SPECTRAmax® 190
Microplate Spectrophotometer
Operator's Manual

Molecular Devices

Molecular Devices Corporation

1311 Orleans Drive

Sunnyvale, California 94089

Part # 0112-0085

Rev. A



Molecular Devices Corporation

SPECTRAmax® 190 Operator's Manual

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SPECTRAmax 190

Microplate Spectrophotometer

100-240V ~ 4A 50-60 HZ T4.0A

2 Lines Fused, **unplug before servicing!**
Vor Wartungsarbeiten Netzstecker ziehen!

Molecular Devices Sunnyvale, CA
Made in USA

TÜV Rheinland GS geprüfte Sicherheit

Protected by US Patents **4,968,148**; **5,112,134**; **6,151,111**; and **6,188,476**
Protected by Canadian Patent **1,305,334**
Other US and International patents pending

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Conventions Used in this Manual

The names of keys that appear on the SPECTRAmax *190* control panel are shown in boxed Helvetica type. Example: Drawer.

Italic and boldface type are used for emphasis. Examples: *"Press carefully to engage,"* **"Do not press down."**

NOTE: A note provides information that will help you properly execute an action or procedure.

⚠ **CAUTION:** Indicates an action or condition that could potentially damage the instrument or one of its components or could result in loss of data.

⚠ **WARNING:** Indicates a situation that could result in potential injury to a person working with the system.

BIOHAZARD: Indicates a condition involving potentially infectious biological agents requiring that proper handling precautions be taken.

Glossary of Terms

Absorbance, A

The amount of light absorbed by a solution. To measure absorbance accurately, it is necessary to eliminate light scatter. In the absence of turbidity, absorbance = optical density.

$$A = \log (I_0/I)$$

I_0 = incident light

I = transmitted light

In this manual, we use the terms absorbance and optical density interchangeably.

Optical Density, OD

The amount of light passing through a sample to a detector relative to the total amount of light available. Optical Density includes absorbance of the sample plus light scatter from turbidity.

Transmittance, T

The ratio of transmitted light to the incident light.

$$T = I/I_0$$

$$\%T = 100\ T$$



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Introduction

General Overview

The SPECTRAmax™ 190 microplate spectrophotometer provides rapid and sensitive measurements of a variety of analytes across a wide range of concentrations. It measures the optical density (OD) of samples in 96-well microplates at a selected wavelength for a single point in time (endpoint), over a specified period of time (kinetic), or over a selected wavelength range (spectral scan).



Figure 1.1: The SPECTRAmax 190 System

The on-board microprocessor calculates and reports the absorbance (or % Transmittance) for each well of a microplate. Data from multiple wavelengths can be acquired during a single reading, if desired, and different calculations can be made based on this data using SOFTmax PRO software, including the subtraction of blanks, use of standard curves, etc.

Typical applications include DNA quantitation, endpoint assays (quantitation of cytoproliferation by MTT reduction, colorimetric protein assays, and endpoint ELISAs) and kinetic measurements (enzyme studies, such as determination of the activity of enzymes released from cells, and kinetic ELISAs).

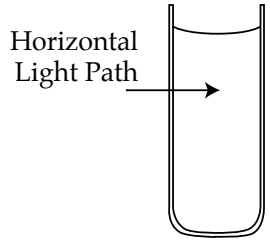
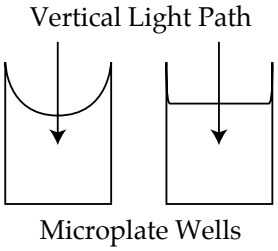
All standard 96-well microplates, strip wells, and filter-bottom microplates can be used in the SPECTRAmax 190.

With SOFTmax PRO, the contents of the wells in a microplate can be mixed automatically by shaking before each read cycle, making it possible to perform kinetic analysis of solid-phase, enzyme-mediated reactions (mixing is not critical for liquid-phase reactions). The temperature of the microplate chamber can also be regulated, if desired, from 4°C above ambient to 45°C.

PathCheck™

As predicted by the Beer Lambert law of light absorption, absorbance is proportional to the distance that light travels through the sample—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 perform extinction-based assays and confusing to compare results between microplate readers and spectrophotometers.

Horizontal  	The standard pathlength of a cuvette is the conventional basis for quantifying the unique absorptivity properties of compounds in solution. Quantitative analyses can be performed on the basis of extinction coefficients, without standard curves (e.g., NADH-based enzyme assays). When using a cuvette, the pathlength is known and is **independent** of sample volume, so absorbance is proportional to concentration.
Vertical  	In the microplate, 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 arise from pipetting the samples and standards. The PathCheck feature of the SPECTRAmax 190 automatically determines the pathlength of aqueous samples in the microplate and normalizes the absorbance in each well to a pathlength of 1 cm. This novel approach to correcting the microwell absorbance values is accurate to within 2.5% of the values obtained directly in a 1-cm cuvette.

This pathlength correction is accomplished only with the use of SOFTmax PRO software. SOFTmax® PRO software from Molecular Devices provides full instrument control and statistical data analysis.

