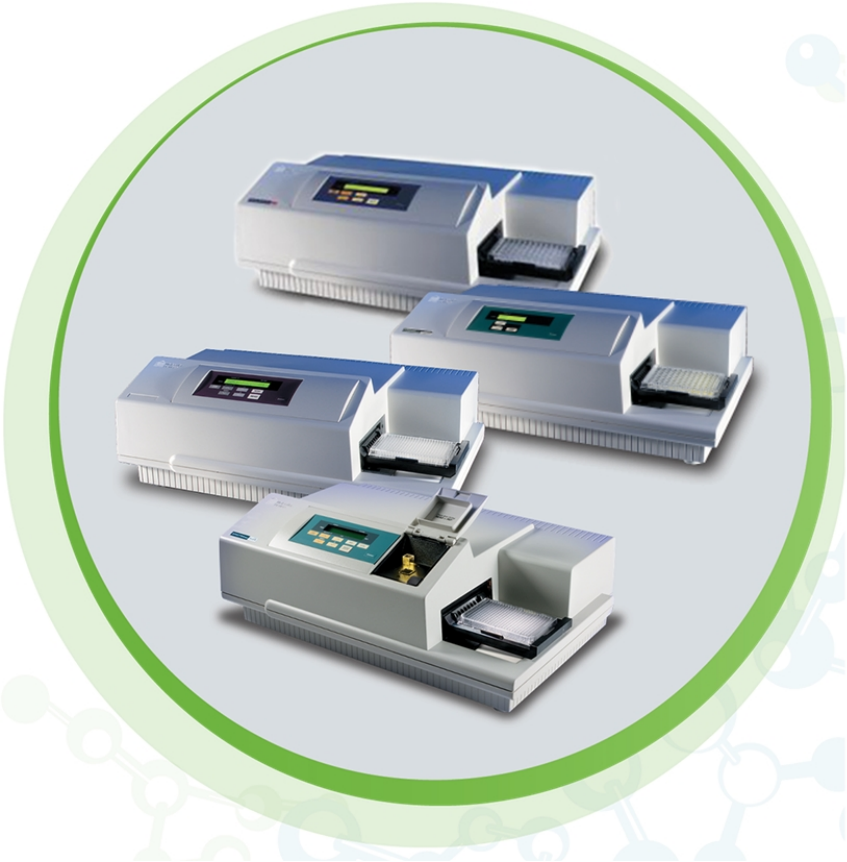

SpectraMax Plus 384
SpectraMax 190
SpectraMax 340PC384
VersaMax

Microplate Spectrophotometers

User Guide

MOLECULAR DEVICES

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September 2020

Product manufactured by Molecular Devices, LLC.
3860 N. First Street, San Jose, California, 95134, United States of America.
Molecular Devices, LLC is ISO 9001 registered.

Contents

Safety Information

Information about the safe use of the instrument from Molecular Devices® includes an understanding of the user-attention statements in this guide, the safety labels on the instrument, precautions to follow before you operate the instrument, and precautions to follow while you operate the instrument.

Make sure that everyone involved with the operation of the instrument has:

- Received instruction in general safety practices for laboratories.
- Received instruction in specific safety practices for the instrument.
- Read and understood all Safety Data Sheets (SDS) for all materials being used.

Read and observe all warnings, cautions, and instructions. The most important key to safety is to operate the instrument with care.

WARNING! If the instrument is used in a manner not specified by Molecular Devices, the protection provided by the equipment might be impaired.

Warnings, Cautions, Notes, and Tips

All warning symbols are framed within a yellow triangle. An exclamation mark is used for most warnings. Other symbols can warn of other types of hazards such as biohazard, electrical, or laser safety warnings as are described in the text of the warning. Follow the related safety information.

The following user attention statements might be displayed in the text of Molecular Devices user documentation. Each statement implies the amount of observation or recommended procedure.

WARNING! A warning indicates a situation or operation that could cause personal injury if precautions are not followed.

CAUTION! A caution indicates a situation or operation that could cause damage to the instrument or loss of data if correct procedures are not followed.

Note: A note calls attention to significant information.

Tip: A tip provides useful information or a shortcut, but is not essential to the completion of a procedure.

Symbols on the Instrument

Each safety label found on the instrument contains an alert symbol that indicates the type of potential safety hazard.

Symbol	Indication
	Consult the product documentation.
	Potential biohazard.
	Potential lifting hazard. To prevent injury, use a minimum of two people to lift the instrument.
	Potential heat hazard.
	Required in accordance with the Waste Electrical and Electronic Equipment (WEEE) Directive of the European Union. It indicates that you must not discard this electrical or electronic product or its components in domestic household waste or in the municipal waste collection system. For products under the requirement of the WEEE directive, contact your dealer or local Molecular Devices office for the procedures to facilitate the proper collection, treatment, recovery, recycling, and safe disposal of the device.

- California proposition 65 requires businesses to provide warnings to Californians about significant exposures to chemicals that cause cancer, birth defects, or other reproductive harm.

Electrical Safety

To prevent electrical injuries and property damage, inspect all electrical equipment before use and report all electrical deficiencies. Contact Molecular Devices technical support for equipment service that requires the removal of covers or panels.

To prevent electrical shock, use the supplied power cord and connect to a properly grounded wall outlet.

To ensure sufficient ventilation and provide access to disconnect power from the instrument, maintain a 20 cm to 30 cm (7.9 in. to 11.8 in.) gap between the rear of the instrument and the wall.

Power off the instrument when not in use.

Chemical and Biological Safety

Normal operation of the instrument can involve the use of materials that are toxic, flammable, or otherwise biologically harmful. When you use such materials, observe the following precautions:

- Handle infectious samples based on good laboratory procedures and methods to prevent the spread of disease.
- Observe all cautionary information printed on the original containers of solutions before their use.
- Dispose of all waste solutions based on the waste disposal procedures of your facility.
- Operate the instrument in accordance with the instructions outlined in this guide, and take all the required precautions when using pathological, toxic, or radioactive materials.
- Splashing of liquids can occur. Take applicable safety precautions, such as using safety glasses and wearing protective clothing, when working with potentially hazardous liquids.
- Observe the applicable cautionary procedures as defined by your safety officer when using hazardous materials, flammable solvents, toxic, pathological, or radioactive materials in or near a powered-up instrument.

WARNING! Never use the instrument in an environment where potentially damaging liquids or gases are present.

Moving Parts Safety

The instrument contains moving parts that can cause injury. Under normal conditions, the instrument is designed to protect you from these moving parts.

WARNING! If the instrument is used in a manner not specified by Molecular Devices, the protection provided by the equipment might be impaired.

To prevent injury:

- Never try to exchange labware, reagents, or tools while the instrument is operating.
- Never try to physically restrict the moving components of the instrument.

Note: Observe all warnings and cautions listed for all external devices attached to or in use during the operation of the instrument. See the applicable user guide for the operating and safety procedures of that device.

CAUTION! Never touch the optic mirrors, lenses, filters, or cables. The optics are extremely delicate, and critical to the function of the instrument.

Chapter 1: Introduction

The SpectraMax® 340PC384, SpectraMax® 190, and VersaMax™ microplate spectrophotometers provide rapid and sensitive measurements of a variety of analytes across a wide range of concentrations. The SpectraMax® Plus 384 adds the ability to read cuvettes. These instruments measure the optical density (OD) of samples at selected wavelengths in a single read mode.

- SpectraMax Plus 384 reads 96-well plates, 384-well plates, and cuvettes.
- SpectraMax 190 reads 96-well plates.
- SpectraMax 340PC384 reads 96-well plates and 384-well plates.
- VersaMax reads 96-well plates.

The high sensitivity and flexibility of these instruments make them useful for applications in the fields of biochemistry, cell biology, immunology, molecular biology, and microbiology.

Typical applications include ELISA, nucleic acid, protein, enzymatic type homogeneous and heterogeneous assays, microbial growth, endotoxin testing, and pipettor calibration.

The instruments support the UV and Visible Absorbance read mode with the following read types.

- Endpoint: at a single point in time.
- Kinetic: over a specified period of time.
- Spectrum: over a specified wavelength range.

The shake feature allows you to mix the contents of the wells in a plate before each read cycle, which makes it possible to perform kinetic analysis of solid-phase, enzyme-mediated reactions (shake is not critical for liquid-phase reactions).

Temperature controls allow the instrument to regulate the temperature of the plate chamber from 4°C above ambient to 45°C.

Computer Integration

Each Molecular Devices microplate reader is shipped with a license key for the SoftMax® Pro Data Acquisition and Analysis Software that you install on the computer that you use to operate the instrument. The SoftMax Pro Software provides integrated instrument control, data display, and statistical data analysis.

You should install the SoftMax Pro Software on the computer before you set up the instrument. Please be aware that some updates to the SoftMax Pro Software require a purchase. Contact Molecular Devices before you update the software. To download the latest version of the software, visit: https://www.moleculardevices.com/products/microplate-readers/acquisition-and-analysis-software/softmax-pro-software#Order.

