UltiMate 3000 Rapid Separation LC System

The UltiMate® 3000 Rapid Separation LC (RSLC) system provides ultrafast, ultrahigh resolution LC separations using high flow rates for increased throughput. Its unique combination of extensive pressure range, high flow rates, and ultrafast data collection facilitates high peak capacity in the shortest run times. Even separations of 10 peaks in 10 seconds are easily achieved. The system is ideal for high speed and high resolution chromatography. Precision-engineered parts and robust operation maximize reliability and instrument uptime. Acclaim® RSLC columns feature small particle sizes for efficiently resolving peaks, optimizing fast LC applications.

System Features
- Ultrahigh performance with both UHPLC and conventional LC methods
- Flow rates up to 5 mL/min at pressures up to 800 bar (11,600 psi)
- Injection cycle times of 15 s
- Temperature range of 5 to 110 °C
- Data collection rate of 100 Hz for all UV-Vis detectors (VWD, MWD, DAD)

- Automatic instrument monitoring uses advanced system wellness features with Chromeleon® Chromatography Management System
- Automatic IQ/OQ/PQ via Chromeleon
- Increased system uptime with easy-to-use diagnostic features

DIONEX

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HPG-3x00RS RSLC Pump

The HPG-3x00RS Rapid Separation binary pump works at ultrahigh back-pressures and flows of up to 5 mL/min. It is designed for high speed, high resolution applications and also delivers high performance for conventional applications. An easy to install micro configuration kit allows quick conversion to a micro pump. The RS pump is the best choice for separating all your peaks in the shortest time.

HPG3x00RS Features

- Unique SmartFlow® technology automatically compensates for changing eluent compressibility and autocorrects compression-related flow anomalies
- Pressures up to 80 MPa (11,600 psi) over the entire flow rate range up to 5 mL/min
- Fast separations, with gradient delay volumes of less than 400 µL for the analytical scale and 50 µL for the micro version
- Active rear-seal wash for maximum seal lifetime, and reduced instrument down time
- Floating piston design for increased life time of piston seals
- Mixer extensions for complete mixing of poorly miscible solvents
- Precise retention times ensured by the most precise gradient and flow delivery with binary high-pressure gradient mixing
- Improved robustness and lifetime through precision engineered mechanics
- Quiet operation for improved laboratory working environment

Figure 1. The HPG-3x00RS pump supports ultrahigh backpressures of 800 bar across the full flow rate range up to 5 mL/min.
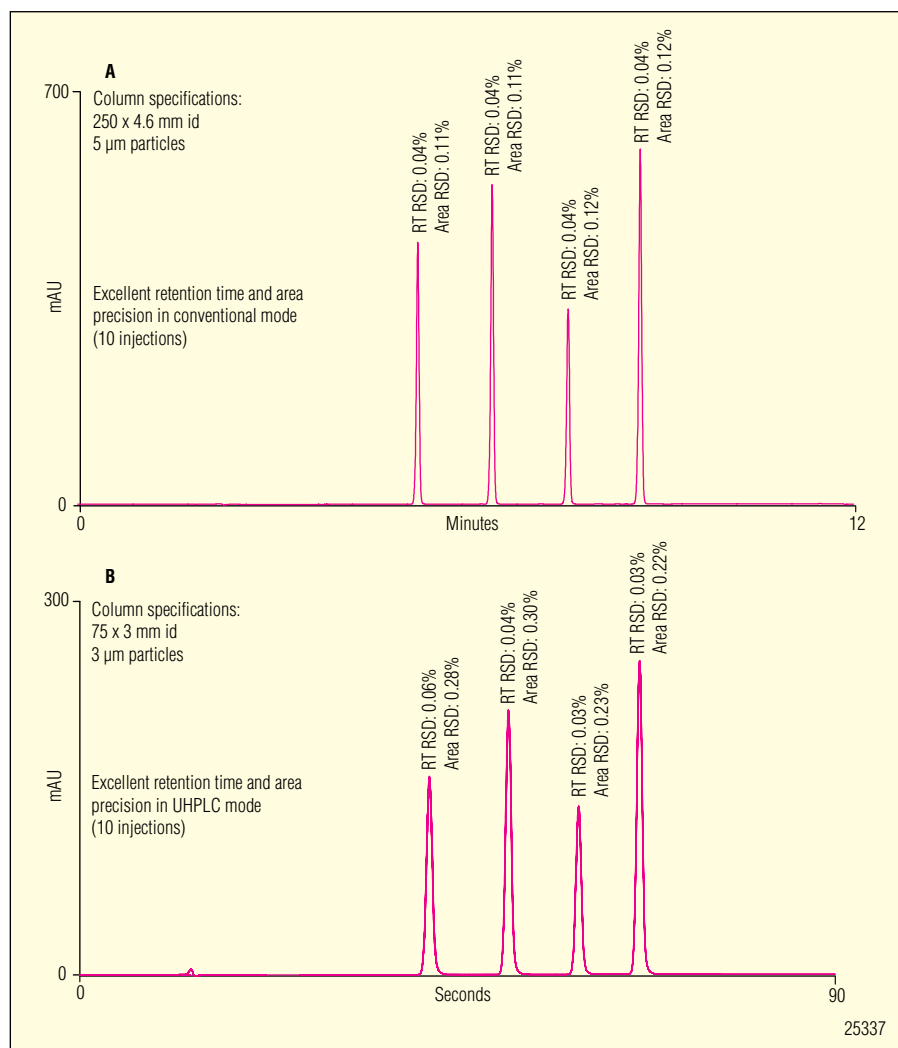

