

UV-Vis spectrophotometer product guide

Powerful spectroscopy for accurate analysis

Understanding UV-Vis

Why UV-Vis?

The power of UV-Vis lies in its simplicity. Ultraviolet-Visible (UV-Vis) spectrophotometry is literally as simple as “abc” since most analyses will follow Beer’s Law: Absorbance = abc. “a” is unique to each molecule at a particular wavelength; “b” is the pathlength; and “c” is the concentration of the analyte.

The significance of spectral bandwidth

Bandwidth is like a pupil in the human eye. The wider it is, the more light the instrument can see. But sometimes, when the bandwidth is too wide, the instrument may not see enough detail in your sample. Therefore, if you know that your samples have wide absorption peaks—large bandwidths are okay (and less expensive!), but if you want to look at narrow peaks—small bandwidths may be required. Check with our product specialist when in doubt.

Cell material

Even though glass looks perfectly transparent to our vision, it is not transparent to ultraviolet radiation (that is why you cannot get a suntan behind a closed window). For this reason “quartz” (aka “silica”) cells need to be used to measure samples in the ultraviolet (UV) region; if you are always going to be measuring above ~325 nm, then “glass” (aka “optical glass”) or plastic cells are okay and less costly to use.

Beam configurations

Single beam spectrophotometers are simple and inexpensive. However, they are somewhat more prone to drift and should be “zeroed” once every hour. Dual-beam instruments offer better stability and can be used to monitor and subtract instrument and solvent variations, as well as provide better precision and stability for longer term measurements.

Fixed wavelength measurement vs. scanning

UV-Vis measurements for quantitative analysis are typically performed at a single wavelength. A blank solution is measured to establish “100 %T” and then the sample is measured and the absorbance is calculated. If a calibrated method has been set up by measuring one or more standards the instrument may report concentration directly. UV-Visible spectroscopy is ideally suited for this kind of measurement. Some quantitative analyses require measurement at more than one wavelength, however, and these require a more sophisticated instrument equipped to move across the spectrum during the experiment or to measure the entire spectrum at once. These “scanning” instruments can also be used to find the location and size of absorbance peaks that can be used to identify analytes and the best wavelength at which to establish a quantitative measurement method for the analyte. All Thermo Scientific™ Spectrophotometers offer scanning capability with the exception of the Thermo Scientific™ NanoDrop™ Lite Plus instrument.

Visible vs. UV-Visible spectrophotometers

A spectrophotometer equipped with a tungsten-halogen lamp and conventional glass optics can measure wavelengths no lower than 325 nm because the lamp does not emit and the optics do not transmit below this wavelength. These instruments are generally referred to as visible spectrophotometers even though they can measure slightly into the UV and near-infrared ranges. If all the measurements made in your laboratory are done at wavelengths between ~350 and 1100 nm then a visible spectrophotometer will be a good choice.

In practice, glass optics begin absorbing light at all wavelengths less than ~350 nm, so for UV measurements below 350 nm an instrument equipped with quartz optics and a lamp that emits in the UV region is recommended. Below 325 nm it is required. Even if your sample appears transparent it may absorb ultraviolet light. Many pharmaceuticals, organic chemicals, DNA, RNA and proteins absorb in the UV range. Established methods for quantifying their concentration in solution rely on UV-Visible spectrophotometers to perform the analysis.

The significance of pathlength

Pathlength is the distance that the light travels through the sample. Doubling the pathlength will double the measured absorbance. A 10 mm pathlength is most commonly used for UV-Vis measurements. Special long-path cells with 20, 40, 50 or 100 mm pathlengths are available for applications where the absorbance of the sample is very low, or the sample solution is very dilute. For highly absorbing or more concentrated solutions, short-path cells of 5, 2 or 1 mm pathlengths can help to keep measured absorbance within the measurement range of the instrument.