Component Description

The main components of the SPECTRAmax 190 are:

- The control panel
- The microplate drawer
- The back panel (connections and power switch)



Figure 1.2: Major areas of the SPECTRAmax 190

Control Panel

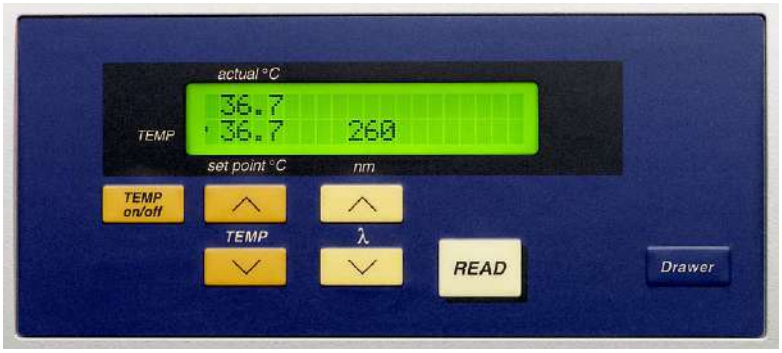


Figure 1.3: Control Panel

The control panel consists of an LCD and seven pressure-sensitive, color-coded membrane keys which can be used to perform the stand-alone functionality of the SPECTRAmax 190, including setting the temperature inside the microplate drawer, setting the wavelength at which to read the microplate, and opening or closing the microplate drawer. Pressing a control panel key activates the function.

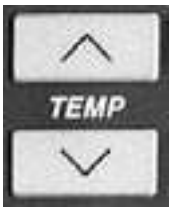
LCD

A 2-×-20-character liquid crystal display which shows the current instrument settings.

Keys



(Incubator) Enables/disables the incubator function.



(Incubator) Allows you to enter a set point to regulate the microplate chamber temperature. Pressing the up or down arrow key scrolls up or down, starting at the previous temperature setting (or the default of 37.0°C, if no setting had been made). Pressing the up (▲) or down (▼) arrow *once* increments or decrements the temperature shown in the display by 0.1°C; pressing and *holding* either arrow increments or decrements the temperature shown in the display by 1°C until it is released. If you increment the setting to the highest limit (45°C) and continue to press the up (▲) arrow, the display will not change. If you decrement the setting to the lowest limit, 15°C, and continue to press the down (▼) arrow, the display will not change.

⚠ **CAUTION:** If the incubator is disabled, pressing the Temp On/Off key will *enable* the incubator.



Selects the wavelength that will be used for reading the microplate manually. Pressing the up or down arrow key scrolls up or down through the available wavelengths, starting at the previous setting. Pressing the up (▲) or down (▼) arrow *once* increments or decrements the wavelength shown in the display by 1 nm; pressing and *holding* either arrow increments or decrements the wavelength shown in the display by 10 nm until it is released. If you increment the setting to the highest limit (850 nm) and continue pressing the up (▲) arrow, the display returns to the lowest possible setting (340 nm) and begins incrementing from there. The inverse is true for decrementing by pressing the down (▼) arrow.

NOTE: Setting the wavelength in SOFTmax PRO and reading using the software will override the manual setting. **The control panel will not show the wavelength selected through SOFTmax PRO.**



Initiates the reading of the microplate in stand-alone mode. Data is sent to the printer port of the SPECTRamax 190.



Opens or closes (toggles) the microplate drawer. Whether or not the drawer will remain open depends on the incubator setting. If the incubator is off, the drawer will remain open; if the incubator is on, the drawer will close after approximately 10 seconds to assist in maintaining temperature control within the microplate chamber.

NOTE: If the SPECTRAmax 190 is idle, all keys on the control panel are active. The instrument will automatically close the microplate drawer for the next reading.

Control Panel Display



The left side of the display shows the temperature, both actual and set point, and whether or not the temperature is at the set point (enunciator blinks if not at set point). (The temperature of the plate drawer is shown in the SOFTmax PRO software.) The middle of the display shows the wavelength.

The Microplate Drawer

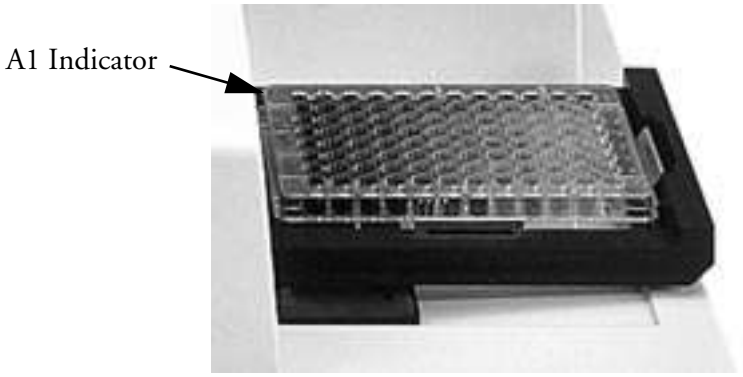


Figure 1.4: Microplate Drawer

The microplate drawer is located on the right side of the SPECTRAmax 190 and slides in and out of the reading chamber. Springs on two sides of the drawer automatically position and hold a microplate in the proper position. The drawer remains in the reading chamber during read cycles.

Microplate drawer operation varies, depending upon the incubator status. To open the drawer, press the Drawer key. If the incubator is turned on, the drawer will remain open for approximately ten seconds, after which a beeping sound will alert you approximately two seconds before the drawer closes automatically.

NOTE: Do not obstruct the movement of the drawer. If you must retrieve a plate after an error condition or power outage and the drawer will not open, it is possible to open it manually (see Chapter 4, "Maintenance and Troubleshooting").

Microplates

The SPECTRAmax 190 can accommodate standard 96-well microplates, strip wells, and filter-bottom microplates.