Figure 2. The HPG-3x00RS pump provides excellent retention time precision. For the two-gradient applications above, the average RT RSD is 0.4% for both conventional LC (A) and UHPLC (B) mode.
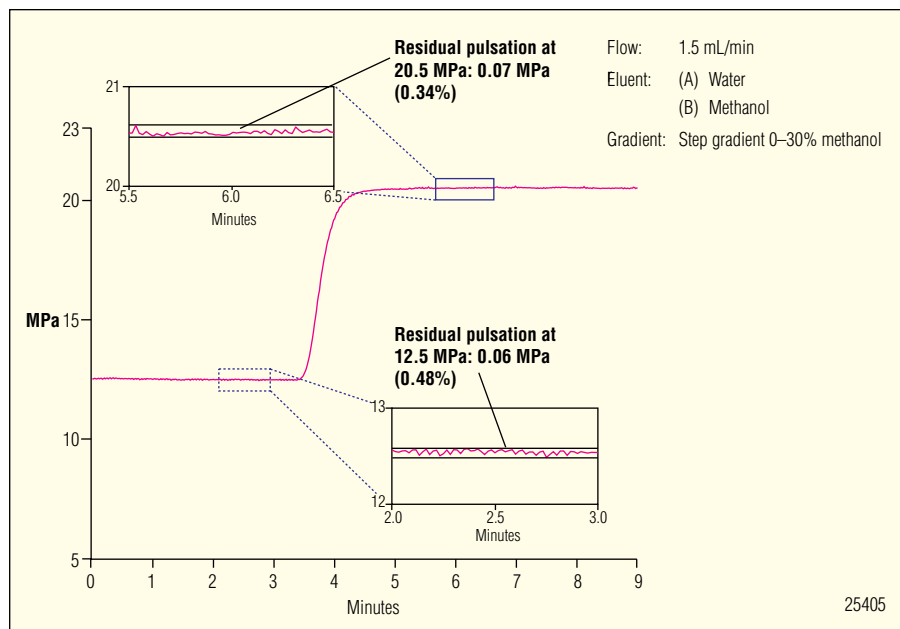
2

Figure 3. Pressure diagram of a 0–30% methanol step gradient. SmartFlow pump mechanism compensates for the effect of changing eluent compressability and system pressure to provide virtually pulse-free eluent delivery. Note that pressure pulsation remains constant at a very low level of 0.06–0.07 MPa (9–10 psi).

KEY SPECIFICATIONS

Operating Principle:

Serial dual-piston; high pressure gradient proportioning

Flow Rate Range:

0–5,000 µL/min (recommended 100–5,000 µL/min)

Flow Rate Accuracy:

+/–0.1% at 1 mL/min and 400 bar

Flow Rate Precision:

<0.1% RSD at 1 mL/min and 400 bar

Pressure Range:

2–80 MPa (11,600 psi)

Pressure Ripple:

Typically <1% or <2 bar whichever is greater

Proportioning Accuracy:

+/–0.2%

Proportioning Precision:

Typically <0.15% RSD

Number of Eluent Lines:

Two (four with optional solvent selector valves)

Gradient Delay Volume:

<50 µL with capillary mixer (recommended for MS)
100 µL (micro)
200 µL (semi-micro)
400 µL (analytical)

Solvent Degassing:

External (optional)

Dimensions (h x w x d):

14.7 x 42 x 51 cm (5.8 x 16.5 x 20 in.)

Power Requirements:

100–120 V, 60 Hz; 200–240 V, 50 Hz

PC Connection:

USB; USB hub with three sockets integrated

I/O Interfaces:

Two relays for output
Two digital inputs for start/stop and hold

Addtional Communication Port:

15 pin d-sub connector for solvent rack/degasser

WPS-3000RS Autosampler

The WPS-3000RS analytical auto-sampler uses the in-line split-loop injection principle, using the needle and sample loop as integral parts of the high-pressure fluidic path. This injection principle provides highly accurate and precise delivery of the sample with ultralow carryover.

WPS-3000RS Features

- Superior results with peak area precision typically less than 0.07% for a 10 μL injection
- Excellent injector linearity ($r^2 = 0.99999$) with a high-precision drive mechanism and in-line split loop injection
- Patented rotor seal design for increased lifetime at high pressures
- Cycle times of only 15 seconds
- Support of a multitude of common vial and wellplate formats
- Consistent results when transferring a method from one UltiMate 3000RS autosampler to another (accuracy typically better than ±0.5% at 20, 50, and 90 μL with a 100-μL syringe)
- Sample thermostatting for optimal protection of your temperature sensitive analytes (4–45 °C with a ±2 °C accuracy)
- Peristaltic pump automatically removes water that may accumulate during condensation when using sample cooling
- Injection volume range of 0.001–100 μL for ultrafast LC and conventional LC applications
- Easy injection volume extention to 2500 μL for added flexibility