Note: For information about the computer specifications that are required to run the software, the software installation and licensing instructions, and the directions to create the software connection between the computer and the instrument, see the *SoftMax Pro Data Acquisition and Analysis Software Installation Guide*.

To prevent data loss turn off all sleep and hibernation settings for the hard disk, the CPU, and the USB ports. You can set these options in Windows Control Panel.

You can connect the instrument to a printer and operate the instrument in standalone mode to run basic Absorbance read mode Endpoint read type protocols. In standalone mode, the instrument control panel allows you to adjust the temperature and the wavelength to do fixed point plate reads. For the SpectraMax Plus 384 you can do fixed point cuvette reads. Standalone mode is not available for the VersaMax.

To run protocols that require advanced acquisition settings or to run Absorbance read mode Kinetic read type and Spectrum read type protocols, you must connect the instrument to a computer and use the SoftMax Pro Software to operate the instrument.

Plate Controls

The plate drawer is located on the right side of the instrument and slides in and out of the plate chamber. Use the instrument control panel or the SoftMax Pro Software to open and close the plate drawer.

The arrows in the following image point to the plate orientation for well A1 and the plastic pusher that holds the plate in place when the drawer is closed.

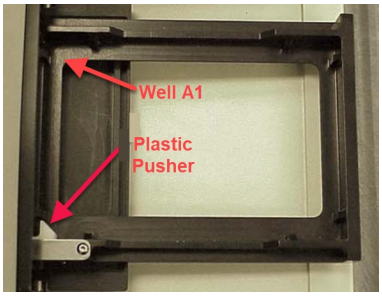


Plate drawer operation is dependent on the incubator setting:

- The drawer closes for each read.
- When you open the drawer, if the incubator is off, the drawer remains open.
- When you open the drawer, if the incubator is on, the drawer closes after approximately 10 seconds to maintain temperature control within the plate chamber.

Do not obstruct the movement of the drawer. If you must retrieve a plate after an error condition or power outage and the drawer does not open, you can open the drawer manually. See Opening the Drawer Manually on page 31.

- SpectraMax Plus 384 reads 96-well plates, 384-well plates and strip-well plates, and cuvettes.
- SpectraMax 190 reads 96-well and strip-well plates.
- SpectraMax 340PC384 reads 96-well plates and 384-well plates and strip-well plates.
- VersaMax reads 96-well and strip-well plates.

When you do reads at wavelengths below 340 nm, you must use special UV-transparent, disposable or quartz plates to allow transmission of the deep UV spectra.

Not all manufacturers' plates are the same with regard to design, materials, or configuration. Temperature uniformity within the plate may vary depending on the type of plate used.

CAUTION! To prevent damage to the instrument, the height of the plate must not exceed 25 mm, including the lid if the plate is lidded.

Shake

The software allows you to define settings to shake the plate linearly along the long axis at preset intervals to mix of the contents of the wells.

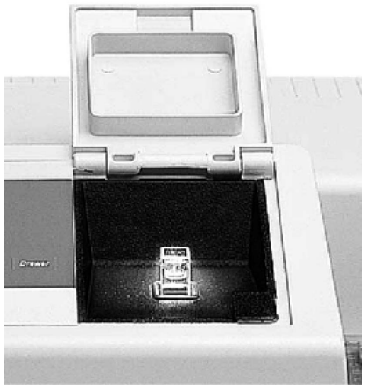
- Endpoint read type: Settings allow you to shake the plate for a definable number of seconds and then read at all selected wavelengths.
- Kinetic read type: Settings allow you to shake the plate for a definable number of seconds before the initial read, and/or for a definable number of seconds before each subsequent read.

Use of shake is recommended for ELISAs and other solid-phase, enzyme-mediated reactions to enhance accuracy.

Cuvette Chamber

The cuvette chamber on the SpectraMax Plus 384 is located at the right front of the instrument. You manually lift up the lid over the chamber to insert or remove a cuvette. The chamber contains springs that position the cuvette in the proper alignment for a read. You must manually close the cuvette door before you initiate a read.

Handle cuvettes on the frosted sides only. Place the cuvette into the chamber so that the “reading” (clear) sides face left and right.



The guidelines for cuvette use in the instrument are the same as those that apply to any high-quality spectrophotometer. You must ensure that the meniscus is comfortably above the light beam in standard cuvettes and that the sample chamber in a microcuvette is aligned properly with the beam. The light beam is 0.625 in (15.87 mm) above the cuvette bottom.

The instrument can accommodate standard-height (45 mm), 1-cm cuvettes and 12 x 75 mm test tubes when used with the test tube cover. The instrument does not accept short (25 mm high) microcuvettes. See Accessories on page 51.

Not all manufacturers’ cuvettes are the same with regard to design, materials, or configuration. Temperature uniformity within the cuvette may vary depending on the type of cuvette you use.

Temperature Regulation

The instrument contains an incubator that allows you to control the temperature in the plate chamber for Endpoint read type protocols. When you power on the instrument the incubator is off. The temperature in the plate chamber is ambient and isothermal.

The instrument is designed to regulate the temperature of the plate chamber from 4°C above ambient to 45°C. The instrument control panel and the SoftMax Pro Software allows you to turn the incubator on and off to adjust the plate chamber temperature. The temperature set point defaults to 37.0°C at start-up.

The instrument control panel displays the temperature in the plate chamber except for the SpectraMax Plus 384 where the instrument control panel displays the cuvette chamber temperature. Use the SoftMax Pro Software to view the plate chamber temperature for the SpectraMax Plus 384.

Typically, the plate chamber reaches 37.0°C in less than 30 minutes. The plate chamber temperature is maintained at the set point until you to turn temperature regulation off.

Temperature regulation and control of the plate chamber is achieved through electric heaters, a fan, efficient insulation, and temperature sensors. The heaters are located in the plate chamber, which is insulated to maintain the temperature set point. The sensors are mounted inside the chamber and measure the air temperature.

Accuracy of the temperature set point is guaranteed only if the set point is at least 4°C above ambient. If the temperature set point is lower than the ambient temperature, the chamber temperature remains at ambient. Temperature regulation is controlled by heaters only and, therefore, cannot cool the temperature to a setting lower than ambient. Additionally, the highest setting (45°C) can be achieved only if the ambient temperature is greater than 20°C.

Should you turn the incubator back on after a momentary shutdown, allow about ten minutes for the control algorithm to fully stabilize the plate chamber temperature.

The temperature feedback closed-loop control algorithms measure the chamber air temperature, compare it to the temperature set point, and use the difference to calculate the regulation of the heating cycles. This technique results in accurate, precise control of the chamber temperature with a temperature variation of the air inside the chamber of less than 1.0°C. The temperature uniformity within the plate depends on its design and composition.

The temperature sensors detect the temperature of the air inside the chamber, not the temperature of the samples in the plate. If you use the instrument to warm the samples, use a seal or lid on the plate to prevent evaporation of the sample. The seal or lid also helps to maintain a uniform temperature. It can take an hour or more for a prepared sample to equilibrate inside the plate chamber. You can speed up equilibration by pre-warming the sample and the assay reagents to the desired temperature before you place the plate in the chamber. Validate the data quality to determine whether the seal or lid can stay on the plate for the read.

Chapter 2: Setting Up the Instrument

Before you unpack and set up the instrument, prepare a dry, flat work area that has sufficient space for the instrument, host computer, and required cables. To provide access for disconnecting power from the instrument, maintain a 20 cm to 30 cm (7.9 in. to 11.8 in.) gap between the rear of the instrument and the wall. To ensure sufficient ventilation, do not block the ventilation grid on the right side of the instrument.

WARNING! Potential lifting hazard. To prevent injury, use a minimum of two people to lift the instrument.

The package contains the instrument and accessories to set up the instrument:

- SoftMax Pro Software, product key, and installation guide
- Instrument Installation Guide
- USB computer connection cable
- AC power adapter
- Parallel printer connection cable

For a complete list of the package contents, see the enclosed packing list.

The packaging is designed to protect the instrument during shipment. Tape is placed on the cuvette door and the plate drawer to protect the instrument from damage during shipment.

CAUTION! Do not touch or loosen screws or parts other than those specifically designated in the instructions. Doing so could cause misalignment and possibly void the warranty.

Note: Retain the shipping box and all packing materials for future transport needs.

CAUTION! When transporting the instrument, warranty claims are void if damage during transport is caused by improper packaging.

To unpack the instrument:

1. Check the box for damage that occurred during transportation. Inform the supplier immediately and keep the damaged packaging.
2. Open the top of the box.
3. Lift the accessories tool box and the instrument from the package and place the instrument on a level surface.
4. Remove the packing material from both ends of the instrument and set the instrument down carefully.

Connecting Instrument Cables

The power cord and USB cable connect to the ports on the rear of the instrument.

