



Automated process monitoring for lower costs and higher yields

Dionex Integral Process Analytical Systems

Optimize your process operations by improving process monitoring

All industrial processes have a common need—**reliable, accurate, and timely** methods for analyzing process chemistry. Continuous monitoring with on-line liquid chromatography (LC) lets you detect process variations earlier than laboratory-based measurements—long before yield is impacted or costly process shutdowns become necessary. By improving process monitoring capabilities, you can fine-tune the process chemistry to maximize efficiency and reduce operating costs. The result? Increased returns on investment and improved profitability.

On-line liquid chromatography-based techniques such as Reagent-Free™ IC (RFIC™) or high performance liquid chromatography (HPLC) systems have several advantages over other process analytical technologies:

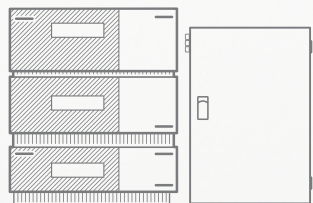
- Multi-component analysis provides more information than single component or bulk property analyses
- Chromatographic separations enable measurement of specific analytes in highly complex matrices
- Unique detection capabilities provide unparalleled detection limits, enabling trace component measurement
- Chromatographic quantification is typically more robust than spectroscopic-based techniques

Since 1984, Thermo Scientific™ Dionex™ has been providing liquid chromatography-based process analytical technology (PAT) to help customers optimize process operations by improving process monitoring. On-line LC process analyzers have enabled critical analytes to be measured in multiple process operations in the following fields:

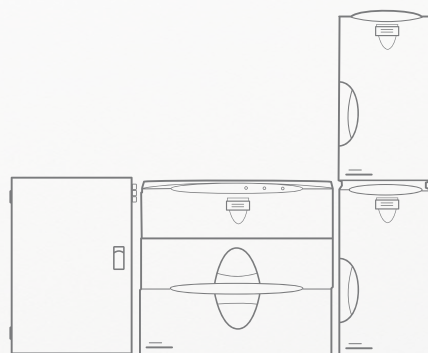
- Pharmaceutical production—reaction intermediates and final products
- Semiconductor manufacturing—contaminant ions in ultrapure water
- Power plants—corrosive ions and additives in coolant and boiler water
- Environmental—contaminants in surface and ground water
- Bioreactors—metabolites and nutrients
- Chemical manufacturing—organic acids and amines
- Industrial waste—metals and organics in plant waste streams
- Food and beverage production—additives and final products
- Plating processes—components, additives, and contaminants in plating baths

A modular system to fit your needs

The Thermo Scientific™ Dionex™ Integral™ Process Analytical System brings the power of industry-leading liquid chromatography instrumentation to process analysis applications, including PAT. The Dionex Integral system provides cost-effective, flexible solutions to apply on-line ion chromatography/high performance liquid chromatography (IC/HPLC) to applications in a controlled environment, such as a laboratory, or in the challenging environment of an industrial site. No matter what the application, the Dionex Integral system has a configuration for on-line IC/HPLC wherever and whenever it's needed.

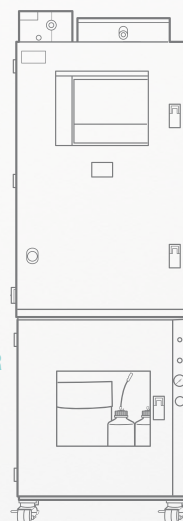


Lab scale



Pilot plant scale

OR



Manufacturing scale

Integral Migration Path

The Thermo Scientific™ Dionex™ Integral™ Migration Path™ enables you to use on-line liquid chromatography to generate timely, high-resolution information when monitoring a small-scale reactor in a process research and development (R&D) lab, testing the production of tomorrow's new product in a pilot plant, or improving current processes in a manufacturing plant.

This flexibility provides several advantages:

- More time to determine the benefits: Develop analytical methods and process parameters before committing to installing the technology in manufacturing
- Lower regulatory risk: Explore this technology in the pharmaceutical process R&D phase when Good Manufacturing Practices (GMPs) are less restrictive
- Cost effective: Add modules and the industrial enclosure only when needed
- Increased versatility: Convert your lab-based, on-line IC/HPLC to a conventional lab IC/HPLC system for grab sample analysis