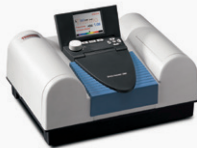


Microvolume measurements

The NanoDrop Microvolume UV-Vis Spectrophotometers can quantify a wide variety of biomolecules using only 1–2 µL of sample. Using surface tension, 1 µL of sample forms a liquid column between two optical surfaces. This enables an automatic pathlength change from 1 mm to as low as 0.03 mm during each sample measurement and allows for a large dynamic range (2–27, 500 ng/µL for dsDNA) essentially eliminating the need to perform dilutions. Designed for life science labs, the NanoDrop instruments include preconfigured applications for dsDNA, ssDNA, RNA, labeled nucleic acids, Protein A280, Protein A205, Protein Colorimetric assays, labeled proteins, OD600, Kinetics, UV-Vis and Custom Methods.

Thermo Scientific instruments and software featured in this guide

- BioMate™ 160 UV-Vis Spectrophotometer
- Evolution™ One/One Plus UV-Vis Spectrophotometer
- Evolution Pro UV-Vis Spectrophotometer
- GENESYS™ 30 Visible Spectrophotometer
- GENESYS 40 Visible/GENESYS 50 UV-Vis Spectrophotometer
- GENESYS 140 Visible/GENESYS 150 UV-Vis Spectrophotometer
- GENESYS 180 UV-Vis Spectrophotometer
- NanoDrop Eight Microvolume UV-Vis Spectrophotometer
- NanoDrop Ultra Microvolume UV-Vis Spectrophotometers and Fluorometers
- NanoDrop Lite Plus Microvolume UV Spectrophotometer
- SPECTRONIC™ 200 Visible Spectrophotometer
- Insight™ Pro Software
- VISION/ite™ Software

Education, basic quality control

| Instrument | SPECTRONIC 200 | GENESYS 30 | GENESYS 40/140 |
|------------------------------------|--|--|---|
| Catalog numbers | 840-281700 | 840-277000 | GENESYS 40: 840-297000 GENESYS 140: 840-308000 |
| |  |  |  |
| Spectrum | visible | | |
| Spectral range | 340–1100 nm | 325–1100 nm | |
| Type | Single beam | | Dual beam |
| Bandwidth | ≤4.0 nm | 5 nm | |
| Lamp(s) | Tungsten-Halogen | | |
| Detector | CCD | Silicon photodiode | |
| Standard functions | A/%T/Concentration/Scan/multiwave-length/Quant (Up to 4 STDs) | A/%T/Concentration/Scan/Fixed with calcs/Quant (up to 6 STDs)/OD600 | A/%T/Concentration/Scan/Fixed with calcs/Quant/Rate/OD600 |
| User interface | On-board or computer control | | On-board touchscreen tablet or computer control |
| Method/data storage | Quant methods to USB/All to computer | Methods On-board, Data to USB | On-board and Computer |
| Display | Color graphical LCD, 320 × 240 pixels, 7 × 5 cm, tiltable | 5" diagonal, 32-bit color display, 800 × 480 pixels | 7" color touchscreen, HD, 800 × 1280 pixels, fixed/tiltable |
| Printing | External printer | Snap-on printer accessory | Snap-on printer accessory, USB, network or Wi-Fi to page printers |
| Optional specialized functionality | Computer control with VISION/ite. Adds kinetics, more sophisticated scanning and quant, plus PV capabilities | | Solution color with VISION/ite ColorCalc Software |
| Validation IQ/OQ | No | | Yes |
| Capacity | single cell | | Standard: single cell Optional: 8 or 4 cell (140 only) |
| Liquid samples – cuvettes | Rectangular or cylindrical to 100 mm | | |
| Liquid samples – test tubes | 13 mm × 100 mm | 12–25 mm dia, up to 150 mm tall | 12–25 mm dia, up to 150 mm tall (40 only) N/A (140 only) |
| Temperature control | N/A | Water thermostatted single cell holder | Water thermostatted single-cell holder (40 only) Peltier thermostatted cell holder (140 only) |
| Solid samples | N/A | Thin solid samples such as films and filters | |
| Warranty | 1 year | 2 year (plus 1 additional year with registration) | |
| Benefits and competitive advantage | <ul style="list-style-type: none">• Very simple operation• Auto-zero at all wavelengths will save time, reduce error• Live measurements every 2 seconds• Scan 400–900 nm in 10 seconds• Quant with 4 standards | <ul style="list-style-type: none">• Larger, removable sample compartment• Large, color screen• Familiar keypad controls• Export data files to USB• Print data to snap-on thermal printer | <ul style="list-style-type: none">• 7", HD color touchscreen• Easy-to-use user interface• Large sample compartment with front access simplifies sample handling• Network equipped – print or store data to a USB stick or a network• Go wireless – optional Wi-Fi adaptor |