Illustration	Part Number	Description
	5064799	USB computer connection cable, 3 meter (9.8 foot)
	4400-0002 or 4400-0036	Power cord, 1 meter (3.3 foot)

Note: Before you connect or disconnect the power cord, make sure that the power switch that is on the rear of the instrument is in the Off position.

1. Make sure that the power switch that is on the rear of the instrument is in the Off position.
2. To use a computer to operate the instrument, connect the appropriate end of the supplied USB cable to the USB port that is on the rear of the instrument, and then connect the other end to a USB port on the computer.
3. To operate the instrument in standalone mode, connect one end of the 25-pin parallel cable to the printer port, and then connect the other end to the printer.
4. Load paper into the printer according to the manufacturer's instructions and connect the printer's power cord.
5. Connect the supplied power adapter to the power port that is on the rear of the instrument, and then connect the other end to a grounded electrical wall outlet.
6. Turn the instrument around so that the front of the instrument now faces you.

Note: Ensure no cables run beneath the instrument.

7. Remove the tape from the cuvette door on the SpectraMax Plus 384.
8. Power on the instrument and wait for the plate drawer to open.
9. Remove the tape and protective covering from the drawer subplate.

Chapter 3: Getting Started

Now that you installed the SoftMax Pro Software on the computer, removed the tape from the drawer and the cuvette port, and connected the cables, it is time to get started.

WARNING! Never use the instrument in an environment where potentially damaging liquids or gases are present.

1. Set the power switch on the rear of the instrument to the On position. Wait for the instrument to complete its diagnostic check and the plate drawer opens.
2. Start the software on the computer. To start the software under normal conditions, wait for the instrument to complete the start-up sequence, and then double-click the **SoftMax Pro** icon on the desktop to start the program.

Power off the instrument when not in use.

Control Panel

When you connect the instrument to a computer that runs the SoftMax Pro Software, you use the computer to define most instrument settings within the software. You can optionally use the instrument control panel in conjunction with the SoftMax Pro Software to open the plate drawer, to adjust the temperature, and to adjust the wavelength settings. See the *SoftMax Pro Data Acquisition and Analysis Software User Guide*.

When you connect the instrument to a printer and operate it in standalone mode, the instrument control panel allows you to run basic Absorbance read mode protocols. The instrument control panel consists of a 2-x-20-character LCD and the following buttons.

- **Temp On/Off** - For the Endpoint read type, press to turn the incubator on or off. When the incubator is on, the set temperature and the actual temperature display in the LCD. Temperature settings are not applicable for the Kinetic and Spectrum read types.
- **Temp** ▲ and ▼ - Press to adjust the plate chamber temperature by 0.1°C increments. Press and hold to rapidly adjust the temperature in 1°C increments.
- **λ** ▲ and ▼ - Press to adjust the wavelength by 1 nm. Press and hold to rapidly adjust the wavelength in 10 nm increments. Wavelength settings are not available for the VersaMax.
- **96/384** - For the SpectraMax 340PC384, press to select to read a 96-well plate or a 384-well plate.
- **REF** - For the SpectraMax Plus 384, press to do a Cuvette Reference correction method read of buffer, water, or air taken in the cuvette that is used as I_0 to calculate Absorbance or % Transmittance with the PathCheck Pathlength Measurement Technology. If no reference read is taken, the instrument uses the I_0 values stored in the instrument firmware. See PathCheck Pathlength Measurement Technology on page 18.
- **Read Cuvette** - For the SpectraMax Plus 384, press to initiate the sample read of the cuvette.
- **Read** - For the SpectraMax 190 and SpectraMax 340PC384, press to initiate the plate read when you operate the instrument in standalone mode. Data is sent to the printer port.
- **% T/A** - For the SpectraMax Plus 384, press to change the display of cuvette data between percent transmission and absorbance.
- **Drawer** - Press to open or close the plate drawer.

General Workflow

CAUTION! Use of organic solvents can cause harm to the optics in the instrument. Extreme caution is recommended when you use organic solvents. Always use a plate lid and do not place a plate that contains these materials in the plate chamber for prolonged periods of time. Damage caused by the use of incompatible or aggressive solvents is NOT covered by the instrument warranty.

The computer running the SoftMax Pro Software operates the instrument. You can use the instrument to run Absorbance read mode, Endpoint read type, Kinetic read type, and Spectrum read type protocols. See the SoftMax Pro Software User Guide.

1. Power on the instrument and the connected computer.
2. Use the computer to define the protocol settings including plate type, read type, read area, wavelength, detection speed, temperature, shake, and kinetic timing.
3. Use the computer to open the plate drawer or manually lift the cuvette chamber door. If you adjust the chamber temperature, the drawer closes after approximately 10 seconds to maintain temperature control.
4. Place the plate on the plate slide for a plate read (well A1 on the front left of the drawer) or place the cuvette into the cuvette chamber for a cuvette read (springs hold the cuvette in place) Handle cuvettes on the frosted sides only. Place the cuvette into the chamber so that the “reading” (clear) sides face left and right.
5. Use the computer to close the plate drawer or manually close the cuvette door.
6. Use the computer to start the read.
7. The computer displays the read data and the plate drawer opens.

Chapter 4: Absorbance Read Mode

The instrument uses the Absorbance (ABS) read mode to measure the Optical Density (OD) of the sample solutions.

Absorbance is the quantity of light absorbed by a solution. To measure absorbance accurately, it is necessary to eliminate light scatter. If there is no turbidity, then absorbance = optical density.

$$A = \log_{10}(I_0 / I) = -\log_{10}(I/I_0)$$

where I_0 is intensity of the incident light before it enters the sample divided by the light after it passes through the sample, and A is the measured absorbance.

The temperature-independent PathCheck® Pathlength Measurement Technology normalizes your absorbance values to a 1 cm path length based on the near-infrared absorbance of water.

The instrument allows you to choose whether to display absorbance data as Optical Density (OD) or %Transmittance (%T).

Optical Density

Optical density (OD) is the quantity of light passing through a sample to a detector relative to the total quantity of light available. Optical Density includes absorbance of the sample plus light scatter from turbidity and background. You can compensate for background using blanks.

A blank well contains everything used with the sample wells except the chromophore and sample-specific compounds. Do not use an empty well for a blank.

Some applications are designed for turbid samples, such as algae or other micro-organisms in suspension. The reported OD values for turbid samples are likely to be different when read by different instruments.

For optimal results, you should run replicates for all blanks, controls, and samples. In this case, the blank value that will be subtracted is the average value of all blanks.

% Transmittance

%Transmittance is the ratio of transmitted light to the incident light for absorbance reads.

$$T = I/I_0$$

$$\%T = 100T$$

where I is the intensity of light after it passes through the sample and I_0 is incident light before it enters the sample.

Optical Density and %Transmittance are related by the following formulas:

$$\%T = 10^{2-OD}$$

$$OD = 2 - \log_{10}(\%T)$$

The factor of two comes from the fact that %T is expressed as a percent of the transmitted light and $\log_{10}(100) = 2$.

When in %Transmittance analysis mode, the instrument converts the raw OD values reported by the instrument to %Transmittance using the above formula. All subsequent calculations are done on the converted numbers.

Applications of Absorbance

Absorbance-based detection is commonly used to evaluate changes in color or turbidity, permitting widespread use including ELISAs, protein quantitation, endotoxin assays, and cytotoxicity assays.

PathCheck Pathlength Measurement Technology

The temperature-independent PathCheck® Pathlength Measurement Technology normalizes your absorbance values to a 1 cm path length based on the near-infrared absorbance of water.

The Beer–Lambert law states that absorbance is proportional to the distance that light travels through the sample:

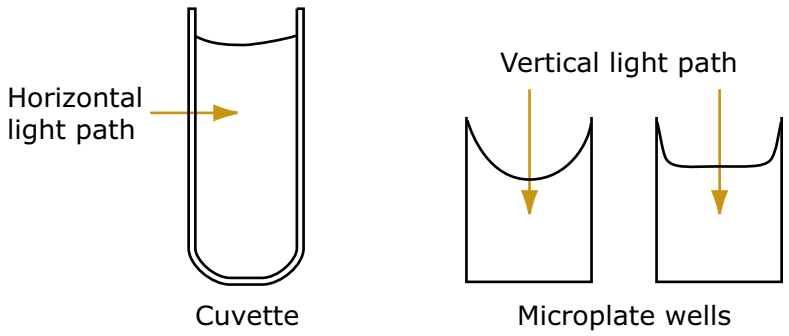
$$A = \varepsilon cL$$

where *A* is the absorbance, ε is the molar absorptivity of the sample, *c* is the concentration of the sample, and *L* is the pathlength. The longer the pathlength, the higher the absorbance.

Microplate readers use a vertical light path so the distance of the light through the sample depends on the volume. This variable pathlength makes it difficult to do extinction-based assays and makes it confusing to compare results between microplate readers and spectrophotometers.

