and Hold |
| Power Requirements                | 90–100 V, 00–0 V; 7–63 Hz   |
| Operating Temperature<br>Range    | –0 °C (0–10 °F)   |
| Operating Humidity<br>Range       | 5–95% relative, noncondensing   |
| Dimensions (h × w × d)            | 1 × × 56 cm<br>(16 × 8.5 × 1.6 in.)   |
| Weight                            | SP: 0. kg (5 lb);<br>DP: .1 kg (53 lb)  |

### EG Eluent Generator Module

The EG Eluent Generator module provides the most recent advances for RFIC systems in a dual system format. The EG continues technology leadership, allowing the user to generate high-purity eluents on-line and run gradient separations as easily as isocratic applications. Reagent-Free IC is the powerful combination of “Just Add Water” electrolytic eluent generation, purification, and suppression technologies. The EG can be configured for a single system or for dual system support.

### EG Features

- Eluents are generated from deionizer water using an EG cartridge and then polished of contaminants using one of the Continuously Regenerating Trap Columns (CR-TCs)
- Now you can enjoy the RFIC system carbonate-based eluent generation using a carbonate cartridge and EPM Electrolytic pH Modifier
- In addition to KOH for anion separations, NaOH and LiOH cartridges are available for specialized applications
- The EG delivers eluent concentrations from 0 to 100 mM
- Control, status, and diagnostics are provided with Chromeleon software
- Improved EG electronics provide smoother eluent delivery with minimal noise for improved peak detection in both gradient and isocratic modes
- A slide-out tray provides easy access to the EG cartridges and CR-TCs for maintenance
- Using on-line eluent generation actually extends the lifetime of pump pistons and seals because the pumps only deliver water
- Front panel displays the status of module power, CR-TC power, and leak functions

| <b>EG Eluent Generator Specifications</b> |  |
|---|--|
| EGC Concentration Range:                  | 0.1–100 mM                               |
| Eluent Types:                             | KOH, LiOH, NaOH                          |
|   | CO <sub>3</sub> /HCO <sub>3</sub>        |
|   | CO <sub>3</sub>                          |
|   | methanesulfonic acid (MSA)               |
| Concentration Increments:                 | 0.01 mM                                  |
| Cartridge Capacity:                       | Two independent                          |
| CR-TC Capacity:                           | Two independent                          |
| Flow Rate Range:                          | 0.1–3.0 mL/min                           |
| Max. Operating Pressure:                  | 3000 psi, 1 mPa                          |
| Max. Solvent Concentration:               | anions— 5% methanol; cations—no solvent  |
| Leak Detection:                           | Optical sensor (no calibration required) |
| Operating Temperature Range:              | – 0 °C                                   |
| Operating Humidity Range:                 | 5–95% relative, noncondensing            |
| Dimensions (h × w × d):                   | 1 × × 56 cm                              |
|   | (16 × 8.5 × 1.6 in.)                     |
| Weight:                                   | 18 kg ( 0 lb)                            |
| Power Requirements:                       | 90– 65 V ac, 7–63 Hz                     |
| EluGen® Cartridge Dimensions (h x w x d): | 3 x 7 x 10 cm (9 x .75 x in.)            |
| Weight:                                   | 1.6 kg (3.5 lb)                          |
| CR-TC Trap Column Dimensions (h x w x d): | 3.8 x 3.8 x 5.8 cm (1.5 x 1.5 x .3 in.)  |
| Weight:                                   | 60 g (0.13 lb)                           |

### Benefits of RFIC System

- Minimizes baseline drift
- Improves retention time stability and resolution
- Provides excellent run-to-run reproducibility

- Supports both gradient and isocratic applications
- Minimizes labor and operating costs

### DC Detector/Chromatography Module

The DC Detector/Chromatography module houses and organizes chromatography components such as valves and columns. The DC module contains three sections: (1) separation, (2) detection, and (3) automation. The lower separation compartment contains injection valves, guard, and analytical columns, and is under independent temperature control. The conductivity and electrochemical detectors are configured above the separation columns. An Automation Manager option can be configured in the upper compartment to support switching valves and other hardware required for advanced applications.