Figure 4. Dionex WPS-3000RS autosampler is designed to support fast cycle times and precise injection volumes, and pressures up to 800 bar.
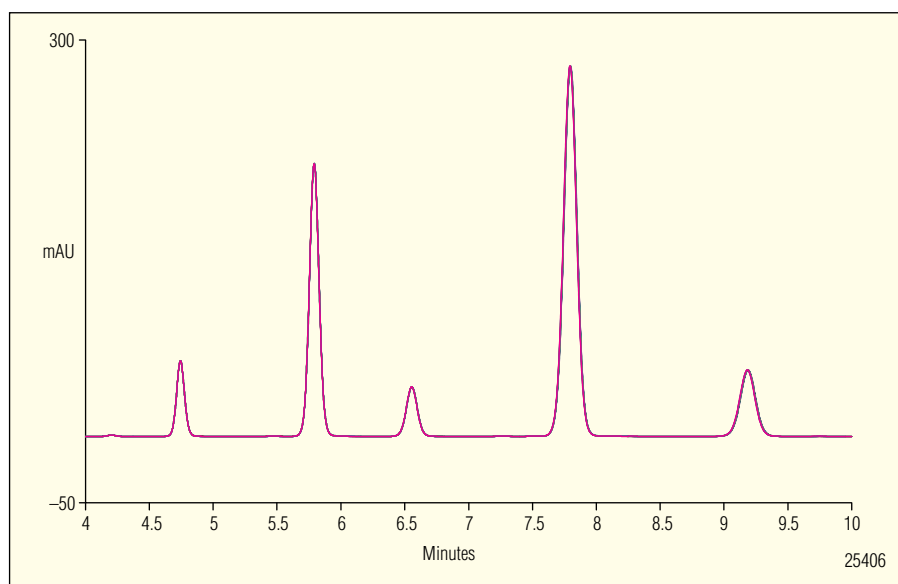

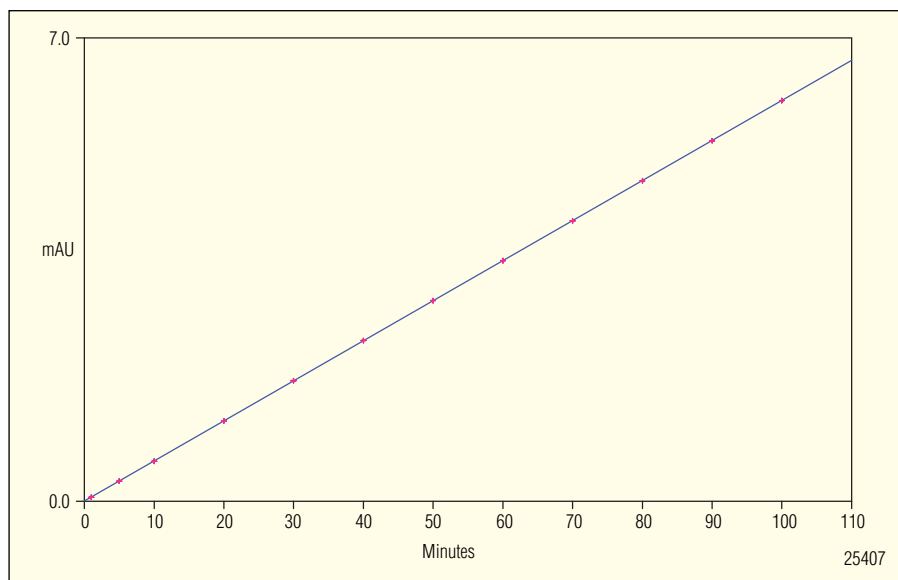Figure 5. Typical peak area precision <0.07% for ten consecutive 10 μL injections.

Figure 6. Correlation coefficient of 0.999998 (three replicates per level) demonstrates the superior linearity of the WPS-3000RS.

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Figure 7. The WPS-3000RS works with a multitude of different sample formats, supporting a maximum of 1167 samples.
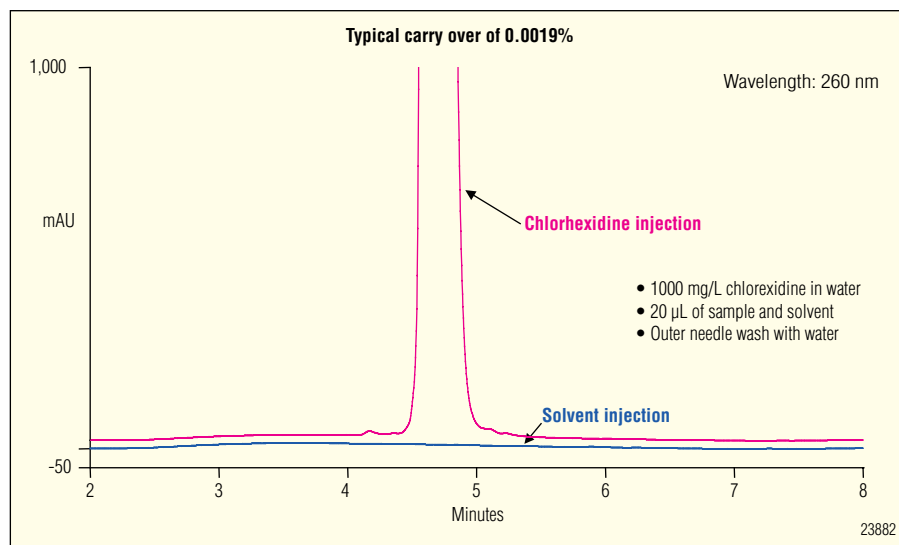

Figure 8. The in-line split-loop design of the autosampler provides very low carryover. This figure shows carryover of less than 0.02% for chlorhexidine, a notoriously sticky substance.

