

detectors

UltiMate 3000 Variable Wavelength Detectors



UHPLC⁺
focused

Dionex products are UHPLC compatible by design, establishing the new standard in conventional LC. Integrating hardware, software, and separation chemistry, Dionex offers UHPLC to everyone—for all needs.

The VWD-3000 is a variable wavelength detector (VWD) series for industry leading UV-vis detection. The forward optics design and wide range of available flow cells ensure optimal performance over a flow rate range of five orders of magnitude. Automated qualification, performance optimization, and instrument wellness monitoring deliver maximum uptime, simplify workflow, and give you full confidence in your analytical results. The detector is available in a standard 100 Hz (VWD-3100) version and a 200 Hz Rapid Separation version (VWD-3400RS) for the most challenging UHPLC applications.

High-Performance UV-Vis Detection

- The VWD-3400RS variant provides data collection rates of up to 200 Hz for optimal support of today's and tomorrow's UHPLC separations.
- The VWD-3100 standard detector operates at up to 100 Hz data rate for optimum support of 62 MPa (9,000 psi) UltiMate[®] 3000 Standard Systems.
- Superior detection of trace analytes with low noise ($< \pm 3.5 \mu\text{AU}$) and drift ($< 100 \mu\text{AU/h}$).
- The detector's large linearity range of up to 2.5 AU is ideal for applications with widely varying analyte concentrations.

- Up to four absorption channels (VWD-3400RS) and spectral scans support effective method development.
- Operate with confidence in any environment with active temperature control for optics and electronics.
- Change lamps and flow cells quickly and easily using ergonomic front panel access.
- Achieve full regulatory compliance with automated qualification period monitoring.
- Large front panel display for monitoring the detector status even from a distance.
- Maximize uptime using predictive performance-based on monitoring the life cycle of detector lamps.



Passion. Power. Productivity.

Now sold under the
Thermo Scientific brand

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VWD-3000 Series UV-Vis Detectors Features and Highlights

Their Benefit to You

Outstanding linear calibration curves (correlation coefficient higher than 99.97%) over a wide absorbance range (up to 2.5 AU in the UV range).

Typical baseline noise of less than $< \pm 2.5 \mu\text{AU}$ (254 nm, time constant 1 s, dry analytical flow cell).

Data collection rates of up to 200 Hz.

Dedicated reference wavelength photodiode and active lamp house temperature control minimize baseline drift to below 100 $\mu\text{AU/h}$.

Wavelength range of 190–900 nm with combined use of deuterium and tungsten lamp on one optical axis.

Up to four absorption channels (VWD-3400RS) and scans across the entire wavelength range.

Fast switching second-order filter for multiwavelength operation in UV and visible range in the same chromatographic run.

Tool-free front panel access to flow cell and lamps.

Large flow cell portfolio for nano to semiprep flows (fused silica, stainless steel, or PEEK™)

Lamps and flow cells equipped with ID chips for identification (e.g., type and serial number) and lifespan monitoring.

Chromeleon® software predicts the anticipated remaining lifespan for wear parts and automatically alerts user when to change wear parts.

Automated wavelength verification with internal holmium filter.

High quantification accuracy over a wide concentration range enables the accurate detection and integration of very small peaks in the presence of very big peaks. No need to re-inject at a different dilution factor.

Low limits of detection/quantification for superior accuracy in trace level analysis. Saves effort for sample enrichment and broadens applicability, e.g., in environmental analysis.

Superior time-resolution for accurate integration—ready for today's and tomorrow's UHPLC detection challenges.

Accurate peak integration for methods with long run times and substances eluting over a wide time range. High quantitation accuracy even in laboratory environments without temperature control.

Sensitive detection in the UV, visible, and near-infrared range.

Easy identification of optimum absorbance wavelength without diode array technology

Unlimited multiwavelength detection over the complete spectral range for superior detection selectivity and sensitivity on all peaks in your chromatogram.

Easy access to detector fluidics and to wear parts.

Highly flexible for any individual application requirement.

History of wear parts is traceable even when the flow cell or lamp is placed in another VWD-3000 series module.

Enables users to plan ahead for required maintenance. Wear parts do not fail unexpectedly, which increases overall productivity.

The detector ensures high wavelength accuracy and precision, as well as minimal manual effort for system qualification.