### DC Features

- Three distinct sections keep plumbing organized while minimizing connection lengths, reducing delay volumes, and improving peak efficiencies
- Two options for overall thermal control offer application and budgetary flexibility
  - Dual temperature zone configuration controls the injection valve and column compartment separately from the upper compartments
  - A single temperature zone configuration controls the temperature of both compartments at one set temperature
    - With either configuration, the CD cells feature temperature control independent of the other sections
    - In the dual temperature zone configuration, up to five separate temperatures can be maintained simultaneously (separation section, detection section, two detector cells, and reaction coil) providing maximum application flexibility
    - Independent compartment doors allow independent access to the separation or detector section without disturbing the other thermal section (with dual temperature zone configuration)
      - Automatic detection of valves, CD/ED cells, and suppressor devices by software
      - Manual loading of sample is possible
      - Column compartment can be configured with two independent injection valves
      - Column/Injection Valve panel slides forward for easy access
      - Optional analog output board provides analog detection signals to data recorders
      - Optional analog board also includes eight user-assignable TTL inputs that are provided for basic valve and detector operation
      - Front panel displays the status of module power, injection valve position, and alarms

| DC Detector/Chromatography Module Specifications |   |
|--|---|
| DC Models:                                       | Single Temperature Model                          |
|  | Dual Temperature Model                            |
| Single Temperature Model:                        | (Upper and Lower sections are thermally combined) |
| Temperature Range:                               | 15– 0 °C in 0.1 °C increments                     |
| Temperature Performance:                         | Accuracy: ± 0.5 °C                                |
|  | Stability: ± 0. °C                                |

|  |  |
|--|--|
|  | Precision: $\pm 0.1$ °C  |
| Heat-up / Cool-down Time:                              | Less than 30 min from 0 °C   |
|  | to 0 °C, or 0 °C to 0 °C   |
| <b>Dual Temperature Model:</b>                         | (Upper and Lower sections are independently thermally controlled)                                  |
| Upper Section Temperature Range:                       | 15– 0 °C in 0.1 °C increments  |
| Lower Section Temperature Range:                       | 10–70 °C in 0.1 °C increments  |
| Temperature Performance:                               | Accuracy: $\pm 0.5$ °C   |
|  | Stability: $\pm 0.1$ °C  |
|  | Precision: $\pm 0.1$ °C  |
| Heat-up/Cool-down Time:                                | Less than 30 min from  |
|  | 0 °C to 50 °C, or 50 °C to 0 °C  |
| <b>Lower Column Section(applies to both DC models)</b> |  |
| High-Pressure Valve Types:                             | (any two) Six-port/two-position Rheodyne PEEK injection valves                                     |
|  | 10-port/two-position Rheodyne PEEK switching valves  |
| Column Capacity:                                       | Two column sets 1–9 mm   |
| Maximum Column length:                                 | 50 mm  |
| Precolumn heat exchangers:                             | Capacity to house two, low-delay volume  |
| <b>General Specifications</b>                          |  |
| Control:   | Chromeleon/Chromeleon Xpress   |
| Computer Connection:                                   | USB, with integrated USB Hub with two type A USB ports   |
| Leak Detection:  | Optical leak sensor, no calibrations required  |
| Output Voltages:                                       | Two, switched AC controllers through Chromeleon/Chromeleon Xpress (90–65 V ac, 7–63 Hz compatible) |



|   |  |
|---|--|
| Power Requirements:                             | 90– 65 V ac, 7– 63 Hz  |
| Operating Temperature Range:                    | – 0 °C ( 0–10 °F)  |
| Operating Humidity Range:                       | 5–95% relative, noncondensing                                |
| Dimensions (w x h x d):                         | .5 × × 57. cm (17.5 × 16.5 × .5 in.)                         |
| Weight:   | 38 kg (8 lb)   |
| Detector Analog Outputs:                        | (Optional) Any two detectors—conductivity or electrochemical |
| TTL and Relay inputs and outputs:<br>(Optional) | Two controlled relay closure—output                          |
|   | Four controlled TTL—output                                   |
|   | Six programmable TTL—inputs                                  |
| <b>AM Automation Manger—Optional</b>            |  |
| High Pressure Valve Types: (any two)            | Six-port/two-position Rheodyne PEEK injection valves         |
|   | 10-port/two-position Rheodyne PEEK switching valves          |
| Low Pressure Valve Types: (any two)             | Two-port shut-off valve, auto-detected and controlled        |
|   | Three-port switching valves, auto-detected and controlled    |
| RCH Reaction Coil Heater:                       | Houses two postcolumn reactors                               |
| Temperature Performance:                        | Range: 5 °C above upper DC temperature                       |
|   | section to 80 °C in 1.0 °C increments                        |
|   | Accuracy: ± 1.0 °C   |
|   | Stability: ± 0. °C   |
|   | Precision: ± 0. °C   |