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

The Back Panel

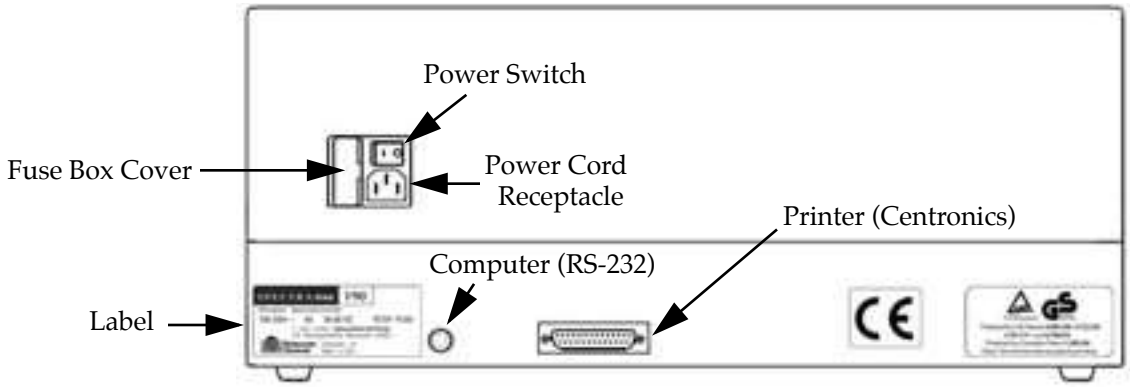


***Figure 1.5: Components on the Back Panel of the SPECTRAmax* 190**

The following components are located on the back panel of the SPECTRAmax 190 system:

- **Power switch**—a rocker switch, labeled I/O (for on and off, respectively).
- **Power cord receptacle**—plug the power cord in here.
- **Fuse box cover**—cannot be opened while the power cord is plugged in. When opened, it provides access to the fuse box containing two fuses that are required for operation.
- **Printer port** (double-shielded, 25-pin parallel, for use in stand-alone operation)—plug the 25-pin end of the cable into this port; the other (Centronics) end attaches to the port on the printer.
- **Computer port** (double-shielded 8-pin RS-232 serial, for use with an external computer)—plug the 8-pin DIN serial cable connector into this port; the other end attaches to the serial (modem) port of the computer.
- **Labels**—provide information about the SPECTRAmax 190, such as line voltage rating, cautionary information, serial number, etc. Record the serial number shown on this label for use when contacting Molecular Devices Technical Services.

Functional Description

Stand-Alone Operation

The paragraphs that follow describe functions that can be activated during stand-alone operation.

When operating the SPECTRAmax 190 as a stand-alone system, you can choose a temperature setting, choose a wavelength, and make an Endpoint read. Data is sent to the printer port of the SPECTRAmax 190. The wavelength is chosen by pressing the up or down arrows beneath the display labeled λ. Temperature regulation of the microplate chamber can be enabled and set using the keys on the left side of the control panel, and actual temperature can be monitored in the display.

Wavelength Selection

The display on the control panel shows the currently selected measurement wavelength (λ). You can change the wavelength by pressing the up or down arrows until the display shows the desired wavelength. The wavelength will wrap around to the top or bottom when the last selectable wavelength is reached.

Temperature Regulation

The SPECTRAmax 190 has been designed to regulate the temperature of the microplate chamber from 4°C above ambient to 45°C. Upon powerup, when the incubator is off, the temperature in the SPECTRAmax 190 microplate chamber is ambient and isothermal. Pressing the incubator [TEMP On/Off] key will cause the instrument to begin warming the microplate chamber. The temperature set point defaults to 37.0°C at start-up.

NOTE: 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 will remain 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 >20°C.

You can change the temperature set point by pressing the up (▲) or the down (▼) arrow keys above and below the word TEMP until the desired set point is shown in the display. Typically, the microplate chamber will reach 37.0°C in 15 to 30 minutes.

The microplate chamber temperature is maintained at the set point until you press the incubator [TEMP On/Off] key again, turning temperature regulation off. The microplate drawer will open and the temperature within the chamber will begin returning to ambient.

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

Temperature regulation within the microplate chamber is achieved through electric heaters, a fan, efficient insulation, and temperature sensors. The heaters are located in the chamber which is insulated to maintain the temperature



set point. The sensors, also mounted inside the chamber, measure the air temperature. The temperature feedback closed-loop control algorithms compare the measured air temperature inside the chamber against the temperature set point and use the difference to calculate 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 microplate will depend upon the design, materials, and/or configuration of that component.)

Computer Control

The SPECTRAmax 190 is equipped with an 8-pin DIN RS-232 serial port through which a computer can communicate with and control the instrument.

SOFTmax PRO®

Molecular Devices' SOFTmax PRO software is a highly integrated program that can be used to control and collect data from the SPECTRAmax 190. SOFTmax PRO makes it possible to access the full capabilities of the SPECTRAmax 190. SOFTmax PRO allows you to:

- Read microplates for endpoint, kinetic, or spectral scans
  - Use up to six wavelengths for endpoint and kinetic readings
  - Perform Absorbance or %Transmittance readings in the 190- to 850-nm range
  - Extend kinetic run times up to 99 hours
  - Select your own read intervals for kinetic runs
  - Specify the duration for Automix before and between readings
  - Read the whole plate or a subset of microplate strips
- Use PathCheck to normalize the absorbance readings in each microplate well to a 1-cm pathlength
- Design microplate templates to simplify data reduction
  - Identify groups of wells with labels of your choice
  - Identify individual wells with unique names
  - Blank the entire plate, groups, and/or individual wells
- Save instrument settings, template formats, and data analysis parameters for microplates as assay protocol files and recall them for later use
  - Rapid instrument and analysis setup for repeated microplate assays
  - Uniform analysis for equivalent microplates
- Turn the incubator on or off to control the temperature in the microplate drawer