Integrate development and production

From bench top to production floor

Sample modules travel with your process

The Dionex Integral system achieves flexibility by separating sample stream selection and sample preparation functions into stand-alone modules controlled by Thermo Scientific™ Chromeleon™ 7 Process Analyzer (PA) software. These modules serve as automated interfaces between your process and your Thermo Scientific analytical systems. The Thermo Scientific™ Stream Selector (SS) module allows you to reduce your financial investment by using one Dionex Integral on-line IC/HPLC system to monitor up to 21 sample streams. The Thermo Scientific™ Sample Preparer (SP) module provides the functionality to automatically:

- Deliver samples or standards to the on-line analyzer
- Add reagents and diluents to process samples or standards
- Capture and concentrate analytes on selective resins
- Generate multi-point calibration curves

Highly customizable systems for the lab and plant

Sample analysis is performed using IC (Thermo Scientific™ Dionex™ Integrion™, Thermo Scientific™ Dionex™ ICS-6000) or HPLC (Thermo Scientific™ UltiMate™ 3000) instrumentation. These instruments are designed to meet your on-line analysis needs:

- RFIC systems for consistency and ease-of-use
- Modular HPLC and IC systems for flexibility and adaptability
- High flow-rate, high-pressure UHPLC or high-pressure IC (HPIC) separations for faster results and higher throughput
- Single channel or dual channel systems for higher throughput or increased information per sample
- Isocratic and binary or quaternary gradient systems for high method flexibility
- Multiple detector options including conductivity, electrochemical, UV-Vis (variable wavelength, multi-wavelength, and diode array), fluorescence, evaporative light scattering detector (ELSD), and refractive index (RI) to cover all analyte classes

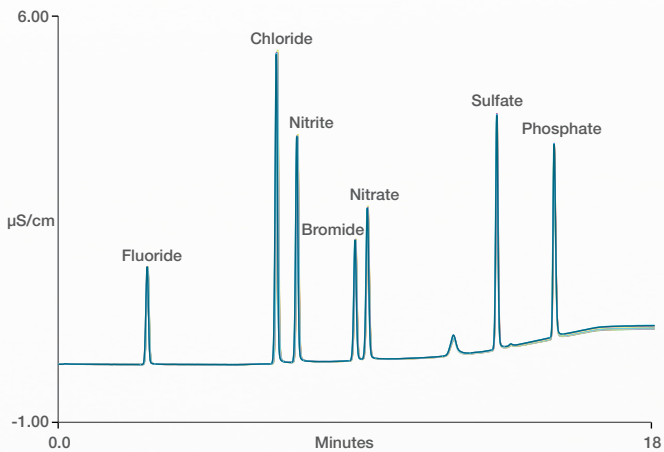


Integrion HPIC system

ICS-6000 system

Ultimate 3000 system

SP module



Overlay of 30 injections of a 200–2,000 ppm anion stock standard diluted 1:1000 using the SP module. Peak Area RSDs <0.5%

When you're ready to apply on-line IC/HPLC technology in the plant, add the optional Thermo Scientific™ Analyzer Enclosure (AE) module and/or Thermo Scientific™ Liquids Enclosure (LE) module:

- Stainless steel construction to protect the instrumentation from the plant environment
- Onboard PC, LCD display, and touchpad mouse controller
- Designed to accommodate single- or dual-channel systems
- Optional air conditioning unit for ambient temperatures above 35 °C
- Easy access to instrumentation for maintenance
- Purge controller options for installation in NEC Class 1, Division 1 (EU Zone 1) and Class 1 Division 2 (Zone 2) explosion hazard areas



IC system in an AE module with an externally mounted SP module on top of an LE module



SS module

New Thermo Scientific Chromeleon 7 Process Analyzer software

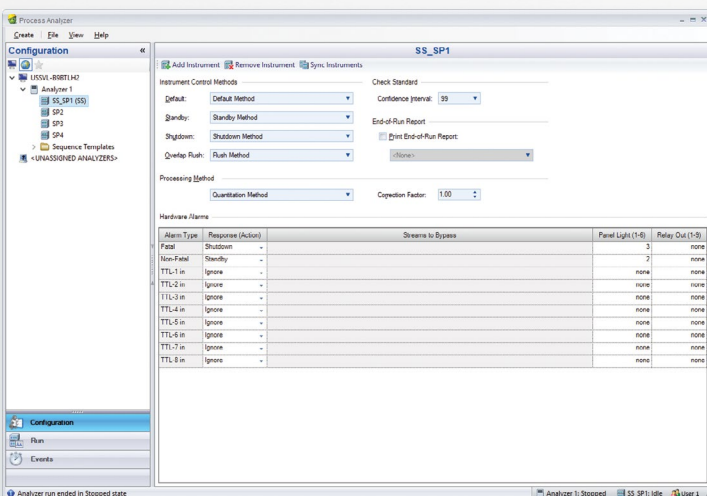
Enabling automated analysis and real-time alerts

Now running on Microsoft™ Windows™ 10, Chromeleon 7 PA software provides configuration and control, as well as data acquisition, processing, and reporting for the Dionex Integral system. It has a versatile software interface for viewing analyzer status, handling alarms, reporting results, and interfacing with plant data acquisition, automation, and control systems using industry standard OPC communications. Chromeleon 7 PA software has a complete suite of tools to comply with regulatory requirements like 21 CFR Part 11, an important requirement for United States Food and Drug Administration (US FDA) regulated industries.