KEY SPECIFICATIONS

Injection Volume Range (Settable):
    0.001–100 µL (2500 µL option available)

Injection Volume Accuracy:
    +/- 0.5% at 20 µL

Minimum Sample Required:
    1 µL out of 5 µL

Injection Volume Precision:
    < 0.25% RSD at 5 µL (typically < 0.15% RSD)

Linearity:
    Corr. Coeff. > 0.9999, RSD < 0.5% at 5–90 µL

Needle Wash:
    Active external

Carryover:
    < 0.005% for caffeine with external wash (at 200 bar)

Injection Cycle Time:
    < 15 s for 5 µL

Optional Sample Thermostatting:
    4–45 °C or 22 °C below ambient

Sample Temperature Accuracy:
    +/- 2 °C

Power Requirements:
    100–120 V, 60 Hz
    200–240 V, 50 Hz

Dimensions (h x w x d):
    40 x 42 x 51 cm (16 x 16.5 x 20 in.)

PC Connection:
    USB

I/O Interfaces:
    Four digital inputs and four programmable outputs

TCC-3000RS Column Compartment

Delivering a temperature range of 5–110 °C and offering eluent precolumn heaters, postcolumn coolers, and a variety of switching valves, the TCC-3000RS column compartment provides the full functionality required for fast, high resolution, and conventional chromatography. Large-area Peltier elements in combination with a forced-air design ensure efficient cooling and heating as well as homogenous and stable conditions inside the compartment.

TCC-3000RS Features

- Wide temperature range: 5–110 °C for reliable separations at elevated, ambient, and subambient temperatures
- Low-dispersion eluent precolumn heater for better peak shapes especially at elevated column temperatures
- Low-dispersion postcolumn eluent cooler for decreased baseline noise at elevated temperatures
- Homogeneous temperature distribution provided by forced-air design
- Capacity for up to six columns with max. 30 cm length to facilitate automated method development
- Short equilibration times, temperature step gradients, and fast changes between methods with different temperatures
- Column identification system for automatic documentation of important column variables for regulatory compliance
- Sensors for humidity and organic vapor with rapid leak detection ensures operational safety
- Holds up to two, 2-position, 6- or 10-port valves for advanced column switching techniques

Figure 9. The TCC-3000RS column compartment provides a temperature range of 5–110 °C, ensuring maximum application flexibility.

Temp. Stability °C = +/–0.3 °C
Oven Temp. °C   = 18.1 °C

Ambient Temp. °C
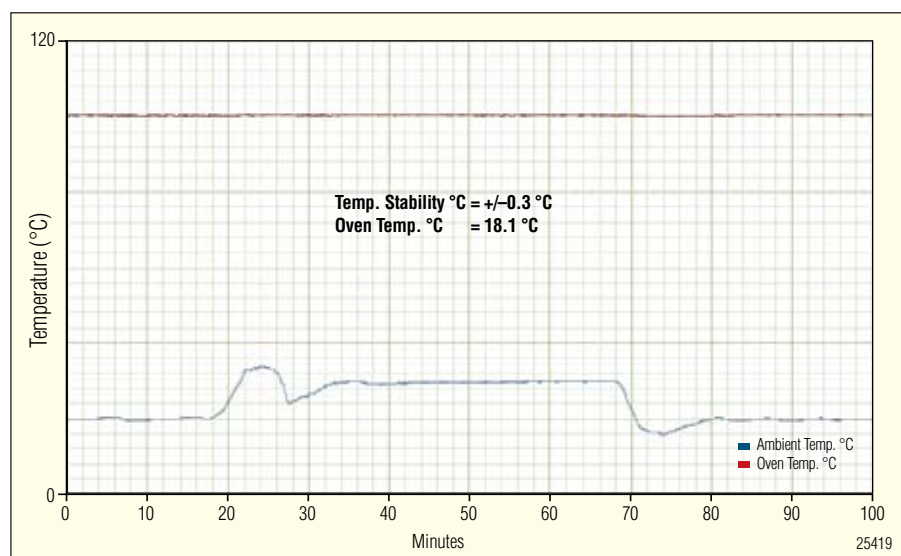Oven Temp. °C

Minutes

25419

Figure 10. Column temperature remains stable even when the ambient temperature fluctuates significantly. This leads to stable retention times and reliable peak identification. In this example the set column oven temperature of 100 °C changes only by +/- 0.3 °C despite an ambient temperature change of 18 °C.
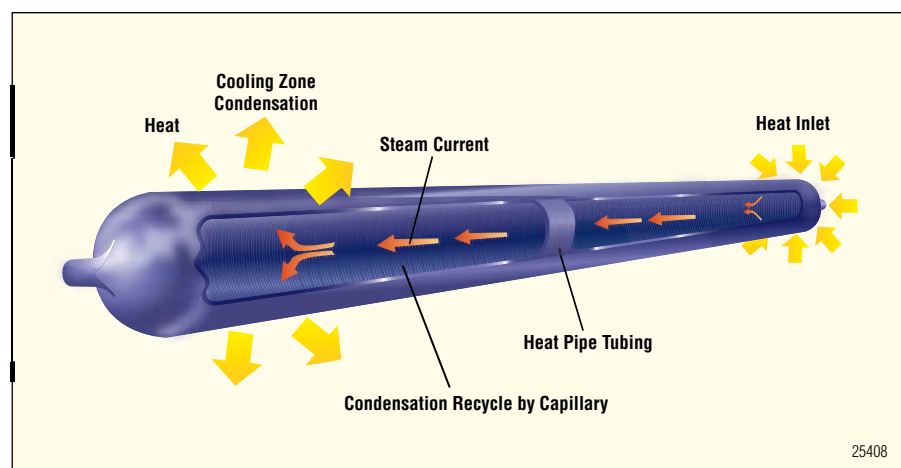

Cooling Zone Condensation

Heat

Steam Current

Heat Inlet

Heat Pipe Tubing

Condensation Recycle by Capillary

25408

Figure 11. The postcolumn eluent cooler uses an advanced heat-pipe design to ensure the highest efficiency.