The standard pathlength of a 1 cm cuvette is the conventional basis to quantify the unique absorptivity properties of compounds in solution. Quantitative analysis can be done on the basis of extinction coefficients, without standard curves (for example, NADH-based enzyme assays). When you use a cuvette, the pathlength is known and is independent of sample volume, so absorbance is directly proportional to concentration when there is no background interference.

In a plate, pathlength is dependent on the liquid volume, so absorbance is proportional to both the concentration and the pathlength of the sample. Standard curves are often used to determine analyte concentrations in vertical-beam photometry of unknowns, yet errors can still occur from pipetting the samples and standards. The PathCheck technology determines the pathlength of aqueous samples in the plate and normalizes the absorbance in each well to a pathlength of 1 cm. This way of correcting the microwell absorbance values is accurate to within ±4% of the values obtained directly in a 1 cm cuvette.



PathCheck technology normalizes the data acquired from an Absorbance read mode Endpoint read type to a 1 cm pathlength, correcting the OD for each well to the value expected if the sample were read in a 1 cm cuvette. The instrument uses the factory installed Water Constant to obtain the 1 cm values. For the SpectraMax Plus 384 you can read a cuvette that contains deionized water or buffer to use the Cuvette Reference correction method (typically not necessary when you use aqueous solutions with minimal alcohol, salt, or organic solvent content).

Water Constant

The PathCheck technology is based on the absorbance of water in the near infrared spectral region (between 900 nm and 1000 nm). If the sample is completely aqueous, has no turbidity and has a low salt concentration (less than 0.5 M), the Water Constant correction method is sufficient. The Water Constant is determined for each instrument during manufacture and is stored in the instrument.

Cuvette Reference

The SpectraMax Plus 384 supports the Cuvette Reference correction method for solvents that do not absorb in the 900 nm to 1000 nm range.

Note: The Cuvette Reference correction method that the software uses with the PathCheck Pathlength Measurement Technology is different from the reference read of a cuvette that occurs when you click the Ref button in the Cuvette Set section tool bar.

Use the Cuvette Reference correction method if the sample contains an organic solvent such as ethanol or methanol. When you add a non-interfering solvent to the aqueous sample, the water absorbance decreases proportionally to the percentage of organic solvent present. For example, 5% ethanol decreases the water absorbance by 5% and results in a 5% underestimation of the pathlength. To minimize the error, put the same water/solvent mixture in a cuvette and use the Cuvette Reference.

Place a standard 1 cm cuvette that contains the aqueous/solvent mixture you use for the plate samples into the cuvette port. The cuvette must be in place when you read the plate. When you click Read, the instrument first makes the 900 nm and 1000 nm measurements in the cuvette and then makes the designated measurements in the plate. The software temporarily stores the cuvette values and uses the cuvette values in the PathCheck calculations for the plate samples.

The Cuvette Reference data does not display in a Cuvette Set section. The software uses the Cuvette Reference data for PathCheck Pathlength Measurement Technology calculations on the data the instrument collects from the plate. You can use the accessors in the Formula Editor dialog to obtain these values. See the !PathCheckLm1000 and !PathCheckLm900 accessor in the *SoftMax Pro Data Acquisition and Analysis Software Formula Reference Guide*.

Note: After you read a plate with PathCheck technology turned on, the software stores PathCheck information permanently in the document. You can apply or not apply PathCheck technology to the absorbance values. If you do select to use PathCheck technology for the plate read, you cannot apply the PathCheck Pathlength Measurement Technology feature after the read.

Eliminating the Pathlength Independent Component

Raw OD measurements of plate samples include both pathlength-dependent components (sample and solvent) and a pathlength-independent component (OD of plate material). The pathlength-independent component must be eliminated from the calculation to get valid results that have been normalized by the PathCheck technology. You can do this using a plate blank or using a plate background constant.

Using a Plate Blank

You can use this method if all samples in the plate are the same volume and the read does not depend on the PathCheck technology to correct for variability in volumes.

To use a plate blank:

1. Designate a minimum of one well (preferably several) as Plate Blank.
2. Pipette buffer (for example, your sample matrix) into those wells and read along with the samples. Do not use an empty well for a blank.
   The instrument automatically subtracts the average of the blank wells from each of the samples. The OD of the plate material is subtracted as part of the blank.
3. Select the Use Plate Blank check box in the Data Reduction dialog.

Using a Plate Background OD

If your sample volumes are not identical or if you choose not to use a Plate Blank, then you must use a Plate Background OD. Omitting a Plate Background OD results in artificially high values after being normalized by the PathCheck technology.

To determine the Plate Background OD:

1. Fill a clean plate with water.
2. Read at the wavelengths you will use for the samples.

The average OD value is the Plate Background OD. If you intend to read your samples at more than one wavelength, there should be a corresponding number of Plate Background OD values for each wavelength.

Note: It is important that you put water in the wells and do not read a dry plate for the Plate Background OD. A dry plate has a slightly higher OD value than a water filled plate because of differences in refractive indices. Use of a dry plate results in PathCheck technology normalized values that are lower than 1 cm cuvette values.

Interfering Substances

Material that absorbs in the 900 nm to 1000 nm spectral region could interfere with PathCheck technology measurements. Fortunately, there are few materials that do interfere at the concentrations generally used.

Turbidity is the most common interference. If you can detect turbidity in your sample, you should not use the PathCheck technology. Turbidity elevates the 900 nm measurement more than the 1000 nm measurement and causes an erroneously low estimate of pathlength. Use of the Cuvette Reference does not reliably correct for turbidity.

Samples that are highly colored in the upper-visible spectrum might have absorbance that extends into the near-infrared (NIR) spectrum and can interfere with the PathCheck technology. Examples include Lowry assays, molybdate-based assays, and samples that contain hemoglobins or porphyrins. In general, if the sample is distinctly red or purple, you should check for interference before you use the PathCheck technology.

To determine possible color interference:

- Measure the OD at 900 nm and 1000 nm (both measured with air reference).
- Subtract the 900 nm value from the 1000 nm value.

Do the same for pure water.

If the delta OD for the sample differs significantly from the delta OD for water, then you should not use the PathCheck technology.

Organic solvents could interfere with the PathCheck technology if the solvents have absorbance in the region of the NIR water peak. Solvents such as ethanol and methanol do not absorb in the NIR region, so the solvents do not interfere, except to cause a decrease in the water absorbance to the extent of their presence in the solution. If the solvent absorbs between 900 nm and 1000 nm, the interference would be similar to the interference of highly colored samples. If you add an organic solvent other than ethanol or methanol, you should run a Spectrum scan between 900 nm and 1000 nm to determine if the solvent would interfere with the PathCheck technology.

Read Types

The instrument supports the following read types:

Endpoint Read Type

In an endpoint read type, a read of each plate well is taken in the center of each well, at a single wavelength or at multiple wavelengths. Raw data values are reported as optical density (OD), % transmittance (%T), relative fluorescence units (RFU), or relative luminescence units (RLU).

Kinetic Read Type

In a kinetic read type, the instrument collects data over time with multiple readings taken in the center of each well at regular intervals. To achieve the shortest possible interval for kinetic reads, choose wavelengths in ascending order.

The software can do the following calculations based on raw data: VMax, VMax per Sec, Time to VMax, and Onset Time. Kinetic reads can be single wavelength or multiple wavelength readings.

The kinetic read type can collect data points in time intervals of seconds, minutes, or hours (up to 99 hours).

Kinetic analysis has many advantages to determine the relative activity of an enzyme in different types of plate assays, including ELISAs and the purification and characterization of enzymes and enzyme conjugates. Kinetic analysis is capable of providing improved dynamic range, precision, and sensitivity relative to endpoint analysis.

Spectrum Read Type

A spectrum read measures optical density (OD), %Transmittance (%T), relative fluorescence units (RFU), or relative luminescence units (RLU) across a spectrum of wavelengths.

Spectrum reads are made using the scanning monochromators of the instrument.

- SpectraMax Plus 384 - Wavelengths from 190 nm to 1000 nm
- SpectraMax 190 - Wavelengths from 190 nm to 850 nm
- SpectraMax 340PC384 - Wavelengths 340 nm to 840 nm
- VersaMax - Not applicable

Chapter 5: Maintenance

Perform only the maintenance tasks described in this guide. Contact a Molecular Devices service engineer to inspect and perform a preventive maintenance service on the instrument each year. See Obtaining Support on page 31.

Before you operate the instrument or perform maintenance operations, make sure you are familiar with the safety information in this guide. See Safety Information on page 4.

CAUTION! Maintenance procedures other than those specified in this guide must be performed by Molecular Devices. When service is required, contact Molecular Devices technical support.

Cleaning the Instrument

Observe the cleaning procedures outlined in this guide for the instrument.

WARNING! BIOHAZARD. It is your responsibility to decontaminate components of the instrument before you request service by a service engineer or you return parts to Molecular Devices for repair. Molecular Devices does not accept items that have not been decontaminated where applicable to do so. If parts are returned, they must be enclosed in a sealed plastic bag that states that the contents are safe to handle and are not contaminated.