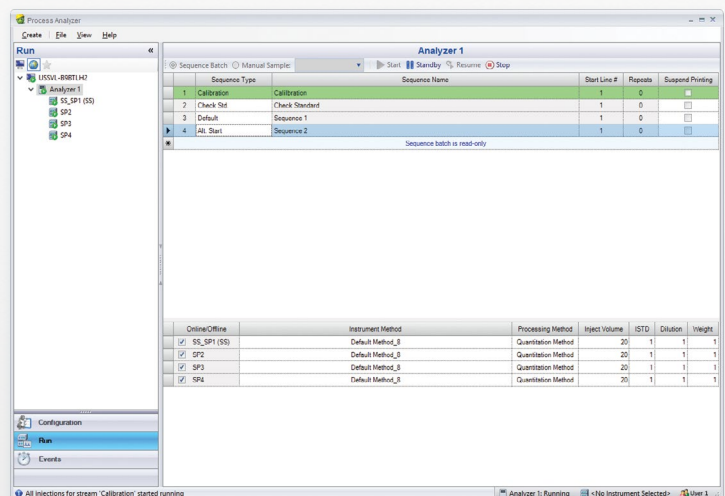
When used with Dionex Integral sample preparation modules, Chromeleon 7 PA saves you time and money by accurately monitoring industrial processes to identify contaminants that impact quality or system integrity—sending real-time alerts when contaminants reach unacceptable levels. With this knowledge, you can react quickly to prevent damage to facilities, reduce product failure, and boost yield. Better yet, Chromeleon 7 PA orchestrates reliable, precise, and integrated control over the entire sample and analysis process—enabling unattended, 24/7 analyzer operation.

Analyzer control

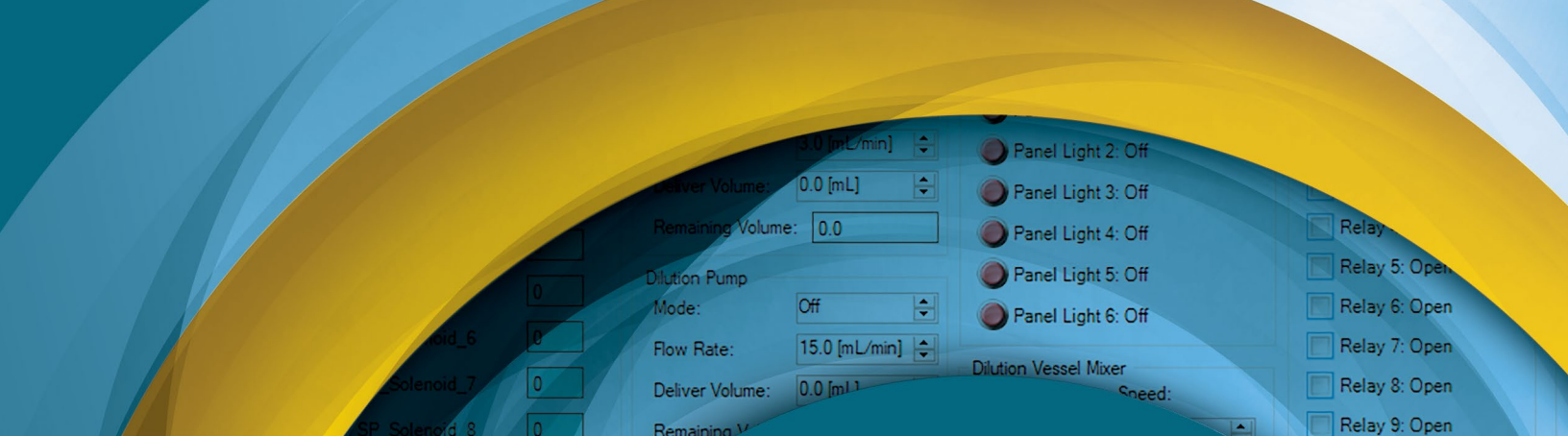
- Controlled analyzer access based on comprehensive user management tools
- Programmable sample stream sequencing and analysis frequency
- Complete control and status of all analyzer components
- Automatic alarm handling using preprogrammed conditional responses including changing stream sequences, analysis frequency, and methods
- Automatic scheduling of system suitability samples, check standards, and calibrations
- Synchronized operation of multi-channel analyzer systems