Featured accessories for SPECTRONIC 200



100 mm Rectangular Cell Holder
840-250500



Test Tube Holder
840-250700

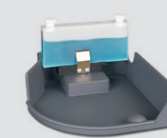
Featured accessories for GENESYS 30/40



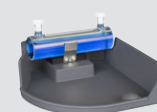
Test-Tube Holder
840-277500



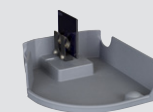
Tall Test-Tube Cap
840-277600



Long Path Rectangular Cell Holder
840-277700



5–100 mm Path Cylindrical Cell Holder
840-277800



Film/Filter Holder
840-278100



Thermostat Rectangular Cell Holder (no baseplate)
335079-000

Featured accessories for GENESYS 140



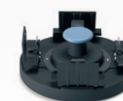
8 Position Carousel for 10 mm Pathlength Cells
840-303400



Peltier Thermostatted Single Cell Holder
840-306600



Integrated Sipper System
840-306900



4 × 10–50 mm Rectangular Cell Holder
840-314700



Long Path Rectangular Cell Holder
840-303800





5–100 mm Path Cylindrical Cell Holder
840-303100



Film/Filter Holder
840-303200

Routine QC and research

| Instrument | GENESYS 50/150 | GENESYS 180 |
|------------------------------------|---|---|
| Catalog numbers | GENESYS 50: 840-298000 GENESYS 150: 840-300000 | 840-309000 |
| |  |  |
| Spectrum | UV-Visible | |
| Spectral range | 190–1100 nm | |
| Type | Dual beam | Double beam |
| Bandwidth | 2.0 nm | |
| Lamp(s) | Xenon | |
| Detector | Dual Silicon Photodiodes | |
| Standard functions | A/%T/concentration/scan/rate/Quant, fixed with equations | |
| User interface | On-board touchscreen or computer control | |
| Method/data storage | On-board and Computer | |
| Display | 7" color touchscreen, HD, 800 × 1280 pixels, tiltable (GEN 150/180 only) | |
| Printing | USB, network and wireless printing to page printers. Snap-on thermal printer option. | |
| Optional specialized functionality | Solution color with VISION/ite ColorCalc Software Enzymatic analysis with VISION/ite EnzLab Software Wine and juice analysis with VISION/ite Wine Software | |
| Validation IQ/OQ | Yes | |
| Capacity | Single Cell (standard), Multi-cell up to 8 (optional—GENESYS 150 only) | Single Cell and Multi-cell up to 8 (standard) |
| Liquid samples | Up to 100 mm cuvettes | |
| Temperature control | Single cell Peltier thermostatted cell holder (GEN 150/180 only) | |
| Solid samples | Thin solid samples such as films and filters | |
| Warranty | 2 years (plus 1 additional year with registration) | |
| Benefits and competitive advantage | <ul style="list-style-type: none"> • Tiltable 7" (GENESYS 150 only), HD color touchscreen tablet to avoid glare • Compatible with automated cell changers, Peltier, sipper and fiber optic probe accessory options (GENESYS 150 only) • Network equipped – print or store data to a USB stick or a network • Go wireless – optional Wi-Fi adaptor | <ul style="list-style-type: none"> • Double-beam optics • Ideal solution when a reference beam is required, such as for kinetics • 8-cell carousel standard • Make measurements outside the sample compartment and without cuvettes using fiber optic coupler and probe |