Optical Design

The VWD-3000 series uses a fast-turning grating monochromator placed in front of the flow cell (forward optics design). Shown in Figure 1, this design ensures that only a narrow band of wavelengths passes the flow cell, controlled by the optical slit. Unlike photodiode array detectors with polychromatic light passing through the flow cell, VWD-3000 detectors minimize all possible interferences and stray light effects in the flow cell. The result: excellent baseline noise performance and a wide linear and dynamic range. The baseline noise and drift are further reduced through the use of a reference diode.

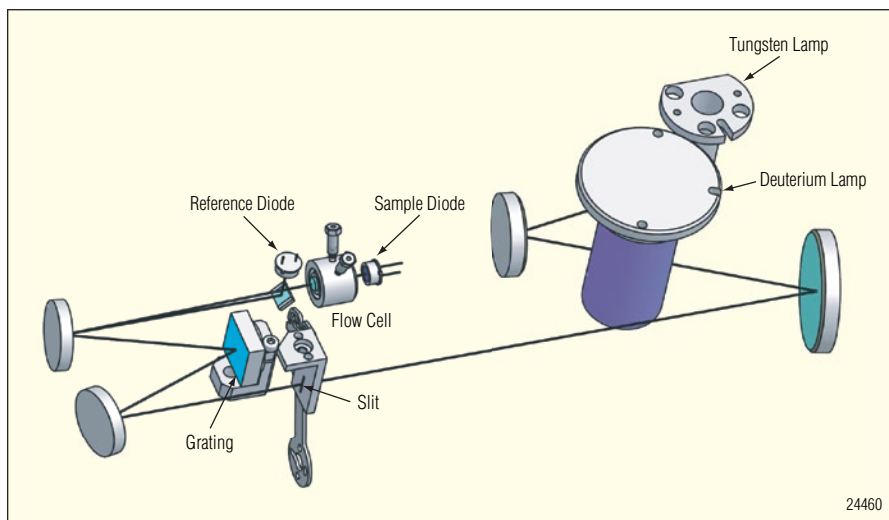


Figure 1. Schematic of the optical design of the VWD-3000 detector series.

Ergonomic Design, Safety Features, and Preventive Maintenance

The VWD-3000 is designed for maximum ease of use and safety. Flow cell connections and internal fluidics are physically separated from electronic parts. In the case of a leak, all liquid is safely drained to a leak sensor which can trigger a stop of the current sample queue or even a customized shut down program. UV and vis lamps are located behind a safety cover. Removing these lamps requires no tools, and is therefore equally easy and fast. All changes are automatically tracked by integrated ID chips for the cell and lamp. The relevant information is stored in the module firmware and moves with the detector if it is transferred to another LC system. Chromeleon software monitors and verifies instrument qualification status, helping ensure compliance (Figure 3).



Figure 2. The ergonomic internal front design: 1) lamp safety cover, 2) flow cell, 3) cell leak drainage, and 4) leak sensor.

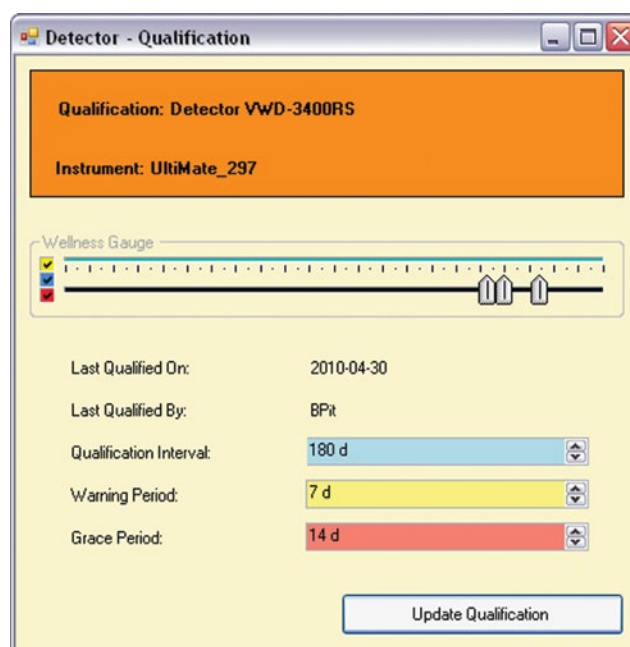


Figure 3. Chromeleon software monitors the module qualification status.