Figure 12. An extensive range of user installable valve options support advanced column switching techniques.
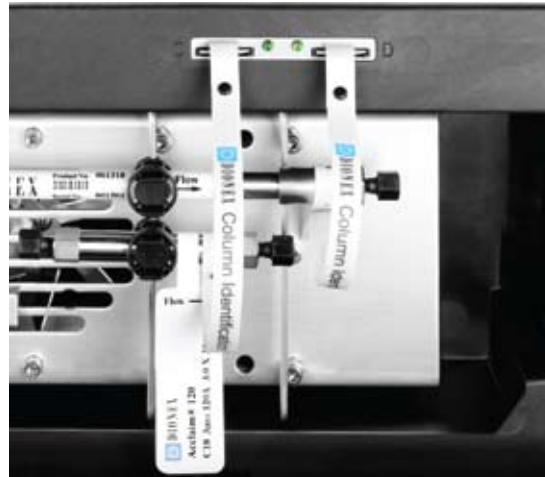

Figure 13. The column identification system enables automatic documentation of important column parameters for regulatory compliance and improved laboratory management.

KEY SPECIFICATIONS

Temperature Range:

   5 –110 °C (maximum 18 °C below ambient)

Temperature Accuracy:

   ±0.5 °C

Temperature Stability:

   +/- 0.1 °C

Temperature Precision:

   +/- 0.1 °C

Column Capacity:

   Six columns; maximum 30 cm

Heatup/Cooldown Time:

   Typically 12 min from 20 to 50 °C
   Typically 15 min from 50 to 20 °C

Switching Valves:

   Up to two 2-position, 6- or 10-port valves

Postcolumn Eluent Cooler:

   Active Temperature Control

Dimensions (h x w x d):

   18 x 42 x 51 cm (7.1 x 16.5 x 20 in.)

Power Requirements:

   100–120 V, 60 Hz;
   200–240 V, 50 Hz

PC Connection:

   USB

Inputs/Outputs:

   Two digital inputs
   Two relay outputs

GLP:

   Dionex AutoQ routines for instrument qualification
   Column identification system for up to four columns

RSLC Detectors

The UltiMate 3000RS UV detectors family consists of a Diode Array Detector, a Multiple Wavelength Detector, and a Variable Wavelength Detector. The DAD-3000RS is a high-resolution, 1024 element photodiode array detector with 1 nm resolution. It features noise and drift performance previously available only in forward optic detectors.

DAD-3000RS Features

- Deuterium and tungsten lamps for low baseline noise, high signal intensity, and application flexibility in the wavelength range from 190 nm to 800 nm
- Baseline noise of less than ± 10 µAU (254 nm, standard flow cell, 1 mL/min, HPLC grade water—typical values less than ± 7 µAU)
- Superior spectral resolution with 1024-element photodiode array
- Up to eight channels of single-wavelength data available together with 3-D data.
- Optimized optical bench design ensures high resolution and signal intensity
- Up to 100 Hz data collection rate even when scanning full wavelength range.
- Excellent linearity up to 1.5 AU
- Flow cells (biocompatible design available) for micro and analytical flow rate applications
- Flow cell and lamp changes automatically recognized and logged

VWD-3400RS Series Features

- Outstanding linearity (correlation coefficient higher than 0.9997) over a wide absorbance range (up to 2.5 AU in the UV range)
- Baseline noise of less than ± 3.5 µAU (254 nm, standard flow cell, 1 mL/min HPLC grade water—typical values are around ± 2.5 µAU)
- Baseline drift below 0.1 mAU/h with dedicated reference wavelength photodiode and active lamp house temperature control
- Data collection rate up to 100 Hz in single wavelength mode
- Wavelength range of 190–900 nm with combined use of deuterium and tungsten lamp on one optical axis
- Fast switching second-order filter for multiwavelength operation in UV and visible range in the same chromatographic run
- Lamps and flow cells exchangeable from the detector front in two minutes without special tools
- Flow cell and lamp changes automatically recognized and logged