Analyzer configuration



Analyzer sequence run



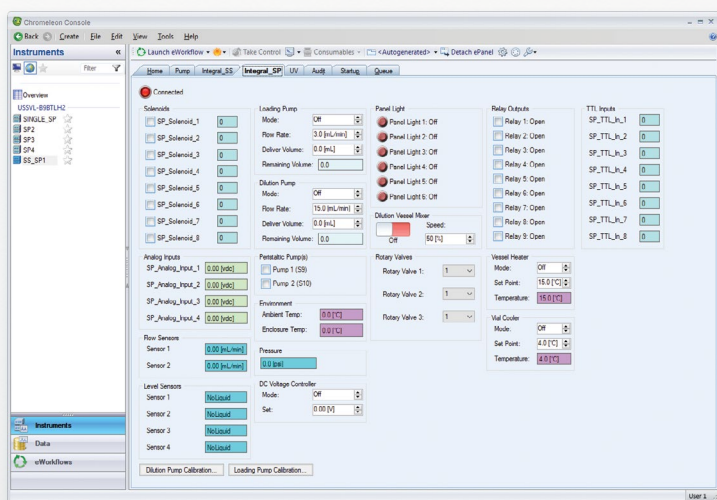
Comprehensive information retrieval and industrial connectivity

- Real-time display of analyzer status and critical component parameters
- Notification of result-based events, hardware alarms, and options for response actions
- Audit trail log showing date, time, and actions being taken by the analyzer
- Hard copy and/or electronic reports with user-defined content and reporting frequency

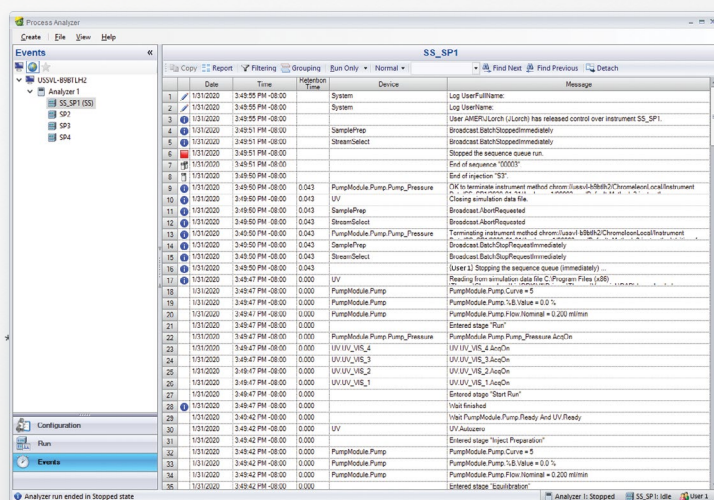
Share analyzer information with external data acquisition, automation and control systems

Export data using simple text files or use the optional OPC. The OPC Server provides bidirectional communications for:

- Sharing results with external OPC compliant systems to enable decisions using the on-line IC/HPLC results
- External control of the analyzer, e.g., start/stop, system suitability checks, and calibrations
- Communication of analyzer status with external control systems



Sample preparation control



Audit trail

Complete solutions for your process analytical needs

Timely and accurate analytical information, versatile sampling modules and enclosure systems, and powerful automation capabilities from Thermo Scientific all work together to provide what you need for your process analytics, wherever and whenever you need it.

When it's time to implement your choice of solutions from the Integral Migration Path, we are committed to providing total satisfaction through after-sales service, on-site training, system qualification services, and a broad range of products for your process analytical applications. With over 35 years of experience in process analytical liquid chromatography, we know how to install and maintain process systems for optimal performance and maximum uptime. We do more than install your system; we ensure it will provide quality solutions for your analytical challenges.

Dionex Customer Support Centers are located in the United States, Europe, and Asia. These state-of-the-art laboratories are equipped with the full line of Dionex IC and HPLC instrumentation and software capabilities. Support Centers provide accessible locations for advanced training and enhanced application development capabilities. Users can attend these laboratories to learn new skills in addressing challenging applications, receive training and support, and discover new, innovative HPLC and IC solutions.

Find out more at thermofisher.com/processanalytical