- Acquire data from the SPECTRAmax 190
  - Save data files for in-depth analysis at a later time
  - Save multiple microplates with individual template and data analysis parameters in one or more experiments in a single data file
  - Pre-read microplates
  - Analyze kinetic and spectrum data as it is collected
- Use the Automix function to shake the microplate at preset intervals, thereby mixing the contents of each well (highly recommended for ELISAs and other solid-phase, enzyme-mediated reactions)
- Display data on screen
  - Raw values, reduced number, or raw values with reduced number
  - Raw microplate data in a microplate format
  - Ranged data as integers between 0 and 9 in a microplate format
  - Threshold data as being above, below, or between set limits in a microplate format
  - Gray scale data in seven shades of gray corresponding to high and low limits in a microplate format
  - Kinetic or spectrum plots of all 96 microplate wells
  - Enlarge the display of individual well plots and overlay multiple well plots
- Perform data analysis using SOFTmax PRO features
  - Calculate maximum kinetic rates on non-linear data
  - Assign plate, group, or sample blanks
  - Perform pathlength correction based on 1-cm cuvette readings
  - Customize data analysis for each group in the template
  - Create graphs with multiple plots
  - Pick from nine curve-fitting routines
  - Analyze unknown samples against a standard curve
  - Analyze and compare data within a plate, between plates, and between experiments
- Multiple print formats
  - Print all or individual sections of the data file
  - Define and print a report containing only selected sections
  - Customize the order of data file sections
- Export data in tab-delimited ASCII format for use with Excel or other database programs

For a complete description of the features of SOFTmax PRO, refer to the *SOFTmax PRO User's Manual*.

Specifications

Thermal specifications for microplates used in the SPECTRAmax 190 apply to flat-bottom microplates with isolated wells. All other microplate specifications apply to standard 96-well polystyrene flat-bottom microplates.

NOTE: Technical specifications are subject to change without notice.

Photometric Performance

Wavelength range	190–850 nm
Wavelength selection	Monochromator tunable in 1-nm increments
Wavelength bandwidth	≤ 2.0 nm FWHM (full width half maximum)
Wavelength accuracy	± 1.0 nm across wavelength range
Wavelength repeatability	± 0.2 nm across all optical channels
Photometric range	-0.3 to 4.000 OD
Photometric resolution	0.001 OD
Photometric accuracy/linearity (microplate), 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 340 nm
Photometric stabilization	Instantaneous
Photometric drift	None—continuous referencing of monochromatic output
Calibration	Automatic before first kinetic read and before every endpoint reading
Optical alignment	None required
Light source	Xenon flash lamp (5 watts)
Average lamp lifetime	1 billion flashes
Illumination	Top down
Photodetectors	Silicon photodiode

Photometric Analysis Modes

Stand-Alone

- Single wavelength Absorbance reading of the microplate

Using SOFTmax PRO

- Express data as Absorbance or %Transmittance
- Single wavelength reading of microplate
- Multiple wavelength (up to six) reading of microplate
- Kinetic and kinetic graphics of microplate
- Spectral scan (190–850 nm) of microplate

Measurement Time (calibration off)

Read time (endpoint)	
-- Standard read*	• 96 wells in 9 seconds (single wavelength) • 96 wells in 19 seconds (dual wavelength—425 & 650 nm)
Kinetic read intervals	• 96 wells, 9-second minimum interval between readings (single wavelength) • 1 column, 2-second minimum interval between readings (single wavelength)

Scan Speed

Normal scan	33*K nm/min (8-well strip); 21*K nm/min (16-well strip)
Speed scan	135*K nm/min (8-well strip); 77*K nm/min (16-well strip)

Temperature Regulation

Reading 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
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
Recommended microplate	Flat-bottom microplates with isolated wells

Automix with SOFTmax PRO

Plate mixing modes	Selectable: off, once prior to any reading, and once prior to and between kinetic readings
Plate mixing duration	Selectable: 1 to 999 seconds (three-second default)

Compatibility

Microplate	Standard and half-area 96-well flat-bottomed microplates (0.3 mL).



General Instrument

Display	2-×-20-character backlit LCD
Operating panel	7 key membrane keypad
Self-diagnosis	Continuous on-board diagnostics
Spill control	Drawer mechanism/reading chamber assembly is protected from accidental spillage by drainage ports
Computer interface	8-pin DIN RS-232 serial (double shielding required)
Printer interface	Parallel 25-pin to Centronics (double shielding required)
Microplates supported	All 96-well and strip-well microplates, including lids

Environmental

For indoor use only

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

Physical

Size (h × w × d)	8.6 in. (22 cm) × 22.8 in. (58 cm) × 15 in. (38 cm)
Weight	30 lb (13.6 kg)
Power consumption	< 250 watts
Line voltage	100-240 VAC, 4 A
Line frequency	50/60 Hz



Chapter 2 Installation

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Installation Warnings

1) Always make sure the power switch on the instrument is in the OFF position and remove the power cord from the back of the instrument prior to any installation or relocation of the instrument.
2) Do not operate the instrument in an environment where potentially damaging liquids or gases are present.