Figure 14. Dionex DAD-3000RS Diode Array detector is designed to support 100 Hz data collection rates with a wavelength range of 190–800 nm.
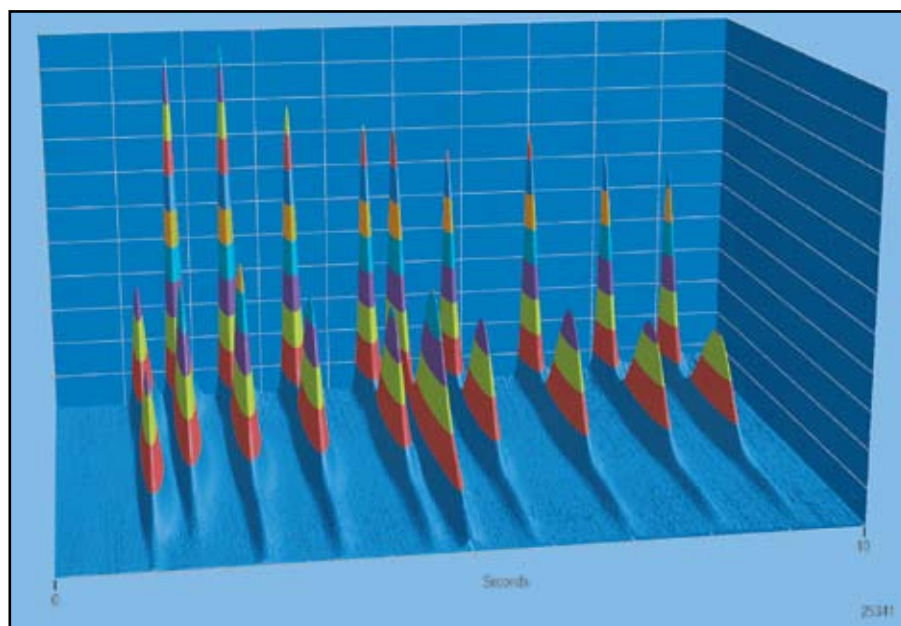

Figure 15. Supporting data collection rates up to 100 Hz, with full wavelength scans, the DAD-3000RS can reliably detect the narrowest peaks. Even 10 s separations are no problem for this high-end detector.
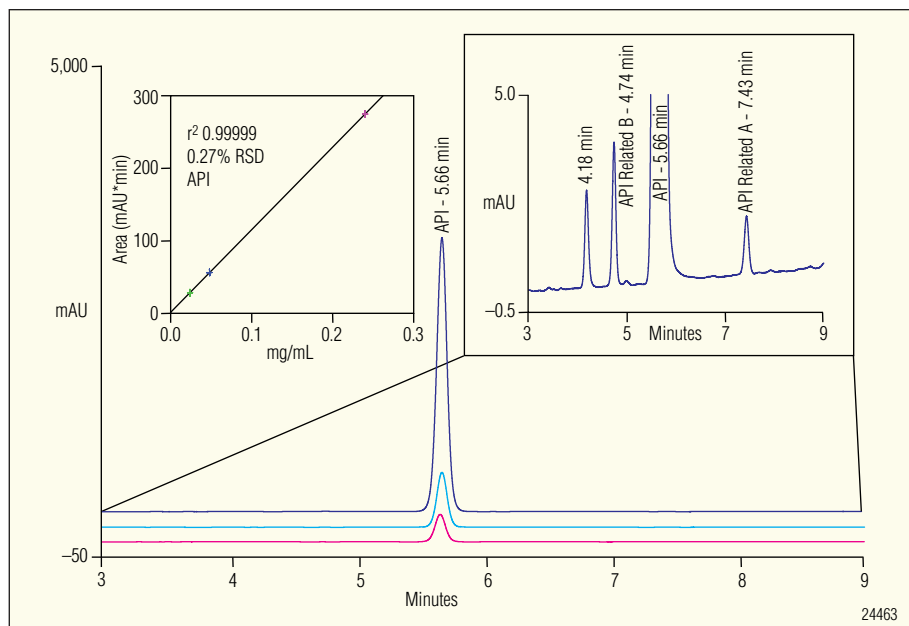
Figure 16. The above example of a pharmaceutical assay shows the outstanding linearity of the detector with absorbance values up to 3000 mAU for the active ingredient (API).

DETECTOR SPECIFICATIONS		
Specification	**DAD/MWD-3000RS**	**VWD-3400RS**
Data Collection	100 Hz even when running full spectral scan (DAD-3000RS)	100 Hz
Maximum number of channels	Eight	Four
Optical System	Single-beam, reverse-optics design with concave holographic grating	Forward optics
Photodiode Array	1024-element	n.a.
Lamps	Deuterium lamp (30 W) for ultraviolet spectrum analysis Tungsten lamp (5 W) for visible spectrum analysis	Deuterium lamp, tungsten lamp Temperature control for both lamps
Pixel Resolution	< 1 nm	n.a.
Wavelength Range	190–800 nm	190–900 nm
Noise	$<\pm$ 10 µAU (typically $<\pm$ 7 µAU) at 254 nm and wet analytical flow cell; Rise time: 2 s, 4 nm bandwidth, flowing water at 1.0 mL/min.	Single Wavelength $<\pm$ 3.5 µAU (typically $<\pm$ 2.5 µAU) at 254 nm and dry analytical flow cell Time constant: 1 s, only deuterium lamp turned on $<\pm$ 5 µAU (typically) at 254 nm and wet analytical flow cell; Time constant: 1 s, only deuterium lamp turned on, flowing HPLC grade methanol at 1.0 mL/min
Drift (after warm up)	$< 1 \times 10^{-3}$ AU/h (typically $< 0.5 \times 10^{-3}$ AU/h) at 254 nm and 520 nm. Measured with wet analytical flow cell (flowing water at 1.0 mL/min), constant ambient conditions (temperature, humidity)	$< 1 \times 10^{-4}$ AU/h at 254 nm and dry analytical flow cell, only deuterium lamp turned on, constant ambient conditions (temperature, humidity) Typically $< 1 \times 10^{-4}$ AU/h at 520 nm and dry analytical flow cell, only tungsten lamp turned on, constant ambient conditions (temperature, humidity)
Linearity	< 3% RSD and Corr. Coeff. > 0.9995 up to 1.5 AU; Typically < 2.5% RSD and Corr. Coeff. > 0.999 up to 1 .8 AU	< 5% RSD at 2.5 AU wavelength: 272 nm based on ASTM < 5% RSD at 2.5 AU wavelength: 520 nm based on ASTM

Software and Columns

The UltiMate 3000 RSLC system is supported by a state-of-the-art chromatography management system and high efficiency columns. Separations are faster than before and data handling is a seamless and easy process.