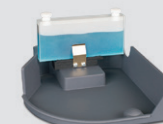
Featured accessories for GENESYS 40/50



Test Tube Holder
840-277500



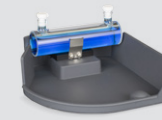
Tall Test Tube Cap
840-277600



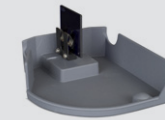
Long Path Rectangular Cell Holder
840-277700



Printer
840-278000



Long Path Cylindrical Cell Holder
840-277800



Film Filter Holder
840-278100

Featured accessories for GENESYS 140/150/180



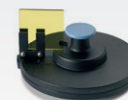
8 Position Carousel for 10 mm Pathlength Cells
840-303400



Wi-Fi Adaptor for GENESYS 40-180
840-309900



Long Path Rectangular Cell Holder
840-303800



Film/Filter Holder
840-278100



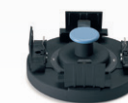
5–100 mm Path Cylindrical Cell Holder
840-303100



Printer
840-278000





Integrated Sipper System
840-306900



4 × 10–50 mm Rectangular Cell Holder
840-314700

Advanced QC, research and pharma

| Instrument | Evolution One | Evolution One Plus | Evolution Pro |
|------------------------------------|--|--|---|
| Catalog Numbers | 840-341400 | 840-341500 | 840-340200 |
| |  | |  |
| Spectrum | UV-Visible | | |
| Spectral range | 190–1100 nm | | |
| Type | Double beam | | |
| Bandwidth | 1.0 nm | 1.0 nm, 2.0 nm & AFBG | 0.5, 1.0, 1.5, 2.0 & 4.0 nm |
| Lamp(s) | Xenon | | |
| Detector | Dual silicon photodiodes | | |
| Standard functions | A/T/Quant/fixed wavelength with advanced calculations/scan/rate/performance verification | | |
| User interface | Computer control | | |
| Method/data storage | Computer control | | |
| Printing | Windows® compatible printers | | |
| Optional specialized functionality | 21 CFR Part 11, customized Analyzer, color, biochemical methods including DNA melting, autosampler | | |
| Validation IQ/OQ | Yes | | |
| Capacity | Multi-cell (up to 8) | | |
| Liquid samples | Up to 100 mm cuvettes; Up to 40 mm tubes and vials | | |
| Temperature control | Peltier accessories and a range of thermostatted cell holders with liquid recirculators | | |
| Solid samples | Thin solid samples | Thin and thick solids, powders, reflecting surfaces, films, DRA, SRA | Thin and thick solids, specular surfaces and films, SRA |
| Warranty | 2 years | | |
| Benefits and competitive advantage | <ul style="list-style-type: none"> Automated performance verification with CVC accessory CUE software scripting capability to simplify complex assays with the touch of a button Powered by Insight Pro Software Smart Accessories™ with unique serial number recorded for comprehensive event logs and audit trails Specialized, easy-to-use accessories for increased productivity Xenon lamp requires no warm-up for instant measurements and has 3-year warranty 0.5 nm bandwidth for highest resolution data (<i>Evolution Pro only</i>) Application Focused Beam Geometry (AFBG) matches hardware to your application (<i>Evolution One Plus only</i>) Double-beam configuration (<i>Large sample compartment and 21 cm beam separation option available with Evolution Pro only</i>) | | |

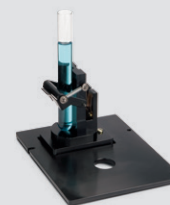
Featured accessories for Evolution One Spectrophotometers



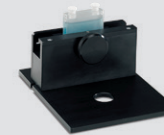
8-Cell Peltier System
699-131200



Single Cell Peltier System
Available soon



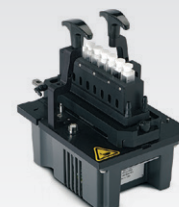
Combination Filter, Vial & Square 10 mm Cell Holder
840-211800