Installation Cautions

Do not touch or loosen any screws or parts other than those specifically designated in the instructions. Doing so might cause misalignment and will void the instrument warranty.

Unpacking

The SPECTRAmax 190 is packed in a specially designed carton. Please retain the carton and the packing materials. If the unit should need to be returned for repair, you must use the original packing materials and carton for shipping. If the carton has been damaged in transit, it is particularly important that you *retain it for inspection by the carrier in case there has also been damage to the instrument.*

⚠ **WARNING:** The SPECTRAmax 190 weighs approximately 30 lb (13.6 kg) and should be lifted with care. It is recommended that two persons lift the instrument together, taking the proper precautions to avoid injury.

After examining the carton, place it on a flat surface in the upright position. Open the top of the box and lift the SPECTRAmax 190, along with the packing materials around the ends, up and out of the shipping box. Remove the packing material from both ends of the instrument and set the instrument down carefully.

Setting Up for Stand-Alone Use

1) Place the SPECTRAmax 190 on a *level surface, away from direct sunlight, dust, drafts, vibration, and moisture.*
2) Turn the instrument around so that the back of the instrument is facing you as shown in Figure 2.1.

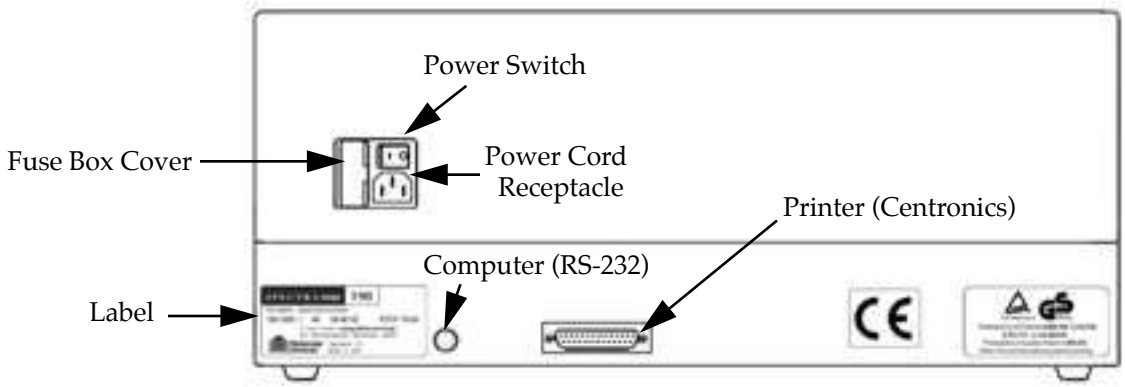


Figure 2.1: View of Rear Panel

3) Insert the appropriate (Macintosh or PC) serial interface cable into the RS-232 serial port on the SPECTRAmax 190. Connect the other end to the serial port of the computer.
4) Insert the female end of the power cord into the power receptacle at the rear of the SPECTRAmax 190. Connect the male end to a grounded power outlet of the appropriate voltage. Molecular Devices recommends that you use a surge protector between the power cord and the grounded power outlet.
5) If you are using a printer for reading microplates in stand-alone mode, locate the printer port (25-pin parallel) on the rear panel of the SPECTRAmax 190. Connect one end of the cable to this port and connect the other (Centronics) end to the printer. Load paper into the printer according to the manufacturer's instructions and connect the printer's power cord to the power outlet.
6) Turn the SPECTRAmax 190 around so that the control panel now faces you. Be sure no cables run beneath the instrument. Leave at least three inches between the back of the instrument and the nearest objects or surfaces to ensure proper ventilation and cooling.
7) Turn on the power to the SPECTRAmax 190, wait for the microplate drawer to open, and remove the tape and protective covering from the drawer subplate.

Chapter 3 Stand-Alone Operation

Prepare for a Reading 3-3
Turn the Instrument and Printer On 3-3
Set the Temperature 3-3
Select the Wavelength 3-3
Operation Overview 3-3



This chapter contains operating information for the SPECTRAmax 190 Microplate Spectrophotometer. If you are an experienced user of this instrument, you can turn to the Operation Overview on page 3-3 for a quick review of the operating steps.

NOTE: Only temperature selection and single-wavelength readings are available in stand-alone mode through front panel control. To achieve full use of this instrument, connect it to a computer and use SOFTmax PRO software.

Prepare for a Reading

Turn the Instrument and Printer On

The power switch for the SPECTRAmax 190 is located on the back panel. Press the rocker switch to the ON position. The instrument will automatically perform diagnostic checks to ensure that it is functioning correctly. Turn the printer on at the same time.

Set the Temperature

If elevated temperature within the microplate chamber is required, you should turn on the incubator first, allowing enough time for the temperature to reach the set point before performing a reading. When you first turn the instrument on, up to 30 minutes may be required for the temperature within the chamber to reach the set point.

To enable the incubator, press the incubator [TEMP On/Off] key. The LCD display will update to show the temperature set point and the current chamber temperature.

To change the temperature set point, press the up or down arrows above and below TEMP until the desired temperature set point is shown in the display.

The microplate chamber temperature will be maintained at the set point until you disable temperature control by touching the incubator [TEMP On/Off] key again. When the incubator is off, the drawer will open and the temperature within the chamber will begin returning to ambient.

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

Select the Wavelength

Press the up or down arrow keys above and below the λ to increment or decrement the wavelength setting (1 nm increments).

Operation Overview

The following steps provide a quick reminder of the basic operating procedures required to read a microplate using the SPECTRAmax 190.