Chromeleon Features

- Intuitive graphical control of system ensures ease of use.
- Monitor and control the system from remote PCs.
- Automated SmartStartup routines can start up and equilibrate your system before you get to the lab, maximizing your utilization of the system.
- Automated SmartShutdown routines conserve solvents and prolong lamp lifetime.
- Advanced wellness monitoring counters automatically inform the operator if a part requires changing.
- AutoQ™ qualification routines fully automate the system IQ/OQ and can have the system ready for use in as little as six hours.
- Smart column switching wizards make even the most complex chromatographic processes easy to use.
- Easy-to-use diagnostic tests allow users to assess instrument performance and help with troubleshooting.
- Advanced data handling features reduce data processing times by as much as 90%.
- Report templates instantly calculate results for method validation, related substances, EPA statistics, dissolution testing, content uniformity, and more.
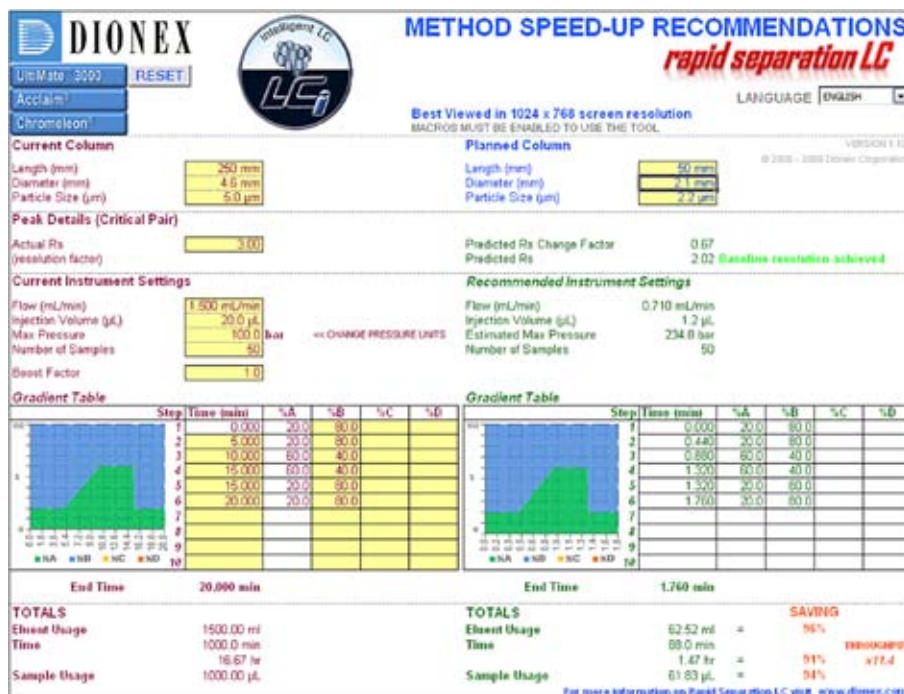

Figure 17. Method speed-up calculator instantly converts conventional LC methods to UHPLC methods.
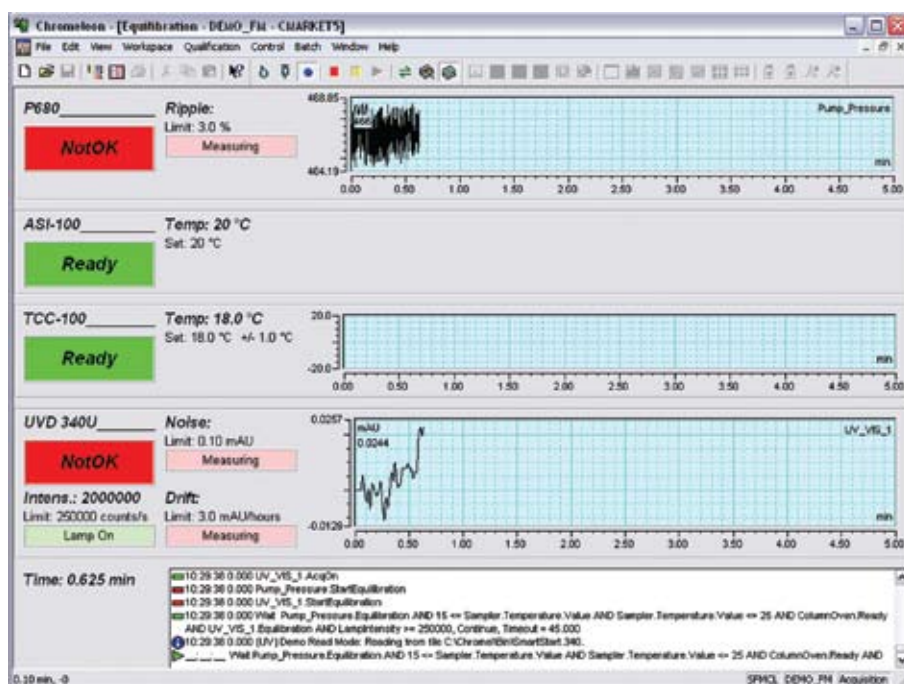