100 mm Rectangular Cell Holder
10011101



Smart Thermostatted Rotary 7-Cell Changer
840-214900



Smart Thermostatted Linear 8-Cell Changer
840-219000



Standard Fiber Optic Dip Probe with 10 mm Tip
840-305000



Temperature Probe Hub and Temperature Probes
840-214600



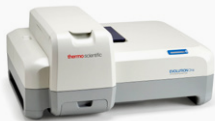


ISA-220 Integrating Sphere
222-269400



Powder Cell Holder
840-289300

Life science

| Instrument | GENESYS 30 | BioMate 160 | Evolution One |
|------------------------------------|--|---|--|
| Catalog Numbers | 840-277000 | 840-301000 | 840-341400 |
| |  |  |  |
| Spectrum | Visible | UV-Visible | |
| Spectral range | 325–1100 nm | 190–1100 nm | |
| Type | Single Beam | Dual Beam | Double Beam |
| Bandwidth | 5.0 nm | 2.0 nm | 1.0 nm |
| Lamp(s) | Tungsten-Halogen | Xenon | |
| Detector | Silicon Photodiode | Dual Silicon Photodiodes | |
| Standard functions | A/%T/concentration/scan/OD600/ fixed with eqns/Quant | A/%T/concentration/scan/OD600/ fixed with eqns/Quant/rate/DNA & protein methods | A/%T/concentration/scan/rate/ temperature kinetics/DNA melting |
| User interface | On-board keyboard and screen or computer | On-board touchscreen, tablet or computer Control | Computer control |
| Method/data storage | On-board: Methods USB: Method and data Computer: Method and data | On-board: Method and data Computer: Method and data | Computer control |
| Display | 5" diagonal, 32-bit color display, 800 × 480 pixels | 7" color touchscreen, HD, 800 × 1280 pixels, tiltable | N/A |
| Printing | Optional GENESYS printer only | Optional GENESYS printer, page printers by USB, network or Wi-Fi (with optional transmitter) | Windows printers |
| Optional specialized functionality | Optional accessory for measuring test tubes and nephelo flasks | Optional: Beckman cell holder, 50 µL disposable cell holder, 8 position cell holder (not thermostatted), Peltier thermostatted single cell holder (20–60 °C) | Temperature ramping with Peltier thermostatted cell holders Advanced measurement automation with thermostatted multiple cell holders |
| Validation IQ/OQ | No | Yes | Yes |
| Capacity | Single cell | Single Cell (standard), multi-cell up to 8 (optional) | |
| Liquid samples | Up to 100 mm cuvettes; Up to 25 mm test tubes | Up to 100 mm cuvettes | |
| Temperature control | Optional water thermostatted single cell holder | Optional Peltier thermostatted single cell holder (20–60 °C) | Peltier accessories and a range of thermostatted cell holders with liquid recirculators |
| Warranty | 2 year (plus 1 additional year with registration) | | 2 years |
| Benefits and competitive advantage | <ul style="list-style-type: none"> Easy to learn, easy to use interface with 5" high resolution color screen and tactile rubber keypad Large sample compartment with front access simplifies sample handling Best choice for OD600 measurements | <ul style="list-style-type: none"> Tiltable 7", high-resolution touch-screen tablet to avoid glare Compatible with automated cell changers, Peltier, sipper and fiber optic probe accessory options Network equipped – print or store data to a USB stick or a network Go wireless – optional Wi-Fi adaptor | <ul style="list-style-type: none"> Double-beam optics Ideal solution when a reference beam is required, such as for kinetics Widest range of accessory options Best option for temperature control Temperature kinetics and DNA melting with single or 8-cell Peltier systems |