1) Turn on the power switch of the SPECTRAmax 190 (located on the back panel).
2) If you wish to regulate the temperature inside the microplate reading chamber, touch the [TEMP On/Off] key to bring the chamber to the default temperature of 37.0°C. The microplate drawer will close and the indicator on the right of the LCD will flash until the set temperature is reached.



3) If the incubator is on, the LCD will show the current temperature along with the temperature set point. To change the set point (to any setting from ambient +4° to 45°C), press either the up or down arrow above or below TEMP.

4) Select the desired measurement wavelength by pressing the up or down arrow near λ. Scroll up or down through the list of wavelengths shown in the LCD using the up or down arrows until the desired measurement wavelength is highlighted.

5) Load the prepared microplate into the chamber. Press the [READ] key.

NOTE: Due to the continuous changes in printer technology leading to printer obsolescence and the ability of SOFTmax PRO software to print on PC- and Macintosh-compatible printers, Molecular Devices does not recommend reliance on printing in the stand-alone mode.

Chapter 4 Maintenance and Troubleshooting

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Warnings and Cautions 4-3
General 4-4
Cleaning 4-4
Changing the Fan Filter 4-4
Changing the Fuses 4-5
Error Codes and Probable Causes 4-7
Error Messages 4-7
Opening the Drawer Manually 4-11



This chapter lists maintenance procedures and troubleshooting information, including error codes that may be seen, followed by their most likely causes and remedies.

Technical Support

Molecular Devices Corporation is a leading worldwide manufacturer and distributor of analytical instrumentation. We are committed to the quality of our products and to fully supporting our customers with the highest level of technical service. In order to fully benefit from our technical services, please complete the registration card and return it to the address printed on the card.

If you have any problems using the SPECTRAmax 190 Microplate Spectrophotometer that are not covered in this chapter, in the U.S., contact our Technical Services group at 1-800-635-5577; elsewhere contact your local representative.

Warnings and Cautions

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.

WARNING: All maintenance procedures described in this manual can be safely performed by qualified personnel. Maintenance not covered in this manual should be performed by a Molecular Devices representative.

WARNING: Removal of protective covers that are marked with the High Voltage warning symbol shown below can result in a safety hazard.



WARNING: Always turn the instrument off and remove the power cord and any computer/printer cables from the back prior to any maintenance or installation operation

WARNING: Never perform any operation on the instrument in an environment where liquids or potentially damaging gases are present.

WARNING: Risk of electrical shock. Refer servicing to qualified personnel.

CAUTION: Use of organic solvents (such as dichloromethane) may cause harm to the optics in the SPECTRAmax 190. Extreme caution is advised when using organic solvents. Always use a plate lid and avoid placing a plate containing these materials in the reading chamber for prolonged periods of time. Damage caused by the use of incompatible or aggressive solvents is NOT covered by the instrument warranty.

CAUTION: Never touch any of the optic mirrors, filters, or cables or their housing, or manifold. The optics are extremely delicate and critical to proper function of the instrument.

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

General

Keep the drawer closed when the instrument is not in use. The drawer can be opened by pressing the DRAWER button. Always close the drawer immediately prior to switching the instrument off.

Cleaning

BIOHAZARD: Wear gloves during any cleaning procedure that could involve contact with either hazardous or biohazardous materials or fluids.

Periodically, you should clean the *outside* surfaces of the SPECTRAmax 190 using a cloth or sponge that has been dampened with water. Do not use abrasive cleaners. 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 any residue. Do not spray cleaner onto the instrument.

If needed, clean the microplate drawer using a cloth or sponge that has been dampened with water.

Should fluids spill in the drawer area when the drawer is out, they will be directed to a tray at the bottom of the instrument from which they will exit to the bench or counter beneath the instrument. Wipe up any spills immediately. Clean only the exterior of the unit (and the microplate drawer, if necessary). Never clean the inside of the instrument. Do not allow excess water or other fluids to drip inside the instrument.

Cleaning the Fan Filter

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

1) Turn power to the instrument OFF and then remove the power cord and cables from the back of the instrument.
2) Make sure no plate is in the instrument. Turn the instrument over so that it rests flat on the bench.
3) Pop the black fan cover off and remove the filter.
4) Clean the filter by blowing clean, canned air through it or by rinsing it—first with water and then with alcohol—and allowing it to dry completely.
5) Place the clean, dry filter over the fan and replace the black cover.
6) Turn the instrument back over. Reconnect the power cord and cables to the instrument.

Changing the Fuses

Fuses burn out occasionally and must be replaced. If the instrument does not seem to be getting power after switching it on (the LCD shows no display), first check to see whether the power cord is securely plugged into a functioning power outlet and into the receptacle at the rear of the SPECTRAmax 190. If power failed while the SPECTRAmax 190 was already on, check 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, follow the steps listed below to replace the fuses. Spare fuses (two U.S. and two metric) are shipped with the instrument. The U.S. and metric fuses are identical except for physical size. They may be taped to the back of the SPECTRAmax 190.

If you no longer have spare fuses, you may obtain new ones from Molecular Devices (part numbers: 4601-0013 for U.S., 4601-0014 for metric) or from a local hardware store. Make sure fuses are rated SLOWBLOW (U.S.: 4-amp time-delay; metric: 4-amp, 5 × 20 mm, time-delay).

To change fuses, follow the steps below.