WARNING! BIOHAZARD. Always wear gloves when you operate the instrument and when you perform cleaning procedures that could involve contact with either hazardous or biohazardous materials or fluids.

Do the following before you clean equipment that has been exposed to hazardous material:

- Contact the applicable Chemical and Biological Safety personnel.
- Review the Chemical and Biological Safety information contained in this guide. See Chemical and Biological Safety on page 6.

Should fluids spill in the drawer area when the drawer is out, they are directed to a tray at the bottom of the instrument, from which they exit to the bench or counter beneath the instrument. Wipe up any spills immediately.

To clean the instrument, use disinfectant wipes according to the supplier instructions. Disinfect the entire instrument outer surface with an emphasis on the following areas you will handle when packing, unpacking, and servicing the instrument:

- Plate Carrier
- Cuvette Chamber (SpectraMax Plus 384)
- Instrument Top
- Cover Edges
- Underneath Between Instrument Feet
- Rear Edges (do not damage the warranty seal)

Always turn the power off and disconnect the power cord from the main power source before you use liquids to clean the instrument.

- Periodically clean the outside surfaces of the instrument using a cloth or sponge that has been lightly dampened with water.
- If required, clean the surfaces using a mild soap solution diluted with water or a glass cleaner and then wipe with a damp cloth or sponge to remove all residue.
- If needed, clean the plate drawer using a cloth or sponge that has been lightly dampened with water.
- If a bleach solution has been used, wipe the instrument using a lint-free cloth that has been lightly dampened with water to remove the bleach residue.

CAUTION! Do not use abrasive cleaners. Do not spray cleaner directly onto the instrument or into any openings. Do not let water or other fluids drip inside the instrument.

Clean Fan Filter

The fan filter on the bottom of the instrument requires periodic cleaning. The frequency of cleaning depends on the cleanliness of the lab and could range from once a month to once every six months.

1. Remove the plate or adapter from the plate drawer.
2. Power off the instrument.
3. Remove the power cord and cables from the back of the instrument.
4. Turn the instrument over so that it rests upside down flat on the bench.
5. Pop the black fan cover off and remove the filter.
6. Clean the filter by blowing clean, canned air through it or by rinsing it — first with water and then with alcohol.
7. Allow the filter to dry completely.
8. Place the clean, dry filter over the fan and replace the black cover.
9. Turn the instrument right side up.
10. Reconnect the power cord and cables to the instrument.

Replacing Fuses

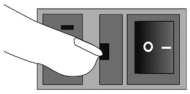
If the instrument does not seem to get power after you switch it on, check to see whether the power cord is securely plugged into a functioning power outlet and to the power port on the rear of the instrument.

If the power failed while the instrument was on, verify that the power cord is not loose or disconnected and that power to the power outlet is functioning properly.

If these checks fail to remedy the loss of power, replace the fuses. You can obtain replacement fuses from Molecular Devices.

CAUTION! Do not touch or loosen screws or parts other than those specifically designated in the instructions. Doing so could cause misalignment and possibly void the warranty.

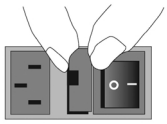
The fuses are located in the fuse carrier which is part of the power switch on the rear of the instrument.



To replace the fuses:

WARNING! HIGH VOLTAGE Always turn off the power and disconnect the power cord from the main power source before you do a maintenance procedure that requires removal of a panel or cover or disassembly of an interior instrument component.

1. Power off the instrument.
2. Unplug the power cord from the power port.
3. Use a small slot-head screwdriver to gently press on the carrier-release tab and then pull the fuse carrier to remove it from the instrument.



4. Gently pull the old fuses from the carrier by hand.

5. Gently place new fuses into the carrier by hand.
6. Press the fuse carrier into the instrument until the carrier snaps into place.
7. Plug the power cord into the power port.
8. Turn on power to the instrument.

Note: If the instrument still does not power on after you change the fuses, contact Molecular Devices technical support.

Before You Move the Instrument

Before you move the instrument, make sure that the new location is a dry, flat work area that has sufficient space for the instrument, host computer, and required cables.

CAUTION! When transporting the instrument, warranty claims are void if improper packing results in damage to the instrument.

To minimize the possibility of damage during storage or shipment, you should pack the instrument in the original packaging materials. Correctly repacking the instrument includes following applicable decontamination procedures and packing instructions.

Note: If you must store the instrument, then store it in a dry, dust-free, environmentally controlled area.

Packing the Instrument

The original packaging is designed to protect the instrument during shipment.

CAUTION! When transporting the instrument, warranty claims are void if damage during transport is caused by improper packaging.

To pack the instrument:

1. Make sure the plate drawer and cuvette chamber are empty.
2. Place tape to hold the cuvette chamber door closed.
3. Place the instrument back in the plastic bag.
4. Place the packing material on both ends of the instrument.
5. Place the instrument and the accessories tool box into the original instrument shipping box.
6. Seal the top of the box with packing tape.

Chapter 6: Troubleshooting

Do only the maintenance described in this guide. Maintenance procedures other than those specified in this guide must be done by qualified Molecular Devices personnel only. See Obtaining Support on page 31.

WARNING! BIOHAZARD: It is your responsibility to decontaminate the instrument, as well as any accessories, before requesting service by Molecular Devices representatives and before returning the instrument or any components to Molecular Devices Corporation.

Error Codes and Resolutions

Fatal Error codes display on the instrument control panel LCD display when a situation arises that requires attention that is significant enough to stop a read in progress. Warning messages indicate a situation that requires attention but is not sufficient to stop or prevent a read. These messages are logged in the error buffer. Examples of situations that might cause warning messages are low memory, entries out of range, or operations that could result in loss of data. These messages are generally self-explanatory. For assistance regarding warning messages, contact your local Molecular Devices representative.

Error Code Classifications

Not all error messages are listed here.

Error Code Ranges	Possible Causes
100-199	Errors possibly caused by unrecognized commands sent from the computer to the instrument.
200-299	Errors probably due to a main board failure or an error in the firmware code. Most of these errors require the assistance of Technical Support.
300-399	Instrument errors due to either a main board failure or other system failure. Most of these errors require the assistance of Technical Support.
400-499	Errors caused by a motor motion failure. Most of these errors require the assistance of Technical Support.
500-599	Errors due to failure or improper initialization of the instruments non-volatile memory (NVRAM). All of these errors require the assistance of Technical Support.

Some errors are considered fatal if they are detected during power up. The instrument aborts the power up sequence and displays FATAL ERROR on the LCD panel.

If the instrument functions normally when you use the SoftMax Pro Software, no errors should be in the buffer (except error number 100).

The following table lists the unrecognized errors sent from the computer.

Error Code	Error Message	Notes
100	command not found	Command string not recognized.
101	invalid argument	Command argument not recognized.
102	too many arguments	Too many arguments after command.
103	not enough arguments	Missing arguments.
104	input line too long	Too many characters in the input line.
105	command invalid, system busy	Instrument could not perform the command because it was busy doing another task.
106	command invalid, measurement in progress	Instrument could not perform command because a measurement was in progress.
107	no data to transfer	Inputting transfer when there is no data in the buffer.
108	data buffer full	Too many data sets in the buffer. Can be caused by setting up a long kinetic read then disconnecting computer or the SoftMax Pro Software is preempted by another application.
109	error buffer overflow	More than 65 errors in the buffer, clear the buffer.
110	stray light cuvette, door open?	Cuvette door open while doing a read.
111	invalid read settings	

Firmware Error Codes	Error Message	Notes
200	assert failed	Firmware error.
201	bad error number	Firmware error.
202	receive queue overflow	Caused by external device sending too much data over serial port and ignoring flow control.
203	serial port parity error	Parity bit error detected with incoming serial data.
204	serial port overrun error	Caused by host computer sending too much data and ignoring the flow control signal.
205	serial port framing error	
206	cmd generated too much output	Firmware error.
207	fatal trap	Instrument error. Instrument locks up.
208	RTOS error	Firmware error.
209	stack overflow	Firmware error.
210	unknown interrupt	Firmware error.