### Expand Your Capabilities with Dual Detection Configurations

- Easily install the CD and ED detectors as plug-in devices and have a dual system in a single system footprint
- Run anion/cation analyses simultaneously from one injection

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- Run confirmatory separations in parallel to verify components
- Inject different sample loop sizes; eliminate reanalysis of samples at different dilutions
  - Implement innovative detection schemes by pairing conductivity and electrochemical detection techniques in series on the same system
- Determine classic anions with conductivity along with sensitive and selective ED detection of electroactive species such as iodide, sulfide, cyanide, and phenols
- Analyze cations and electroactive amines, organic acids, and carbohydrates from a single separation

### AM Automation Manager

Simplify complex applications with the AM Automation Manager option. This option, which fits in the upper section of the DC module, organizes and controls high-pressure rotary valves, low-pressure solenoid valves, the RCH Reaction Coil Heater, and a variety of reaction coils.

- Configure up to two each, six- or 10-port high-pressure rotary valves for automated sample preparation, preconcentration, matrix elimination, or flow-diversion applications
- Configure up to two each, low-pressure two port shut-off or three port switching valve for selection of reagents for postcolumn reagent addition, rinse solutions, or regenerants
- Install the optional RCH for heated reactions, or simply mount nonheated reaction coils to support ambient reagent addition
- Installed components are automatically recognized through Chromeleon
- All valves and positions are recognized with Chromeleon
- Preconcentrate samples during a run to increase throughput

### CD Conductivity and ED Electrochemical Detectors

The CD and ED detectors install inside the DC compartment as snap-in devices. They can be configured in series for dual detection, or as separate detectors for a dual system.

#### CD Features

- Microprocessor-controlled digital signal processing detects high and low concentrations of analytes in the same run
- Supports all IC and RFIC system applications with maximum range up to 15,000  $\mu\text{S}$
- Control through Chromeleon software or locally through TTL inputs
- Mount inside the DC compartment in either of two locations
- No tools are required
- Minimizes noise and maximizes thermal stability
- Electronics are integrated between cell and detector for greater stability
- Heats CD cell independently from other chromatography components
- Innovative built-in electronics allow for easy calibration and diagnostics

#### CD Conductivity Detector Specifications

|                          |   |
|--------------------------|---|
| <b>Electronics Type:</b> | Microprocessor-controlled digital signal processing |
| Detection types:         | Single- and dual-conductivity detection             |
| Cell Drive:              | 8 kHz square wave                                   |
| Linearity:               | 1% at 1000 $\mu\text{S}$                            |

|                                    |  |
|------------------------------------|--|
| Resolution:                        | 0.10 nS  |
| Full-Scale Output Range:           | Digital: 0–15,000 $\mu$ S  |
|                                    | Analog: 0–15,000 $\mu$ S   |
| Signal Sampling Rate:              | Maximum of 100 Hz  |
| Electronic Noise, Dry:             | S/N ratio = 100,000:1  |
|                                    | (Example: 1000 $\mu$ S:5 nS)   |
| Electronic Noise, Wet:             | At 3 $\mu$ S, noise <0.1 nS  |
|                                    | At 1 $\mu$ S, noise <0.1 nS  |
| Filter:                            | Rise times from 0 to 10 s  |
| Temperature Compensation:          | Factory default at 1.7%,   |
|                                    | programmable from 0.0–3.0 %  |
| Analog Signal Output Voltage:      | User-selectable full-scale recorder output of 10, 100, or 1000 mV              |
| Analog Signal Output Frequency:    | Output rate of 100 Hz  |
| Control Modes:                     | Local or remote using relay closures, TTL, by Chromeleon through the DC module |
|                                    | Chromeleon software or by tablet PC with Chromeleon Xpress                     |
| Autoranging:                       | Autoranging digital conductivity signal monitoring with Chromeleon software    |
| Conductivity Flow Cell Electrodes: | Passivated 316 stainless steel micro electrodes                                |
| Cell Body:                         | Chemically inert polymeric material  |
| Cell Volume:                       | <1.0 $\mu$ L   |
| Maximum Operating Pressure:        | 500 psi  |
| Cell Temperature Range:            | 5 °C above the upper DC enclosure temperature; up to 60 °C max.                |
| Cell Temperature Stability:        | <0.001 °C  |
| Pre-cell Heat Exchanger:           | PEEK or other inert material   |

|                         |   |
|-------------------------|---|
|                         | Low dispersion                            |
| Dimensions (h x w x d): | 6.9 x 16.7 x 9.9 cm ( .7 x 6.5 x 3.9 in.) |
| Weight:                 | 00 g (1.6 lb)                             |