1) Switch power to the instrument off and then remove the power cord from the outlet and from the SPECTRAmax 190 power cord receptacle.
2) Remove the printer cable and computer cable (if connected) from the back of the SPECTRAmax 190.
3) Turn the instrument around for easy access to the rear panel.
4) On the left-hand side of the rear panel (viewed from the back) are the power switch, fuse box, and power cord receptacle. As shown in the figures below, press to the right of the black plastic cover of the fuse box to release it. Pull the fuse box cover away from the instrument. The fuse box will begin to slide forward.

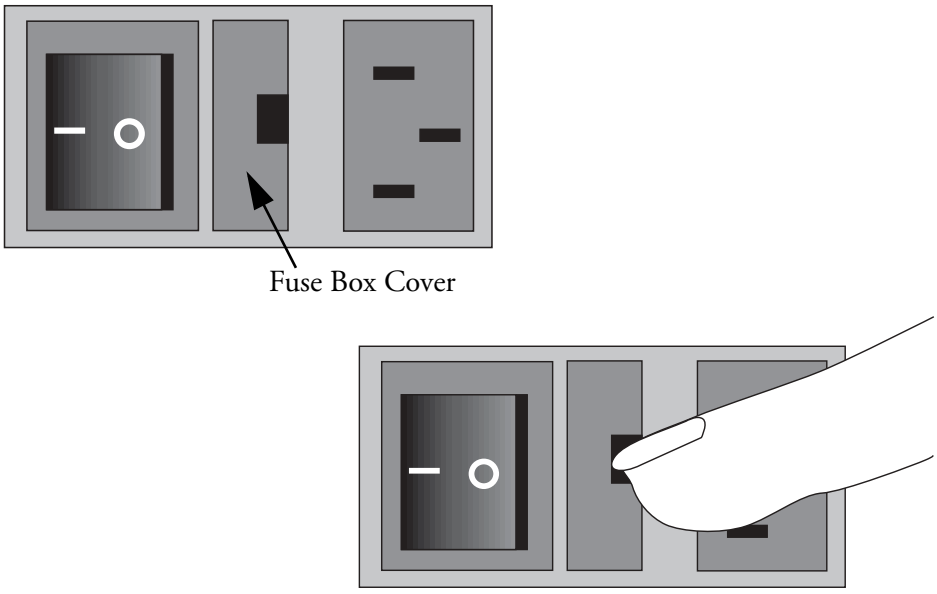


Figure 4.1: Power Switch, Fuse Box, and Power Receptacle

5) Continue gently pulling the fuse box forward until it is free of the instrument.

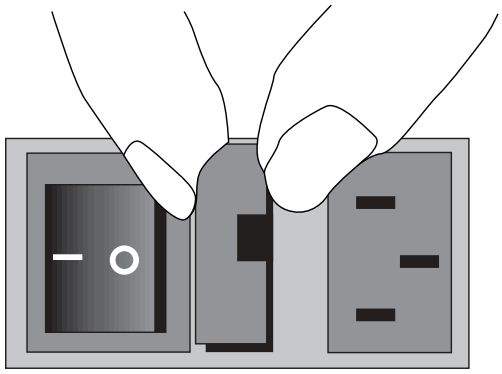


Figure 4.2: Removing the Fuse Box

6) When removed, the fuse assembly will appear as shown in Figure 4.3. The holder inside contains two fuses.

7) It is possible that only one of the fuses may have blown. Molecular Devices recommends that you replace both fuses, however, to ensure continued proper operation. Pull both fuses out of the holder and discard them.

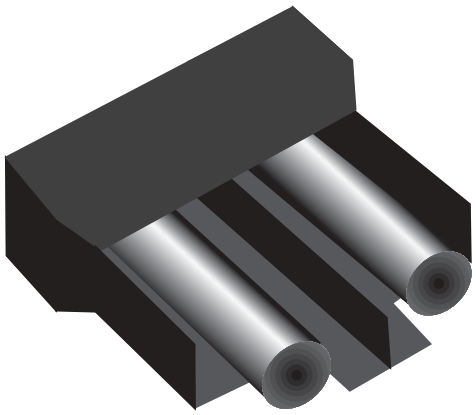


Figure 4.3: The Fuse Box and Holder (with Fuses) Removed

8) Insert new SLOWBLOW-rated fuses into the fuse holder. Either end of the fuse may be forward.

9) Insert the fuse box into the opening in the instrument, making sure that the fuses are on the right side (toward the power receptacle). Press the fuse box into place, making sure the cover snaps closed.

10) Reconnect the power cord to the instrument and to the wall outlet and reconnect other cables previously disconnected.

Error Codes and Probable Causes

If a problem occurs during operation that causes an unrecoverable error, the instrument will stop and an error code number will be shown in the display on the front panel. To correct the problem, call your local Molecular Devices representative for assistance.

Error Messages

The LCD will display ***Fatal Error*** codes when a situation arises that requires attention. Any reading in progress will stop. *Warning* messages do not stop a reading but are logged in the error buffer. Warning messages indicate a situation that requires attention but is not sufficient to stop or prevent a reading. Examples of situations that might cause warning messages are low memory, entries being 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 in this manual. The errors are grouped in relationship to possible causes as follows:

Error Code Numbers	Possible Causes
100 -199	Errors possibly caused by unrecognized commands being 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 instrument's non-volatile memory (NVRAM). All of these errors require the assistance of Technical Support.