Rapid Separation LC Detection

Depending on the required accuracy and precision, a peak should consist of 20–30 data points to guarantee accurate determination of area and retention time. Already today, ultrafast chromatographic methods generate peak widths of less than 500 milliseconds and therefore the need for more than 50 Hz data collection rate. The Rapid Separation variable wavelength detector can not only fulfill this requirement, but its maximum data collection rate of 200 Hz is even prepared to meet any future detection challenge.

Full UHPLC Compatibility Beyond Data Collection Rate

The precise and fast-tuning monochromator is the VWD-3000 Series' backbone for full UHPLC compatibility. If your application requires a wavelength switch, only a marginal baseline resolution is required as it is always done in less than 250 milliseconds.

If you want to optimize the absorption wavelength of a UHPLC method, the detector design and Chromeleon software control are a powerful combination. Customizable Chromeleon trigger commands execute scans based on real peak detection, not just on an entered time. This assures that a scan is conducted at the right time, no matter how narrow the target peak is. Depending on the requirements, users can perform high-, medium-, or low-resolution scans. With the latter setting, scans can even be conducted during continuous-flow UHPLC separations.

For short term use, the VWD-3400RS can also operate in a multiple wavelength mode. For any data point, the monochromator quickly changes between up to four wavelength channels. Even the simultaneous operation in the UV and vis range is possible at highest quality standards with the two fast switching second order filters for improved signal to noise. The detector can achieve a maximum data rate of up to 5 Hz which typically provides enough data for sub-5 min screening separations (Figure 6).

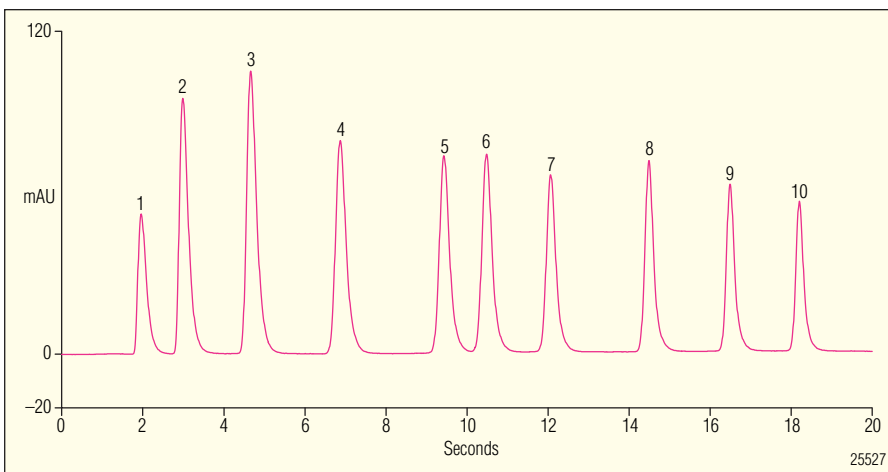


Figure 4. The VWD-3400RS is suited for any UHPLC application with up to 200 Hz data collection rate.

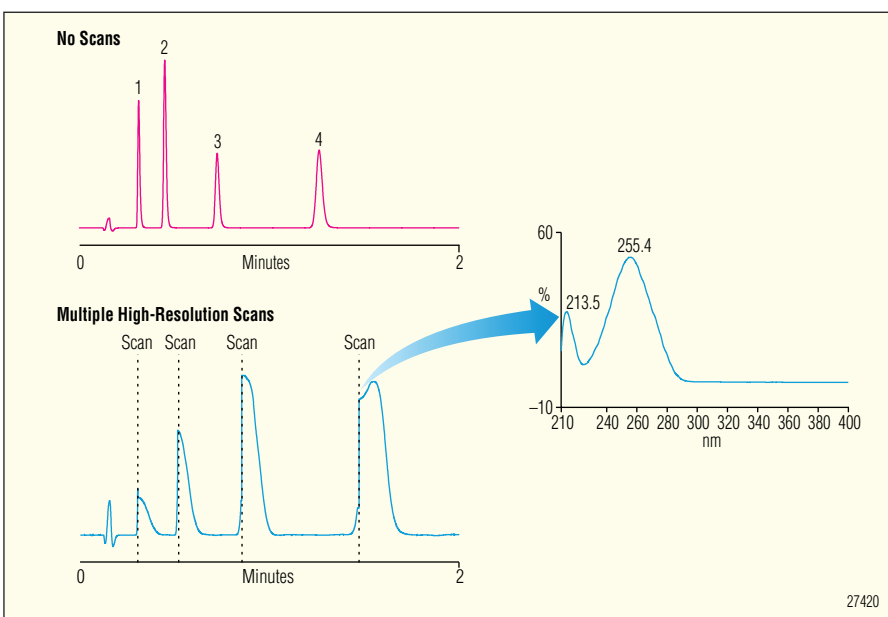


Figure 5. Multiple stop-flow scans in a single run cause shifting peak retention times. Superior Chromeleon software control executes scans where a peak is identified and can therefore easily handle varying retention times.