### ED Features

- New one-piece reference electrode provides consistency and reliability
- New handle design provides consistent torque to cell electrode for consistent installation and mounting of working electrode
- Uses microprocessor-controlled digital signal processing
- Supports dc amperometry, pulsed amperometry, or integrated amperometry detection modes
- New detection capabilities include use of multiple waveforms and multiple integration times to optimize detection conditions for individual analytes
- Three-dimensional display of the raw integrated amperometry data set similar to PDA data display, with cross-hairs on an isoamperometric plot used to select “slices” of the plot along the applied voltage axis (to render a chromatogram) and along the time axis (to render a voltammogram)
- Three-dimensional wireframe rendering, printing, color selection, display of apex, and other spectra on peaks in chromatograms are echoed in the integrated amperometry implementation
- The integrated amperometry mode provides complete freedom to change the waveform profile’s number of segments, duration of each segment, and voltage applied at each segment
- Control through Chromeleon software or locally through TTL inputs
- Mounts within the DC compartment in either of two locations
- No tools are required for installation
- Cell and detector electronics integrated to minimize noise, maximize electrical isolation and shielding, and maximize thermal stability
- Innovative, built-in electronics for easy calibrations and diagnostics
- Can be used in dual-detection configurations (detectors in series or systems in parallel)

| <b>ED Electrochemical Detector Specifications</b> |  |
|---|--|
| Electronics Type:                                 | Microprocessor-controlled digital signal processing                    |
| Detection Types:                                  | Single- and dual-electrochemical detection                             |
| Noise: Amperometry Electronics                    | DC amperometry: <1 pA at lowest range<br>Integrated amperometry: 10 pC |
| Potential Range:                                  | – .00 V to .00 V in 0.001 V increments                                 |
| Signal Range: Digital and Analog                  | DC amperometry: 5 pA to 7 μA<br>Integrated amperometry: 50 pC to 00 μC |
| Electronic Noise:                                 | IPAD <5 pC<br>DC amperometry <1 pA                                     |

|                                      |   |
|--------------------------------------|---|
| Filter:                              | 0–10 s response time  |
| Control Mode:                        | Local or remote using relay closures, TTL, or by Chromeleon through the DC module   |
| Cell Body:                           | Titanium body, titanium inlet tubing, compatible with 0.5-mm i.d. columns (flow rate 3–10 $\mu\text{L}/\text{min}$ ) and -mm i.d. columns ( mL/min); pressure rating 1 0 psi when fully assembled |
| Working Electrode (interchangeable): | Gold, glassy carbon, platinum, silver   |
| Disposable Working Electrode:        | Gold, silver  |
| Counter Electrode:                   | Titanium  |
| Reference Electrode:                 | pH-Ag/AgCl combination  |
| Autoranging:                         | Autoranging digital amperometry signal with Chromeleon software   |
| Analog Signal Output Voltage:        | User-selectable full-scale recorder, output of 10, 100, or 1000 mV  |
| Analog Signal Output Frequency:      | Output rate of 100 Hz   |
| Wetted Materials:                    | PEEK, titanium, Kel-F® polyetherimide,  |
|                                      | EPR, glass, high-density polyethylene   |
|                                      | (HDPE), ULTEM, working electrode materials  |
| Cell Volume at Working Electrode:    | <0.5 $\mu\text{L}$  |
| Maximum Operating Pressure:          | 0.7 MPa (100 psi)   |
| Dimensions (h x w x d):              | 6.9 x 16.7 x 9.9 cm ( .7 x 6.5 x 3.9 in.)   |
| Weight:                              | 00 g (1.6 lb)   |

### Optical Detectors

The ICS-3000 can be configured with any of several optical detectors available.