Some errors (shown in **boldface** in this manual) are considered fatal if they are detected during power up (the instrument will abort the power up sequence and display "FATAL ERROR ###" on the LCD panel). Check the following table to see if you can do something to prevent the fatal error. After correcting the problem, leave the instrument on for about five minutes, turn it off and then back on. If you continue to get the fatal error message on powerup, record the error message number and contact Molecular Devices Technical Support or your local representative for assistance.

NOTE: If the instrument is functioning normally when using SOFTmax PRO, no errors should be in the buffer (except error number 100).



Table 4.1. Error Codes, Messages, and Notes about the Errors

ERROR CODE	ERROR MESSAGE	NOTES
100-199: Unrecognized Command Errors Sent from the Computer		
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 give command because it was busy doing another task. Example: Request a wavelength while the monochromator is in motion.
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's no data in the buffer
108	data buffer full	To many data sets in the buffer. Can be caused by setting up a long kinetic and disconnecting computer, or if SOFTmax PRO is preempted by another application.
109	error buffer overflow	More than 65 errors in the buffer, **clear** the buffer.
110	stray light	
111	invalid read settings	
200-299: Firmware Errors		
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.

Table 4.1. Error Codes, Messages, and Notes about the Errors

ERROR CODE	ERROR MESSAGE	NOTES
207	fatal trap	Instrument error. Instrument locks up.
208	RTOS error	Firmware error.
209	stack overflow	Firmware error.
210	unknown interrupt	Firmware error.
300-399: Hardware Errors		
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 will be shut off and remain off until a successful completion of power-up reset.
302	low light	Not enough light detected to make an accurate measurement.
303	**unable to cal dark current**	**Too much stray light detected on power-up, faulty or disconnected pre-amp boards.**
304	signal level saturation	
305	reference level saturation	
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 reading chamber. Could also be a faulty pre-amp board.
309	front panel not responding	LCD front panel bad or disconnected.
310		
311		
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's gain out of tolerance. Could be due to bad or disconnected pre-amp board or excessive stray light.**
314	low lamp level warning	



Table 4.1. Error Codes, Messages, and Notes about the Errors

ERROR CODE	ERROR MESSAGE	NOTES
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 didn't move to where it was commanded to in a reasonable time.**
317	**monitor ADC faulty**	
400-499: Motion Errors		
400	**carriage motion error**	**Carriage did not move to either of its photo interrupts in a reasonable time, or can't find its photo interrupt.**
401	**filter wheel error**	**Filter wheel did not move to its photo interrupt in a reasonable time, or can't find its photo interrupt.**
402	**grating error**	**Grating did not move to its photo interrupt in a reasonable time, or can't find its photo interrupt.**
403	**stage error**	**Stage did not move to its photo interrupt in a reasonable time, or can't find its photo interrupt.**
500-599: NVRAM Errors		
500	NVRAM CRC corrupt	The CRC for the NVRAM data is corrupt.
501	NVRAM Grating cal data bad	Grating 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).

Opening the Drawer Manually

If an error occurs while the drawer is closed and you need to open the drawer, press the [Drawer] key. If the drawer does not open, turn power to the instrument off and then on again.

If the drawer still remains closed, turn the power off and using your thumb nail, locate the groove in the upper left side wall of the door. Open the door, and with your index finger, pull the microplate drawer out of the instrument *(do not force the drawer)* and remove the microplate. This action will not harm the instrument, but should be taken only if the first two options have failed to open the drawer.

If you are still unable to open the drawer, contact Molecular Devices Technical Support or your local representative for assistance.



Appendix A Printers and Cables

Compatible Printers A-3
Cables A-3



Compatible Printers

The SPECTRAmax 190 can be used with an Epson-compatible 80-column printer. Compatibility may require changing the dip switch or pin settings on the printer or insertion of an emulation cartridge. Please check your printer's manual to assess compatibility based on this criterion—some printers will not meet this requirement.

NOTE: Due to the continuous changes in printer technology leading to printer obsolescence and the ability of SOFTmax PRO software to print on PC- and Macintosh-compatible printers, Molecular Devices does not recommend reliance on printing in the stand-alone mode.

Cables

Molecular Devices recommends that you use high-quality, double-shielded cables to connect the SPECTRAmax 190 to other peripheral instruments, such as a printer or computer. Choose cables that meet the following requirements:

Printer Cable (for Stand-alone operation only):

Centronics parallel, male 25D to Centronics.

Serial Interface Cable
(contact Molecular Devices for specific pin-out requirements)

Macintosh: Male DB8 to Male DB8

IBM Compatible: Male DB8 to Female DB9 (custom cable made by Molecular Devices)



Appendix B Accessories

Items Available for Use with the
SPECTRAmax 190. . . . . B-3

for Instruments with Serial Numbers
Beginning with NN



Items Available for Use with the SPECTRAmax 190

	Part Number
Cable, RS-232, Macintosh to SPECTRAmax 190 8-pin DIN to 8-pin DIN	9000-0091
Cable, RS-232, PC to SPECTRAmax 190 9-pin to 8-pin DIN	9000-0149
Fuse, 4-amp (5 × 20 mm) Time Delay	4601-0014
Power Cord (US, Canada, Japan, Mexico, India)	4400-0002
Power Cord, EC1 (Germany, France, Scandinavia, Italy, Korea)	4400-0036
Power Cord, EC2 (UK, Indonesia, Singapore, Malaysia)	4400-0037
Power Cord, AP1 (Australia, Hong Kong, China)	4400-0038
SPECTRAmax Mouse Pad	9000-0133
SPECTRAtest 190 Validation Package	0200-2405



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