Figure 18. Chromeleon SmartStartup automatically starts the system, then equilibrates it against predefined limits such as pressure ripple and detector noise and drift.
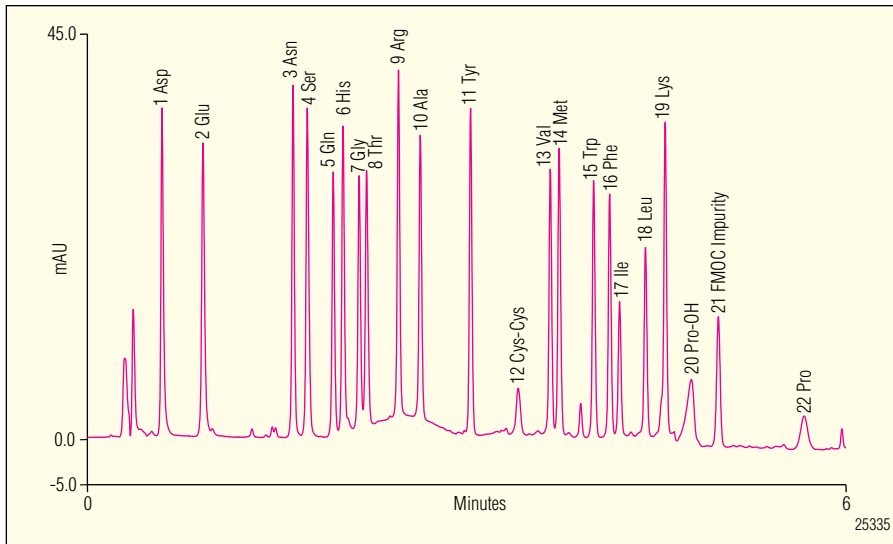
Figure 18. Baseline separation of 21 amino acids in 6 min on the Acclaim RSLC 2 µm column.

Column Features

- Stationary phases of 2 µm and 3 µm for ultrafast, ultrahigh resolution chromatography
- Small particle size distribution provides lower back pressures and excellent separation efficiencies
- Maximum reliability with 800 bar pressure limit to match pump performance reliability
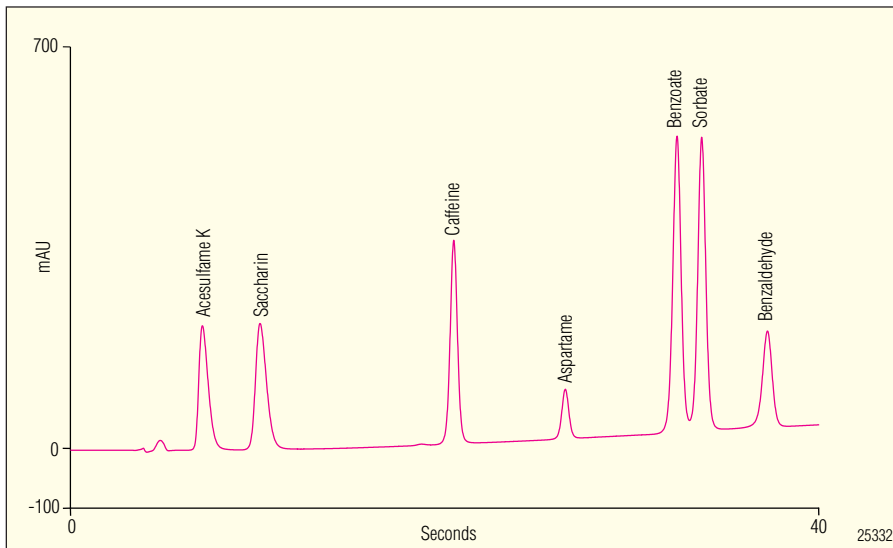

Figure 19. Analysis of seven key compounds in soft drinks in less than 40 seconds on the Acclaim RSLC 2 µm column.

Figure 20. Acclaim RSLC 2 µm columns achieve high-throughput separations without sacrificing chromatographic performance.

ORDERING INFORMATION

In the U.S., call 1-800-346-6390, or contact the Dionex Regional Office nearest you. Outside the U.S., order through your local Dionex office or distributor. Refer to the following part numbers:

Product Description	Part Number
SRD-3200 (solvent rack with two degasser channels)	5035.9250
SRD-3400 (solvent rack with four degasser channels)	5035.9245
SRD-3600 (solvent rack with six degasser channels)	5035.9230
HPG-3200RS rapid separation binary analytical pump	5040.0026
HPG-3400RS rapid separation binary analytical pump with solvent selector	5040.0046
WPS-3000RS rapid separation in-line split-loop wellplate autosampler	5840.0010
WPS-3000TRS rapid separation in-line split-loop wellplate autosampler with sample thermostatting	5840.0020
TCC-3000RS rapid separation thermostatted column compartment	5730.0000
DAD-3000RS rapid separation diode array detector	5082.0020
MWD-3000RS rapid separation multiple wavelength detector	5082.0040
Analytical flow cell, 13 µL, 10 mm, SST (DAD/MWD-3000RS)	6082.0100
Semimicro flow cell, 2.5 µL, 7 mm, SST (DAD/MWD-3000RS)	6082.0300
VWD-3400RS variable wavelength detector	5074.0010
Analytical flow cell, 11 µL, 10 mm, SST (VWD-3400RS)	6074.0250
Semimicro flow cell, 2.5 µL, 7 mm, SST (VWD-3400-3000RS)	6074.0360

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