### PDA-100 Photodiode Array Detector

The PDA-100 is a high-resolution, 10 -element photodiode array detector with low noise and drift. Two light sources, a deuterium lamp and a tungsten lamp, provide a broad spectral range. The PDA-100 is operated using Chromeleon software with a 3-D data processing option. Get the benefits of performance and versatility of the PDA-100 Photodiode Array detector through the following unique features:

- Photodiode array (10 -element) provides optimum wavelength resolution
- Broad wavelength range from 190 to 800 nm
- Low noise and high light intensity over the full spectral range via deuterium and tungsten lamps
- Full control and data collection through Chromeleon software with 3-D option



- LAN-based digital data collection for simple installation
- Four analog outputs support alternate data collection
- Built-in holmium oxide filter for easy verification of wavelength accuracy

### PDA-100 Photodiode Array detector

- Low baseline drift for excellent reliability and reproducibility
- Front access to prealigned cells and lamps for easy maintenance
- Four front-panel LEDs that clearly indicate detector status

| PDA-100 Photodiode Array Detector Specifications |  |
|--|--|
| <b>Performance</b>                               |  |
| Noise:   | $\pm 10 \mu\text{AU}$ at 5 nm (flowing water, 100 ns rise time)  |
|  | $\pm 15 \mu\text{AU}$ at 50 nm (flowing water, 100 ns rise time) |
| Drift:   | $< 500 \mu\text{AU/h}$   |
| Wavelength Accuracy:                             | $\pm 1 \text{ nm}$ , self-calibration with deuterium lines       |
|  | verification with built-in holmium oxide filter                  |
| Linearity:                                       | Deuterium lamp, $> 1 \text{ AU}$                                 |
|  | Tungsten lamp, $> 1 \text{ AU}$                                  |
| <b>Optics</b>                                    |  |
| Photodiode Array:                                | 10 element   |
| Pixel Resolution:                                | 0.7 nm   |
| Lamps:   | Tungsten and deuterium   |
| Photodiode Array:                                | 10   |
| Pixel Resolution:                                | 0.7 nm   |
| Optical Resolution:                              | 1.0 nm   |
| Wavelength Range:                                | 190–800 nm   |
| <b>Electronics</b>                               |  |
| Analog Outputs:                                  | Four, 0–3 AU, selectable,  |
|  | 1000 mV range  |

|                                       |                                       |
|---------------------------------------|---------------------------------------|
| Analog Outputs:                       | Four, 0–3 AU, 1000 mV range           |
| Flow Cell                             | Cell: PEEK, fused silica              |
| Cell Path Length:                     | 10 mm                                 |
| Cell Volume:                          | <13 $\mu$ L                           |
| Pressure:                             | <300 psi                              |
| Flow Cell Materials:                  | PEEK, fused silica, SST               |
| Path Length:                          | 10 mm                                 |
| Cell Volume:                          | 13 $\mu$ L                            |
| Flow Cell Pressure Limit:             | < 3 MPa (300 psi) PEEK                |
|                                       | <3 MPa (500 psi) SST                  |
| <b>Physical Specifications</b>        |                                       |
| Power Requirements:                   | 90– 65 V ac, 7–63 Hz                  |
| Operating Temperature Range:          | – 0 °C ( 0–10 °F)                     |
| Operating Humidity Range:             | 5–95% relative, noncondensing         |
| Dimensions (h $\times$ w $\times$ d): | 17. $\times$ 33.6 $\times$ 9.5 cm     |
|                                       | (6.7 $\times$ 13.1 $\times$ 19.3 in.) |
| Weight: 15.9 kg (35 lb)               |                                       |

### AD25 Absorbance Detector

Get the benefits of performance and versatility of the AD 5 through the following features:

- Deuterium and tungsten lamps that provide operation over the entire wavelength range of 190–800 nm
- Compact design for optimal plumbing of liquid flow path and minimal use of bench space
- Built-in holmium oxide filter for automated wavelength verification
- High signal-to-noise ratio for maximum sensitivity
- Low baseline drift for reliable results
- Excellent resolution that yields high linearity
- Integrated flow cell heat exchanger for thermal stability
- Lamp lifetime monitor to prevent downtime
- Front access to prealigned lamps and flow cell to simplify detector maintenance
- Available with 10-mm PEEK and SST flow cells for compatibility with a wide range of IC and HPLC applications