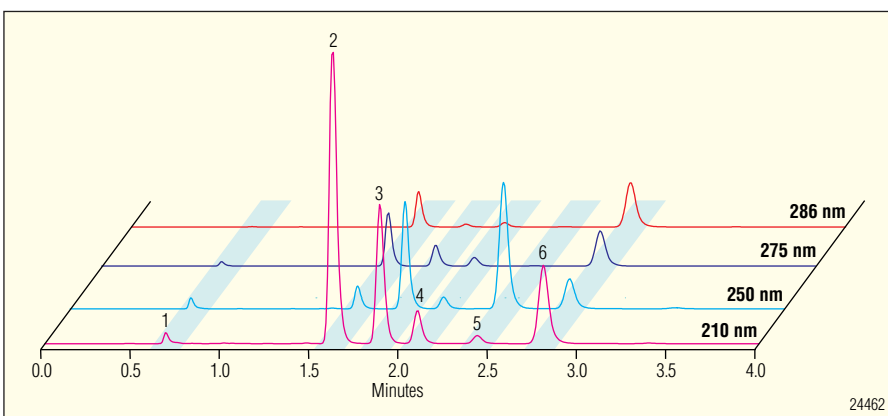


Figure 6. Up to four wavelengths can be recorded simultaneously with up to a 2.5 Hz data collection rate, making the four-channel mode compatible with even fast chromatography.

Superior Linearity and Minimal Noise

Figure 7 shows the chromatogram of a drug assay with detail of the baseline to reveal related impurities. The detector linearity is calculated from a calibration curve of the active ingredient, yielding an RSD of 0.27% and r^2 of 0.99999 up to a peak height of 3000 mAU. Outstanding baseline noise performance of the detector enables quantitative analysis of peaks in the lower μ AU range. Figure 8 shows the detection of one of the impurity peaks from the pharmaceutical formulation at different dilutions. A signal to noise ratio greater than 15 is achieved even at the lowest concentration (approximately 200 μ AU peak height). This enables quantification of impurities at 0.007% of the main peak, as confirmed by the calibration curve in Figure 8.

The outstanding signal linearity combined with the baseline noise and drift performance enables drug assay and impurity profiling. Now, in a single run, you can fulfill common requirements in pharmaceutical quality control laboratories.

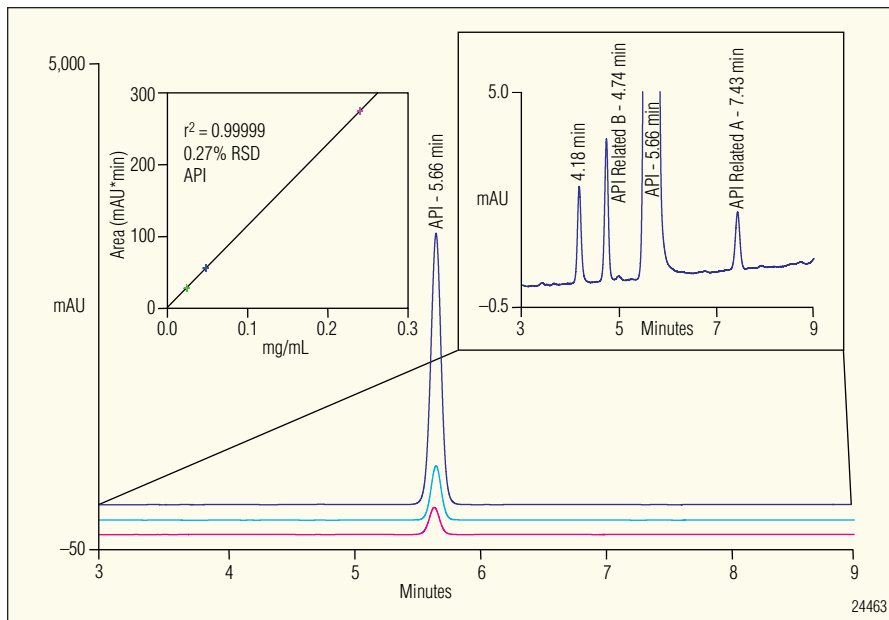


Figure 7. The above example of a pharmaceutical assay shows the outstanding linearity of the detector up to absorbance values of 3000 mAU for the given active pharmaceutical ingredient (API).