Featured accessories for GENESYS 30



Test Tube Holder
840-277500



Tall Test Tube Cap
840-277600



GENESYS Printer Accessory
840-278000

Featured accessories for BioMate 160



Beckman Style Cell Holder
840-299000



8 Position Carousel for 10 mm Pathlength Cells
840-303400



Microcell Holder
840-303300



Peltier Thermostatted Single-Cell Holder
840-306600



Printer Accessory
840-278000

Featured accessories for Evolution One



8-Cell Peltier System
699-131200






Single Cell Peltier System
Available soon



Temperature Probe Hub and Temperature Probes
840-214600

Life science

| Instrument | NanoDrop Eight | NanoDrop Ultra/Ultra ^c / Ultra FL/Ultra ^c FL | NanoDrop Lite Plus |
|------------------------------------|---|--|---|
| Catalog Numbers | NDE-GL | Ultra: NDULTRAGL Ultra ^c : NDULTRACGL Ultra FL: NDULTRAFLGL Ultra ^c FL: NDULTRACFLGL | No Printer: NDPLUSGL Printer: NDPLUSPRGL |
| |  |  |  |
| Spectrum | UV-Visible | | UV |
| Spectral range | 190–850 nm (scans) | 190–850 nm (scans) | Fixed: 230 nm, 260 nm, 280 nm |
| Bandwidth | ≤1.8 nm | | |
| Lamp(s) | Xenon | | |
| Detector | 2048-element linear silicon CCD array | | |
| Standard functions | DNA, RNA, protein A280 and A205, colorimetric protein assays, proteins and labels | DNA, RNA, protein A280 and A205, proteins and labels. Ultra ^c and Ultra ^c FL Only: Kinetics Ultra FL and Ultra ^c FL Only: DNA Fluorescence and RNA Fluorescence | DNA, RNA and purified A280 protein measurements |
| User interface | Computer software | Built-in touchscreen or computer software | Built-in touchscreen |
| Method/data storage | Computer | On-board, Wi-Fi, PC and USB transferable | On-board and USB transferable |
| Display | N/A | 10.1" color touchscreen, tiltable | LCD touchscreen |
| Printing | Computer | Print from on-board control via Wi-Fi, Ethernet or USB connection | Optional label printer |
| Optional specialized functionality | Software for 21 CFR Part 11 compliance | - SciVault 2 Software for 21 CFR Part 11 compliance - Acclaro Pro Software for exceptional accuracy | N/A |
| Validation IQ/OQ | Yes | | No |
| Capacity | Microvolume (up to 8 samples at a time) | Microvolume and cuvette | Microvolume |
| Liquid samples | 1–2 µL | 1–2 µL samples and 10 mm cuvette (Ultra ^c and Ultra ^c FL) | 1–2 µL |
| Temperature control | N/A | Cuvette at 37 °C (Ultra ^c and Ultra ^c FL) | N/A |
| Warranty | 1 year | 2 years | 1 year |
| Benefits and advantage | <ul style="list-style-type: none"> • High-sample throughput (measures 8 samples simultaneously) • 1–2 µL of sample • Sample contaminant identification • Differentiates mammalian DNA and RNA • Optional 21 CFR Part 11 software • Data output for LIMS integration | <ul style="list-style-type: none"> • Stand-alone instrument with on-board control • 10.1" high resolution touchscreen interface • Contaminant identification • Differentiates mammalian, plant, and bacterial DNA and RNA • Integrated qPCR recipe calculator • LIMS API Integration • Only 1–2 µL of sample • Computer, Wi-Fi, USB, Cloud Data Transfer • Guided troubleshooting • Diagnostic Scheduler | <ul style="list-style-type: none"> • Most popular methods including dsDNA, RNA, and Protein A280 • Purity ratios A260/A280 & A260/A230 • Last 1000 measurements saved locally; export data to a USB device • Optional printer available for freezer-compatible labels |

Featured accessories and software for NanoDrop Ultra Spectrophotometers and Fluorometers



SciVault 2 Software
NDU-SCIVALT2



DYMO 550 Printer
DYMO-PRNTR-ND



PV-1 Performance
Verification Solution
CHEM-PV-1

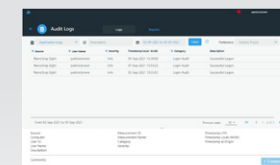


NanoDrop Ultra
Instrument Dust Cover
NDU-INST-COVER



Cuvette Qualification Filter Kit
for NanoDrop Instruments
840-257300

Featured accessories and software for NanoDrop Eight



SciVault™ Software
840-371100



PV-8 Performance
Verification Kit
CHEM-PV-8

Other accessories



PR-1 Reconditioning Kit for
NanoDrop Instruments
CHEM-PR1-KIT



NanoDrop Lite Plus
Printer
NDLP-PRNTR-MOD



Learn more at thermofisher.com/uv-vis

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