| <b>AD25 Absorbance Detector Specifications</b> |   |
|--|---|
| <b>AD25 Optics</b>                             |   |
| Optical System:                                | Forward, dual-beam monochromator with a concave holographic grating and reflective beamsplitter |
| Light Source:                                  | Deuterium lamp (30 W) for UV range and tungsten lamp (10 W) for visible range                   |
| Wavelength Range:                              | 190–800 nm in 1-nm increments   |
| <b>AD25 Electronics</b>                        |   |
| Analog Output Ranges:                          | 0.001–3.0 AU  |
| Rise Time:                                     | 0.1–10 s  |
| Full-Scale Recorder Output:                    | 1 V   |
| Digital Output:                                | Full dynamic autoranging digital absorbance signal output to Chromeleon 6 software              |
| Control Modes:                                 | Local through relay closures or TTL. Software remote control through Chromeleon 6.              |
| <b>AD25 Flow Cell</b>                          |   |
| Cell:  | PEEK, fused silica  |
| Cell Path Length:                              | 10 mm   |
| Heat Exchanger Volume:                         | 1 .5 µL   |
| Cell Volume:                                   | 10 µL PEEK  |
| Maximum Flow Cell Operating Pressure:          | MPa (300 psi)   |
| <b>AD25 Performance</b>                        |   |
| Wavelength Accuracy:                           | ±1 nm   |
| Bandwidth:                                     | <5 nm   |
| Linearity:                                     | > AU  |
| Noise:   | ±10.0 µAU peak-to-peak  |
|  | ( 5 nm, -s rise time, flowing water)  |
| Drift:   | <100 µAU/h  |

|                                     |   |
|-------------------------------------|---|
| <b>AD25 Physical Specifications</b> |   |
| Power Requirements:                 | 90– 65 V ac, 7–63 Hz                                |
| Operating Temperature Range:        | – 0 °C ( 0–10 °F); cold-room                        |
|                                     | ( °C) compatible as long as system power remains on |
| Operating Humidity Range:           | 5–95% relative, noncondensing                       |
| Dimensions (h × w × d):             | 17 × .5 × cm  |
|                                     | (6.6 × 8.8 × 16. in.)                               |
| Weight:                             | 10.9 kg ( lb)                                       |

## AUTOSAMPLERS

### AS Autosampler

The new AS Autosampler delivers high precision, reliability, ruggedness, and ease of use. It offers a wide range of options to fit your needs, including sample preparation, temperature control, and chemistry switching. The AS works with the entire ICS product line. Configure the sampler for simultaneous injection and perform concurrent injections of a sample or standard onto two analytical systems running unique or similar applications. Improve efficiency by controlling two independent IC systems with one autosampler through sequential injections. This setup allows different applications to be run, or doubles the throughput in one application. With simultaneous and sequential injection, you can increase sample throughput, and eliminate errors associated with multiple operators and sampling locations. New features include reagent prime, reagent flush, and concentrate. These capabilities offer additional flexibility that range from matrix elimination to concentrate. In addition, sequences can now be run in “overlap” with the previous sample to minimize overall cycle time. Free up your schedule and lab time with automated sample handling for your IC:

- Simultaneous injection
- Sequential injection
- Preconcentration
- Matrix elimination
- Automated dilutions
  - Eliminate complex laboratory procedures with automated standard preparation

| AS Autosampler Specifications              |  |
|--|--|
| <b>Sample Capacity:</b>                    | 9 10 mL; 100 1.5 mL  |
| Vial Size:                                 | 10-mL polystyrene and 1.5-mL glass, septum vials, 1.5-mL polypro |
| Vial Temperature Control Range: (Optional) | Programmable from –60 °C in                                      |
|  | 1 °C increments  |