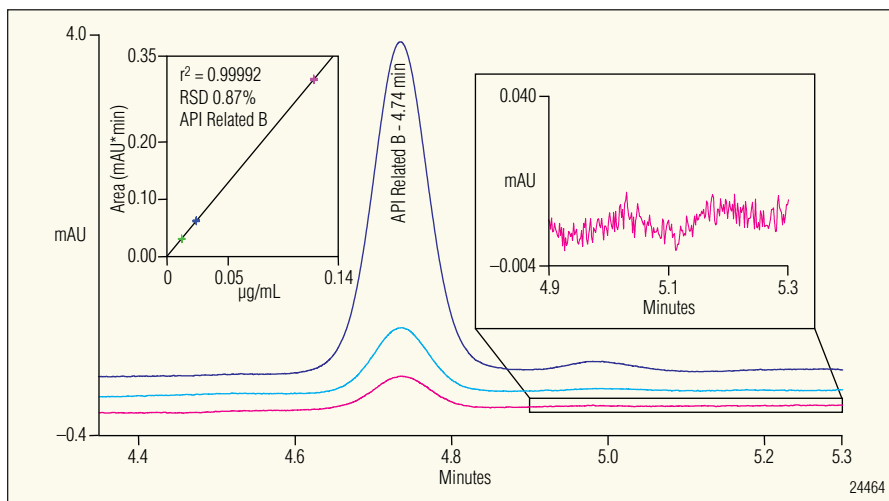


Figure 8. Impurity profiling in a pharmaceutical formulation (from the same injection as shown in Figure 6).

Reliability and Ease of Use

Reliability of scientific instruments mainly reflects a high quality standard of materials, excellent technical design, and strictly controlled manufacturing processes. However, instruments include wear parts that may fail at inopportune times. Figure 9 shows how Chromeleon software supports the user by predicting an estimated remaining lifetime of a detector lamp, based on monitoring characteristic criteria from the day of installation. This combination of instrumentation and software ensures greater up-time than detectors relying solely on reliability of the instrument's parts.

Meet Your Specific Requirements

Select from eight different flow cells based on your column dimensions and application-related requirements (Table 1). The VWD-3000 series offers a unique 3 nL cell for nano LC, a 45 nL cell for capillary LC, and a 180 nL cell for the lower end of micro LC (< 1 mm internal column diameter). These flow cells have a fused silica flow path and are fully biocompatible. The 2.5 µL semi-micro flow cell and the 11 µL analytical flow cells are available in stainless steel for optimal robustness and pressure resistance and in PEEK for applications requiring metal-free hardware. A dedicated semi-preparative flow cell with 0.4 mm optical light path (PEEK) completes the range of options.

Status Display and Standalone Operation Control

Large characters in brilliant blue front-panel displays make the detector's operational parameters clearly visible across the room. The front panel also provides a software-independent interface to control detector settings via a magnetic pen for standalone operation (see Figure 10).

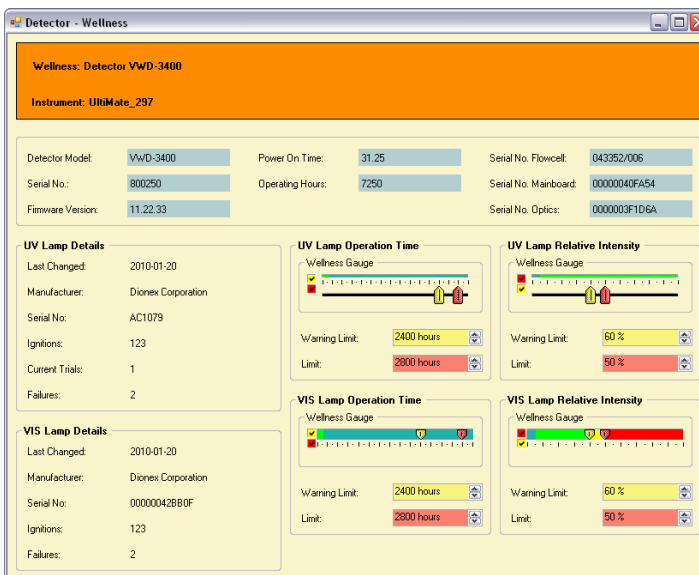


Figure 9. Wellness data and lifetime prediction of wear parts.