Hardware Error Codes	Error Message	Notes
300	thermistor faulty	Unable to read a reasonable thermistor value. Thermistor faulty or disconnected, main board problem, or ambient temperature out of range.
301	safe temperature limit exceeded	A temperature of over 50°C detected on one or more of the 4 thermistors. Temperature is shut off and remains off until a successful completion of power-up reset.
302	low light	Not enough light detected to make an accurate measurement. If doing a cuvette read, the cuvette door may be open.
303	unable to cal dark current	Too much stray light detected on powerup, faulty or disconnected pre-amp boards.
304	signal level saturation	During a cuvette read, could be due to cuvette door being open.
305	reference level saturation	During a cuvette read, could be due to cuvette door being open.
306	plate air cal fail, low light	Minimum signal/reference ratio not met during air calibration.
307	cuv air ref fail	
308	stray light	Light leak in read chamber or cuvette door open. Could also be a faulty pre-amp board.
309	front panel not responding	LCD front panel bad or disconnected.
312	gain calibration failed	Power-up calibration and check of signal path gain is out of tolerance. Could be due to bad or disconnected pre-amp or excessive stray light.
313	reference gain check fail	Power-up check of the reference amplifier gain out of tolerance. Could be due to bad or disconnected pre-amp board or excessive stray light.
314	low lamp level warning	
315	can't find zero order	On power-up, grating motor could not find zero-order home position.
316	grating motor driver faulty	Grating motor did not move to where it was commanded to in a reasonable time.
317	monitor ADC faulty	

Motion Error Codes	Error Message	Notes
400	carriage motion error	Carriage did not move to either of its photo interrupts in a reasonable time, or cannot find its photo interrupt.
401	filter wheel error	Filter wheel did not move to its photo interrupt in a reasonable time, or cannot find its photo interrupt.
402	grating error	Grating did not move to its photo interrupt in a reasonable time, or cannot find its photo interrupt.
403	stage error	Stage did not move to its photo interrupt in a reasonable time, or cannot find its photo interrupt.

NVRAM Error Codes	Error Message	Notes
500	NVRAM CRC corrupt	The CRC for the NVRAM data is corrupt.
501	NVRAM Grating cal data bad	Grating calibration data is unreasonable.
502	NVRAM Cuvette air cal data error	Cuvette air calibration data is unreasonable.
503	NVRAM Plate air cal data error	Plate air calibration data is unreasonable.
504	NVRAM Carriage offset error	Carriage offset data is unreasonable.
505	NVRAM Stage offset error	Stage offset data is unreasonable.
506	NVRAM Battery	Time to replace the NVRAM battery (U3).

For all other error messages, contact your local Molecular Devices representative for assistance.

Opening the Drawer Manually

If an error occurs while the drawer is closed and you need to remove a plate.

- If the drawer does not open, turn power to the instrument off and then on again.
- If the drawer remains closed, turn the incubator off (if it was on).
- If the drawer still remains closed, power off the instrument and unplug the power cord. Then try to use a blunt, flat object (such as a spatula) to open the door. With your index finger, pull the plate drawer out of the instrument (do not force the drawer) and remove the plate. This action will not harm the instrument, but should only be taken if the first two options fail to open the drawer.

If you are still unable to open the drawer, contact your local Molecular Devices representative.

Obtaining Support

Molecular Devices is a leading worldwide manufacturer and distributor of analytical instrumentation, software, and reagents. We are committed to the quality of our products and to fully supporting our customers with the highest level of technical service.

Our Support website, www.moleculardevices.com/service-support, has a link to the Knowledge Base, which contains technical notes, software upgrades, safety data sheets, and other resources. If you still need assistance after consulting the Knowledge Base, you can submit a request to Molecular Devices Technical Support.

You can contact your local representative or Molecular Devices Technical Support at 800-635-5577 X 1815 (North America only) or +1 408-747-1700. In Europe call +44 (0) 118 944 8000.

To find regional support contact information, visit www.moleculardevices.com/contact.

Please have your instrument serial number or Work Order number, and your software version number available when you call.

Appendix A: Instrument Specifications

Thermal specifications for plates apply to flat-bottom plates with isolated wells. All other plate specifications apply to standard 96-well polystyrene flat-bottom plates. Molecular Devices provides validation documentation for software and hardware, as well as absorbance, fluorescence, and luminescence detection test tools with its SpectraTest® solutions. The SpectraTest line of microplate reader validation packages provide automated and comprehensive validation of a microplate reader's optical performance.

Validation Packages Part Numbers

Part Number	Item Name	Compatible Instruments
0200-6117	SpectraTest ABS1 Absorbance Validation Plate	FlexStation 3, SpectraMax 190, 340PC 384, ABS, ABS Plus, i3, i3x, iD3, iD5, M2, M2e, M3, M4, M5, M5e, Plus 384, VersaMax
0200-6191	SpectraTest ABS2 Absorbance Validation Plate	FlexStation 3, SpectraMax ABS, ABS Plus, i3, i3x, iD3, iD5, M2, M2e, M3, M4, M5, M5e, Plus 384
0200-5060	SpectraTest FL1 Fluorescence Validation Plate	FlexStation 3, Gemini EM, Gemini XPS, SpectraMax i3, i3x, iD3, iD5, M2, M2e, M3, M4, M5, M5e
0200-6186	SpectraTest LM1 Luminescence Validation Plate	FlexStation 3, SpectraMax i3, i3x, iD3, iD5, SpectraMax L, M3, M4, M5, M5e
0200-2420	Cuvette Absorbance Validation Set	SpectraMax ABS Plus, M2, M2e, M3, M4, M5, M5e, Plus 384
0200-7200	Multi-Mode Validation Plate	FilterMax F3, FilterMax F5, SpectraMax i3*, i3x*, iD5*, SpectraMax Paradigm * Specific read modes or cartridges.

SpectraMax Plus 384 Specifications

Performance specifications for cuvette reads apply to aqueous solutions that have solute molal concentrations less than 0.4 M. When you apply pathlength compensation to plate absorbance measurements, agreement with cuvette absorbance measurements for the same solution requires that the solution volume in the plate well is between 100 µL and 300 µL.

Photometric Performance SpectraMax Plus 384

Item	Description
Wavelength range	190 nm to 1000 nm
Wavelength selection	Monochromator tunable in 1 nm increments
Wavelength bandwidth	≤ 2.0 nm full width half maximum
Wavelength accuracy	±1.0 nm across wavelength range
Wavelength repeatability	±0.2 nm
Photometric range	0 to 4.000 OD
Photometric resolution	0.001 OD
Photometric accuracy linearity (plate), 0-2.0 OD	190-1000 nm < ± 1.0% and ± 0.006 OD
Photometric accuracy linearity (cuvette), 0-2.0 OD	190-1000 nm < ± 1.0% and ± 0.005 OD
Photometric precision (repeatability)	190-1000 nm < ± 1.0% and ± 0.003 OD
Stray light	≤ 0.05% at 230 nm
Photometric stabilization	Instantaneous
Photometric drift	None (continuous referencing of monochromatic input)
Calibration	Automatic before every endpoint read and before the first kinetic read
Optical alignment	None required
Light source	Xenon flash lamp (5 Watts)
Average lamp lifetime	1 billion flashes
Illumination	Top down (plates); horizontal (cuvettes)
Photodetector	Silicon photodiode

Photometric Analysis Modes SpectraMax Plus 384

Item	Description
Standalone	Single wavelength Absorbance or %Transmittance read of the cuvette (or test tube)
SoftMax Pro Software	Express data as Absorbance or %Transmittance Single wavelength read of plate and/or cuvette Multiple wavelength (up to six) read of plate or cuvette Kinetic read type and kinetic graphics of plate and/or cuvette Spectrum read type (190–1000 nm) of plate and/or cuvette

Measurement Time for Plates (calibration off) SpectraMax Plus 384

Item	96-Wells	384-Wells
Endpoint standard read *Measurement conditions: endpoint, column priority (for dual-wavelength measurements), calibrate off.	9 seconds single wavelength 19 seconds dual wavelength 425 & 650 nm	29 seconds single wavelength 59 seconds dual wavelength 425 & 650 nm
Endpoint speed read *Measurement conditions: endpoint, column priority (for dual-wavelength measurements), calibrate off.	5 seconds single wavelength 12 seconds dual wavelength 425 & 650 nm	16 seconds single wavelength 34 seconds dual wavelength 425 & 625
Kinetic read intervals	9 seconds minimum interval between reads single wavelength 1 column, 2-second minimum interval between reads Single wavelength	29 seconds minimum interval between reads single wavelength

Measurement Time for Cuvettes (calibration off) SpectraMax Plus 384

Item	Description
Endpoint	1 second single wavelength
Kinetic	2 seconds minimum interval between reads single wavelength

Scan Speed (*K = wavelength interval) SpectraMax Plus 384

Item	Description
Plate: normal scan	33*K nm/min (8-well strip) 21*K nm/min (16-well strip)
Plate: speed scan	135*K nm/min (8-well strip) 77*K nm/min (16-well strip)
Cuvette: normal scan	45*K nm/min
Cuvette: speed scan	130*K nm/min

Temperature Regulation SpectraMax Plus 384

Item	Description
Read chamber	Isothermal when temperature regulation is not enabled
Range	4°C above ambient to 45°C when temperature regulation enabled. The ambient temperature must be >20°C to achieve temperature regulation at 45°C.
Resolution	± 0.1°C
Accuracy	± 1.0°C for plate chamber and cuvette chamber
Temperature uniformity at equilibrium	± 0.5°C at 37°C
Chamber warm-up time	15–30 minutes (measured on air) after initiation of temperature regulation
Temperature regulation	4 sensors
Drift	± 0.2°C (regulated)
Temperature regulation diagnostics	Temperature regulation system is continuously monitored and updated
Evaporation	Plate lid required to minimize evaporative cooling
Recommended plate	Flat-bottom plates with isolated wells and lid

Shake SpectraMax Plus 384

Item	Description
Shake modes	Selectable: off, once prior to any read, and once prior to and between kinetic reads
Shake duration	Selectable: 1 to 999 seconds (three-second default)

Compatibility SpectraMax Plus 384

Item	Description
Plates	Standard and half-area 96-well flat-bottomed plates (0.3 mL). 384-well flat bottomed plates. Polystyrene plates for wavelengths above 340 nm; UV transparent plates above 220 nm; quartz plates above 190 nm.
Cuvettes	Standard height (45 mm) cells with 10 mm pathlength (12.5 mm x 12.5 mm outside) with minimum inside width of 4 mm (typical for 3 mL volume cells).
Test tubes	12 x 75 mm test tubes with test tube cover, read in the cuvette chamber.