|                                |   |
|--------------------------------|---|
|                                | Cooling – 0 °C from ambient                     |
|                                | Heating + 0 °C from ambient                     |
| Vial Temperature Accuracy:     | ± °C (from –10 °C and 1–60 °C);                 |
|                                | ±1 °C (from 11– 0 °C)                           |
| Vial Temperature Differential: | < °C between any two vials                      |
| Temperature Stability:         | ±5 °C   |
| Temperature Reproducibility:   | ±5 °C   |
| Time to Temperature:           | Cools tray from to °C in                        |
|                                | <30 min; heats tray from to 60 °C, in <30 min   |
| Number of Injections per Vial: | 1–99  |
| Minimum Sample Volume:         | 10 µL can be sampled from a 300-µL microvial    |
|                                | 0 µL can be sampled from 500 µL in a 10-mL vial |
| Variable Volume Range:         | 1–100 µL in 0.1-µL increments                   |
|                                | 100–8000 µL in 1-µL increments                  |
| Injection Valve: (Optional)    | PEEK Rheodyne with Tefzel® rotor seal           |
| Injection Loop Size:           | 5-µL standard; other sizes available            |
| Injection Precision:           | Fixed-loop <0.3% RSD at 0 µL or                 |
|                                | greater; variable <0.5% RSD at 0 µL             |
| Dilution Precision:            | <1.0% RSD for a 1:100 dilution                  |
| Dispensing Precision:          | <0. % RSD by weighing                           |
| Carryover:                     | <0.01% with 500-µL flush volume                 |
| Ambient Temperature Range:     | 10– 0 °C  |
| Humidity range:                | 50–90% relative humidity, noncondensing         |
| Power Requirements:            | 90– 65 V ac, 7–63 Hz                            |

## Key AS Autosampler Features Provide Performance and Versatility

IET - Used Lab Equipment - Refurbished Analytical Laboratory Instruments



- Consistent operation at RSDs of less than 0.3% that provide reproducible and accurate results
- Specially designed 10-mL polystyrene sample vials with wide openings that are easy to fill, easy to handle, and permit large-volume injections
- Easy access to components for effective troubleshooting
- All-PEEK flow paths that ensure compatibility with aqueous and reversed-phase eluents and protect sensitive samples from metallic contamination
- Control through Chromeleon or module front panel
- Moving-needle design to guarantee reliable sampling from a variety of vial sizes
- Easy syringe priming
- Sample preparative option that saves time and labor by automating your sample and standard preparations
- Chemistry-switching option to provide fully automated switching between two independent applications on the same IC system
- Sample tray temperature control option for thermally sensitive samples that offers precise, reliable control over a temperature range of  $-60\text{ }^{\circ}\text{C}$

### ICS-3000 System Control

The ICS-3000 is controlled by a TabletStation mounted on a flexible arm. The TabletStation can be configured with a powerful user interface, Chromeleon Xpress for stand-alone control. Xpress is a complete system controller that replaces and combines module front panels into one convenient system control panel. The TabletStation can also be configured with full Chromeleon for complete control, data acquisition, and management mounts on the side or on top of the ICS-3000 depending on user needs.

- Chromeleon Xpress is control-only, made with a unique, easy-to-use graphical interface.
- The panel provides complete singlepoint control and status monitoring of all modules.
- Off-the-shelf, tablet PC—mounted on a user-adjustable arm—adjusts to different user requirements.
- Tablet options:
  - Touchpad controller
  - Laptop/touchpad controller
    - Configuration options include:
      - TabletStation with Chromeleon Xpress
      - TabletStation with full-featured Chromeleon
      - TabletStation with wireless keyboard and mouse with fullfeatured Chromeleon
      - Desktop PC with full-featured Chromeleon

| Minimum Table Station Specifications |  |
|--------------------------------------|--|
| Tablet PC:                           | 1.□ GHz Pentium® M Centrino™ Processor |
|                                      | 51 MB RAM                              |
|                                      | 0 GB hard drive                        |
| CD-RW/DVD-ROM                        | 10/100 Ethernet                        |
|                                      | 80 .11 b/g WiFi Ethernet               |

|                                   |
|-----------------------------------|
| Window XP Tablet Edition          |
| 15.1 in. XGA active matrix screen |

### EO Eluent Organizer

The EO Eluent Organizer holds eluent containers in a liner for spill and leak containment. The EO holds and organizes eluent tubing and air lines. The EO is designed for placement on top of or adjacent to ICS-3000 modules.

### EO Features

- The flexible design of the EO Eluent Organizer accommodates:
  - Four 1- or 2-L plastic containers
  - Two 5-L plastic containers
- Up to two EO eluent organizers stack on top of the DC module.
- Translucent liner contains spills and allows view of liquid levels
- Constructed of corrosion-proof polypropylene and epoxy
- Pressure regulator option is available

### ELUENT CONTAINERS

#### Features

- Available in 1-, 2-, and 5-L sizes constructed from polypropylene
- Non-twist stopper with separate retaining ring prevents tubing from tangling
- Graduations marked on containers in 100-mL increments
- Includes custom-molded polyethylene end-line filters with 5- $\mu$ m pores



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