Description	Cell Volume	Light Path Length (mm)	Maximum Pressure (MPa)
Standard (SST)	11 µL	10	12
Standard (PEEK)	11 µL	10	5
Semi-micro (SST)	2.5 µL	7	12
Semi-micro (PEEK)	2.5 µL	7	5
Semi-preparative (PEEK)	0.7 µL	0.4	10
U-Z View™ Nano (Fused Silica)	3 nL	10	20
U-Z View Cap (Fused Silica)	45 nL	10	20
U-Z View Micro (Fused Silica)	180 nL	10	20

Table 1. Eight flow cells are available to cover the full range from nano to semi-preparative applications.



Figure 10. The large front display provides all important status information. Standalone operation control enabled via a magnetic pen.

Connection to Other Systems for Data Recording

A two-channel analog output card is available as an option for the VWD-3000 series. As a plug-and-play device, it can be easily mounted with no need to dismantle the HPLC system (see Figure 10). With a high digital resolution (20 bit) and a data rate up to 50 Hz, the connection fully supports the performance of the detector. Now the detector can be easily connected to other devices for data recording.



Figure 10. Using standard tools, the optional D/A converter can be installed at the instrument's rear panel in just a few minutes.

SPECIFICATIONS

Data collection rate:

Single wavelength up to 100 Hz (VWD-3100)
 Single wavelength up to 200 Hz (VWD-3400RS)
 Multiple wavelength up to 5 Hz (VWD-3400RS)

Noise, single wavelength:

< ±3.5 μAU (typical < ±2.5 μAU) at 254 nm, time constant 1 s, dry analytical flow cell

Noise, multiple wavelength (VWD-3400RS):

< ±10 μAU (typical < ±7 μAU) at 254 nm and 280 nm, 2 s time constant, dry analytical flow cell

Drift:

< 1 × 10⁻⁴ AU/h at 254 nm and dry analytical flow cell.

Linearity:

< 5% RSD (typical < 3% RSD) at 2.5 AU caffeine, wavelength: 272 nm based on ASTM

Light source:

Deuterium lamp, tungsten lamp
 (Tungsten lamp optional on VWD-3100)
 Temperature control for both lamps

Wavelength range:

190–900 nm

The tungsten lamp is recommended for wavelengths > 600 nm

Wavelength accuracy:

±1 nm (over detector lifetime)

Wavelength repeatability:

±0.1 nm

Optical bandwidth:

6 nm at 254 nm

I/O interfaces:

Four digital inputs, four digital outputs

Analog output:

Two analog outputs available as an option via DAC plug-in module
 Software selectable: absorbance, 20-bit resolution, 0–1V (full range) and 0–10 V (full range with adjustable mA ranges).

Safety feature:

Power-up diagnostics of optics, cooling fans, motors, and electronics leak sensor

Power consumption:

85–260 V AC, 50/60 Hz, max. 150 W

Wide range (automatic voltage selection)

Wetted parts:

PEEK™, quartz glass, stainless steel

Dimensions (h × w × d):

16 × 42 × 51 cm (6.3 × 16.5 × 20 in.)

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.

Detectors

VWD-3100 Variable Wavelength Detector (without flow cell).....	5074.0005
VWD-3400RS Rapid Separation Variable Wavelength Detector (without flow cell).....	5074.0010

Accessories

Analytical flow cell, 11 μ L, stainless steel.....	6074.0250
Analytical flow cell, 11 μ L, PEEK.....	6074.0200
Semi-micro flow cell, 2.5 μ L, stainless steel.....	6074.0360
Semi-micro flow cell, 2.5 μ L, PEEK.....	6074.0300
Semi-preparative flow cell, 0.7 μ L, PEEK.....	6074.0320
Nano flow cell, U-Z View, 3 nL.....	6074.0270
Capillary flow cell, U-Z View, 45 nL.....	6074.0280
Micro flow cell, U-Z View, 180 nL.....	6074.0290
Deuterium lamp.....	6074.1110
Tungsten lamp.....	6074.2000
Analog output card.....	6074.0305

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