General Instrument SpectraMax Plus 384

Item	Description
Display	2-x-20-character back lit LCD
Control panel	8-key membrane keypad
Self-diagnosis	Continuous on-board diagnostics
Spill control	Drawer mechanism and read chamber assembly protected from accidental spillage by drainage ports
Computer interface	USB cable
Printer interface	Parallel 25-pin to Centronics (double shielding required)
Supported plates	All 96-well and strip-well plates, including lids

Environmental (for indoor use only) SpectraMax Plus 384

Item	Description
Operating temperature	15°C to 40°C
Operating Humidity	0 to 70%, non-condensing
Storage temperature	-20°C to 65°C

Physical SpectraMax Plus 384

Item	Description
Size (h x w x d)	220 mm (8.6") x 580 mm (22.8") x 380 mm (15")

Physical SpectraMax Plus 384 (continued)

Item	Description
Weight	13.6 kg (30 lb)
Power consumption	< 250 W
Line voltage and frequency	100–240 VAC autoranging, 50/60 Hz

SpectraMax 340PC384 Specifications

Technical specifications are subject to change without notice.

Photometric Performance SpectraMax 340PC384

Item	Description
Wavelength range	340 nm to 850 nm
Wavelength selection	Monochromator tunable in 1 nm increments
Wavelength bandwidth	≤ 2.0 nm full width half maximum
Wavelength accuracy	±1.0 nm across wavelength range
Wavelength repeatability	±0.2 nm across all optical channels
Photometric range	0 to 4.000 OD
Photometric resolution	0.001 OD
Photometric accuracy linearity (plate), 0-2.0 OD	340-850 nm < ± 1.0% and ± 0.006 OD
Photometric precision (repeatability), 0-2.0 OD	340-850 nm < ± 1.0% and ± 0.003 OD
Stray light	≤ 0.05% at 340 nm
Photometric stabilization	Instantaneous
Photometric drift	None (continuous referencing of monochromatic input)
Calibration	Automatic before every endpoint read and before the first kinetic read
Optical alignment	None required
Light source	Xenon flash lamp (5 Watts)
Average lamp lifetime	1 billion flashes
Illumination	Top down
Photodetector	Silicon photodiode

Photometric Analysis Modes SpectraMax 340PC384

Item	Description
Standalone	Single wavelength Absorbance or %Transmittance read of the plate
SoftMax Pro Software	Express data as Absorbance or %Transmittance Single wavelength read of plate Multiple wavelength (up to six) read of plate Kinetic read type and kinetic graphics of plate Spectrum read type (340–850 nm) of plate

Measurement Time (calibration off) SpectraMax 340PC384

Item	96-wells	384-wells
Endpoint standard read	9 seconds single wavelength 19 seconds dual wavelength 425 & 650 nm	29 seconds single wavelength 59 seconds dual wavelength 425 & 650 nm
Kinetic read intervals	9 seconds minimum interval between reads single wavelength 1 column, 2-second minimum interval between reads Single wavelength	29 seconds minimum interval between reads single wavelength

Scan Speed (*K = wavelength interval) SpectraMax 340PC384

Item	Description
Plate: normal scan	33*K nm/min (8-well strip) 21*K nm/min (16-well strip)
Plate: speed scan	135*K nm/min (8-well strip) 77*K nm/min (16-well strip)

Temperature Regulation SpectraMax 340PC384

Item	Description
Read chamber	Isothermal when temperature regulation is not enabled
Range	4°C above ambient to 45°C when temperature regulation enabled. The ambient temperature must be >20°C to achieve temperature regulation at 45°C.
Resolution	± 0.1°C
Accuracy	± 1.0°C for plate chamber
Temperature uniformity at equilibrium	± 0.5°C at 37°C
Chamber warm-up time	15–30 minutes (measured on air) after initiation of temperature regulation
Temperature regulation	4 sensors
Drift	± 0.2°C (regulated)
Temperature regulation diagnostics	Temperature regulation system is continuously monitored and updated
Evaporation	Plate lid required to minimize evaporative cooling
Recommended plate	Flat-bottom plates with isolated wells and lid

Shake SpectraMax 340PC384

Item	Description
Shake modes	Selectable: off, once prior to any read, and once prior to and between kinetic reads
Shake duration	Selectable: 1 to 999 seconds (three-second default)

Compatibility SpectraMax 340PC384

Item	Description
Plates	Standard and half-area 96-well flat-bottomed plates (0.3 mL). 384-well flat bottomed plates. Polystyrene plates for wavelengths above 340 nm; UV transparent plates above 220 nm; quartz plates above 190 nm.

General Instrument SpectraMax 340PC384

Item	Description
Display	2-x-20-character back lit LCD
Control panel	8-key membrane keypad
Self-diagnosis	Continuous on-board diagnostics
Spill control	Drawer mechanism and read chamber assembly protected from accidental spillage by drainage ports
Computer interface	USB cable
Printer interface	Parallel 25-pin to Centronics (double shielding required)
Supported plates	All 96-well and strip-well plates, including lids

Environmental (for indoor use only) SpectraMax 340PC384

Item	Description
Operating temperature	5°C to 40°C
Operating altitude	< 2000 m
Installation category	II
Pollution Degree	2
Operating humidity	< 80%
Storage temperature	-20°C to 65°C

Physical SpectraMax 340PC384

Item	Description
Size (h x w x d)	220 mm (8.6") x 580 mm (22.8") x 380 mm (15")
Weight	13.6 kg (30 lb)
Power consumption	< 250 W
Line voltage and frequency	100–240 VAC autoranging, 50/60 Hz

SpectraMax 190 Specifications

Technical specifications are subject to change without notice.

Photometric Performance SpectraMax 190

Item	Description
Wavelength range	190 nm to 850 nm
Wavelength selection	Monochromator tunable in 1 nm increments
Wavelength bandwidth	≤ 2.0 nm full width half maximum
Wavelength accuracy	±1.0 nm across wavelength range
Wavelength repeatability	±0.2 nm across all optical channels
Photometric range	0 to 4.000 OD
Photometric resolution	0.001 OD
Photometric accuracy linearity (plate), 0-2.0 OD	190-850 nm < ± 1.0% and ± 0.006 OD
Photometric precision (repeatability), 0-2.0 OD	190-850 nm < ± 1.0% and ± 0.003 OD
Stray light	≤ 0.05% at 230 nm
Photometric stabilization	Instantaneous
Photometric drift	None (continuous referencing of monochromatic input)
Calibration	Automatic before every endpoint read and before the first kinetic read
Optical alignment	None required
Light source	Xenon flash lamp (5 Watts)
Average lamp lifetime	1 billion flashes
Illumination	Top down
Photodetector	Silicon photodiode

Photometric Analysis Modes SpectraMax 190

Item	Description
Standalone	Single wavelength Absorbance read of the plate
SoftMax Pro Software	Express data as Absorbance or %Transmittance Single wavelength read of plate Multiple wavelength (up to six) read of plate Kinetic read type and kinetic graphics of plate Spectrum read type (190–850 nm) of plate

Measurement Time (calibration off) SpectraMax 190

Item	96-wells
Endpoint standard read	9 seconds single wavelength 19 seconds dual wavelength 425 & 650 nm
Kinetic read intervals	9 seconds minimum interval between reads single wavelength 1 column, 2-second minimum interval between reads Single wavelength

Scan Speed (*K = wavelength interval) SpectraMax 190

Item	Description
Plate: normal scan	33*K nm/min (8-well strip)
Plate: speed scan	135*K nm/min (8-well strip)

Temperature Regulation SpectraMax 190

Item	Description
Read chamber	Isothermal when temperature regulation is not enabled
Range	4°C above ambient to 45°C when temperature regulation enabled. The ambient temperature must be >20°C to achieve temperature regulation at 45°C.
Resolution	± 0.1°C
Accuracy	± 1.0°C for plate chamber
Temperature uniformity at equilibrium	± 0.5°C at 37°C
Chamber warm-up time	15–30 minutes (measured on air) after initiation of temperature regulation
Temperature regulation	4 sensors
Drift	± 0.2°C (regulated)
Temperature regulation diagnostics	Temperature regulation system is continuously monitored and updated
Evaporation	Plate lid required to minimize evaporative cooling
Recommended plate	Flat-bottom plates with isolated wells and lid

Shake SpectraMax 190

Item	Description
Shake modes	Selectable: off, once prior to any read, and once prior to and between kinetic reads
Shake duration	Selectable: 1 to 999 seconds (three-second default)

Compatibility SpectraMax 190

Item	Description
Plates	Standard and half-area 96-well flat-bottomed plates (0.3 mL).

General Instrument SpectraMax 190

Item	Description
Display	2-x-20-character back lit LCD
Control panel	8-key membrane keypad
Self-diagnosis	Continuous on-board diagnostics
Spill control	Drawer mechanism and read chamber assembly protected from accidental spillage by drainage ports
Computer interface	USB cable
Printer interface	Parallel 25-pin to Centronics (double shielding required)
Supported plates	All 96-well and strip-well plates, including lids

Environmental (for indoor use only) SpectraMax 190

Item	Description
Operating temperature	5°C to 40°C
Operating altitude	< 2000 m
Installation category	II
Pollution degree	2
Operating humidity	< 80%
Storage temperature	-20°C to 65°C

Physical SpectraMax 190

Item	Description
Size (h x w x d)	220 mm (8.6") x 580 mm (22.8") x 380 mm (15")
Weight	13.6 kg (30 lb)
Power consumption	< 250 W
Line voltage and frequency	100–240 VAC autoranging, 50/60 Hz

VersaMax Specifications

Technical specifications are subject to change without notice.

Photometric Performance VersaMax

Item	Description
Wavelength range	340 nm to 850 nm
Wavelength selection	Monochromator tunable in 1 nm increments
Wavelength bandwidth	≤ 2.0 nm full width half maximum
Wavelength accuracy	±1.0 nm across wavelength range
Wavelength repeatability	±0.2 nm across all optical channels
Photometric range	0 to 4.000 OD
Photometric resolution	0.001 OD
Photometric accuracy linearity (plate), 0-2.0 OD	340-850 nm < ± 1.0% and ± 0.006 OD
Photometric precision (repeatability), 0-2.0 OD	340-850 nm < ± 1.0% and ± 0.003 OD
Stray light	≤ 0.05% at 340 nm
Photometric stabilization	Instantaneous
Photometric drift	None (continuous referencing of monochromatic input)
Calibration	Automatic before every endpoint read and before the first kinetic read
Optical alignment	None required
Light source	Xenon flash lamp (5 Watts)
Average lamp lifetime	1 billion flashes
Illumination	Top down
Photodetector	Silicon photodiode

Photometric Analysis Modes VersaMax

Item	Description
SoftMax Pro Software	Express data as Absorbance or %Transmittance Single wavelength read of plate Dual wavelength read of plate Kinetic read type and kinetic graphics of plate

Measurement Time (calibration off) VersaMax

Item	96-wells
Endpoint standard read	9 seconds single wavelength 19 seconds dual wavelength 425 & 650 nm
Kinetic read intervals	9 seconds minimum interval between reads single wavelength 1 column, 2-second minimum interval between reads Single wavelength

Temperature Regulation VersaMax

Item	Description
Read chamber	Isothermal when temperature regulation is not enabled
Range	4°C above ambient to 45°C when temperature regulation enabled. The ambient temperature must be >20°C to achieve temperature regulation at 45°C.
Resolution	± 0.1°C
Accuracy	± 1.0°C for plate chamber
Temperature uniformity at equilibrium	± 0.5°C at 37°C
Chamber warm-up time	15–30 minutes (measured on air) after initiation of temperature regulation
Temperature regulation	4 sensors
Drift	± 0.2°C (regulated)
Temperature regulation diagnostics	Temperature regulation system is continuously monitored and updated
Evaporation	Plate lid required to minimize evaporative cooling
Recommended plate	Flat-bottom plates with isolated wells and lid

Shake VersaMax

Item	Description
Shake modes	Selectable: off, once prior to any read, and once prior to and between kinetic reads
Shake duration	Selectable: 1 to 999 seconds (three-second default)

Compatibility VersaMax

Item	Description
Plates	Standard and half-area 96-well flat-bottomed plates (0.3 mL).

General Instrument VersaMax

Item	Description
Display	2-x-20-character back lit LCD
Control panel	8-key membrane keypad
Self-diagnosis	Continuous on-board diagnostics
Spill control	Drawer mechanism and read chamber assembly protected from accidental spillage by drainage ports
Computer interface	USB cable
Printer interface	Parallel 25-pin to Centronics (double shielding required)
Supported plates	All 96-well and strip-well plates, including lids

Environmental VersaMax (for indoor use only)

Item	Description
Operating temperature	5°C to 40°C
Operating altitude	< 2000 m
Installation category	II
Pollution degree	2
Operating humidity	< 80%
Storage temperature	-20°C to 65°C

Physical VersaMax

Item	Description
Size (h x w x d)	220 mm (8.6") x 580 mm (22.8") x 380 mm (15")
Weight	13.6 kg (30 lb)
Power consumption	< 250 W
Line voltage and frequency	100–240 VAC autoranging, 50/60 Hz

Electromagnetic Compatibility

Regulatory for Canada (ICES/NMB-001:2006)

This ISM device complies with Canadian ICES-001.

Cet appareil ISM est confomre à la norme NMB-001 du Canada.

ISM Equipment Classification (Group 1, Class A)

This equipment is designated as scientific equipment for laboratory use that intentionally generate and/or use conductively coupled radio-frequency energy for internal functioning, and are suitable for use in all establishments, other than domestic and those directly connected to a low voltage power supply network which supply buildings used for domestic purposes.

Appendix B: Accessories

B

Available Accessories

Part Number	Description
0200-6117	SpectraTest ABS1 Absorbance Validation Test Plate
9000-0161	Cuvette Absorbance Validation Kit
R8024	SpectraPlate-Quartz UV-transparent Microplate
4400-0002	Power Cord (US, Canada, Japan, Mexico, India)
4400-0036	Power Cord, EC1 (Germany, France, Scandinavia, Italy, Korea)
4400-0037	Power Cord, EC2 (UK, Indonesia, Singapore, Malaysia)
4400-0038	Power Cord, AP1 (Australia, Hong Kong, China)
2400-0116	Dust Cover

Cuvettes

The following cuvettes have been tested with the instrument. All have an optical pathlength of 1 cm (10 mm) and standard external dimensions (12.5 cm x12.5 cm). Their fill volumes differ only because of their different internal width and chamber height dimensions.

Standard and Semi-micro Cuvettes

Several brands available.

Internal Width	Minimum Volume	Maximum Volume
10 mm	~ 1.8 mL	4.0 mL
4 mm	~ 0.75 mL	1.4 mL
2 mm	~ 0.40 mL	0.7 mL

Ultra-micro Cuvettes (Hellma)

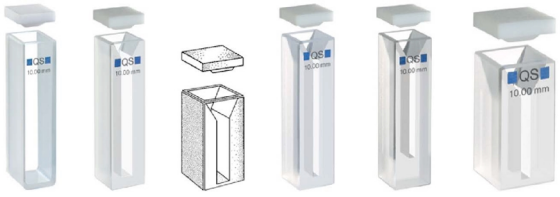
When ordering, specify the Z-dimension to be 15 mm.

Hellma Cat. No.	Window Size	Chamber Volume	Fill Volume
105.201-QS	2.0 x 5.0 mm	100 µL	120 µL
105.202-QS[a]	2.0 x 2.5 mm	50 µL	70 µL
105.210-QS[b]	0.8 mm diameter	5 µL	10 µL

a. You must put a riser (0.8–1 mm) on cuvette bottom to match the cuvette window to the beam. 2.0 x 2.5 mm 50 µL 70 µL 105.210-QSb

b. You must put a riser (0.8–1 mm) on cuvette bottom to match the cuvette window to the beam. Gives good qualitative results (i.e. spectral scans), but quantitative results are impractical because the window is smaller than the beam.

Standard, Semi-micro, and Microcuvettes (Hellma)



Item	Standard	Semi-Micro		Micro		
Hellma Cat. No.	100	104	105.004	104.002	108.002	105
Internal Dimensions	10 x 10	4 x 10	4 x 10	2 x 10	2 x 10	2 x 10
Fill Volume	4 mL	1.4 mL	600 µL	700 µL	500 µL	300 µL

Ultra-Micro Cuvettes (Hellma)

Hellma Cat. No.	105.200	105.201	105.202	105.210
Optical Pathlength	10 mm	10 mm	10 mm	10 mm
Fill Volume	180 µL	120 µL	70 µL	10 µL

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Visit our website for a current listing of worldwide distributors.

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