# SPECTRAmax® 340PC Microplate Spectrophotometer Operator's Manual

Molecular Devices Corporation

1311 Orleans Drive
Sunnyvale, California 94089

Part # 0112-0049

Rev. A

**Molecular Devices Corporation**

**SPECTRAmax® 340PC Operator's Manual**



**Patents**

The SPECTRAmax 340PC and methods are protected by the following patents:

U.S. Patents **4,968,148** and **5,112,134**; Canadian Patent **1,305,334**.

Other U.S. and International patents pending.

**Trademarks**

Automix and PathCheck are trademarks and SPECTRAmax and SOFTmax are registered trademarks of Molecular Devices Corporation.

Apple and Macintosh are registered trademarks of Apple Computer, Incorporated.

All other company and product names are trademarks or registered trademarks of their respective owners.

**Disclaimer**

Molecular Devices Corporation reserves the right to change its products and services at any time to incorporate technological developments. This manual is subject to change without notice.

Although this manual has been prepared with every precaution to ensure accuracy, Molecular Devices Corporation assumes no liability for any errors or omissions, nor for any damages resulting from the application or use of this information.

**Molecular Devices Corporation Instrument Warranty**

Molecular Devices Corporation warrants this product against defects in material or workmanship as follows:

1) All parts of the SPECTRAmax 340PC Microplate Spectrophotometer are warranted for a period of one (1) year from the original date of delivery.

1) All labor charges to repair the product for a period of one (1) year from the original date of delivery will be paid by Molecular Devices Corporation.

1) This warranty covers the SPECTRAmax 340PC instrument only, and does not extend to any computer, printer, software, reagents, or disposables used with the instrument.

**Labor and Parts**

To obtain warranty service during the applicable warranty period, you must take the product or deliver the product properly packaged in the original shipping materials and carton to an authorized Molecular Devices Corporation service facility. You must call or write to the nearest Molecular Devices Corporation service facility to schedule warranty service. You may call Molecular Devices Corporation at the telephone number or address below to locate the nearest service facility. You must schedule warranty service **prior** to bringing or shipping the product for servicing. At the time of requesting warranty service, you must present proof of purchase documentation which includes the date of purchase and Molecular Devices Corporation must have the enclosed Warranty Registration form completed, signed and returned by you within ten (10) working days of the date of delivery.

This warranty only covers defects arising under normal usage and does not cover malfunctions of failures resulting from misuse, abuse, neglect, alteration, modification, or repairs by other than an authorized Molecular Devices Corporation service facility.

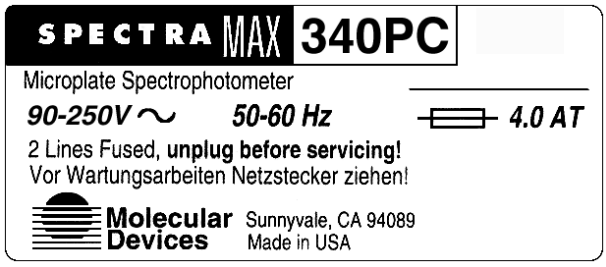
Repair or replacement as provided under this warranty is the exclusive remedy of the purchaser (the "Buyer"). **Molecular Devices Corporation (the "Seller") shall not be liable for any incidental or consequential damages for breach of any express or implied warranty on this product, except to the extent required by applicable law. The Seller specifically excludes all express and implied warranties including without limitation any implied warranty that the products sold under this agreement are merchantable or are fit for any particular purpose, except such warranties expressly identified as warranties and set forth in the Seller's current operating manual, catalog or written guarantee covering such product. The Seller also makes no warranty that the products sold under this agreement are delivered free of the rightful claim of any third party by way of patent infringement or the like.** If the Buyer furnishes specifications to the Seller, the Buyer agrees to hold the Seller harmless against any claim which arises out of compliance with the specifications.

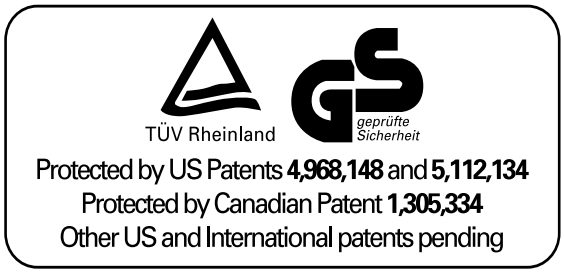
Any description of the products contained in this agreement is for the sole purpose of identifying them. Any such description is not part of the basis of the bargain, and does not constitute a warranty that the products shall conform to that description. Any sample or model used in connection with this agreement is for illustrative purposes only, is not part of the basis of the bargain, and is not to be construed as a warranty that the products will conform to the sample or model. No affirmation of fact or promise made by the Seller, whether or not in this agreement, shall constitute a warranty that the products will conform to the affirmation or the promise.

For the name of the nearest authorized Molecular Devices Corporation service facility please contact Molecular Devices at one of the following telephone numbers:

(408) 747-1700

(800) 635-5577 (U.S. and California)



# *Contents*

## *Figures*



## *Tables*

## *Conventions Used in this Manual*

The names of keys that appear on the SPECTRAmax 340PC control panel are shown in boxed Helvetica type. Example: Setup.

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.

$$T = I/I_0$$

$$\%T = 100\ T$$

# *Chapter 1 Instrument Description*

## *Introduction* General Overview

The SPECTRAmax® 340PC incorporates a holographic grating monochromator which allows you to specify a precise wavelength, from 340 nm to 850 nm, for the absorbance maximum of your sample. The SPECTRAmax 340PC can measure optical density (OD) for a single point in time (endpoint), over a specified period of time (kinetic), or over a selected wavelength range (spectral scan).

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

Standard 96-well microplates, strip wells and filter-bottom microplates can be used in the SPECTRAmax 340PC. The contents of the wells in a microplate can be mixed automatically by shaking before each read cycle, which makes 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.

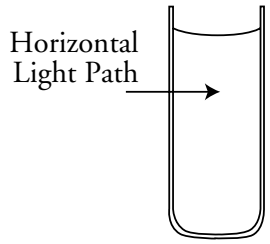
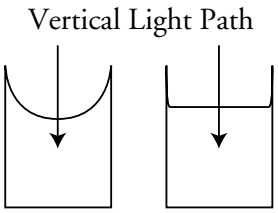
An on-board microprocessor calculates and reports the absorbance (optical density) or the Kinetic rate (change in optical density over time) for each well, allowing the SPECTRAmax 340PC to function as a stand-alone system when connected to an external printer.

The SPECTRAmax 340PC can also be controlled by an external computer. SOFTmax® PRO software from Molecular Devices provides integrated instrument control and statistical data analysis.

## PathCheck™ Sensor

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<br>  <br><br>Cuvette | 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<br>  <br><br>Microplate Wells | 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 340PC 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 5% of the values obtained directly in a 1-cm cuvette. |

Factory-stored values derived from deionized water are used to normalize the OD data for microplate wells. This pathlength correction is accomplished only with the use of SOFTmax® PRO software from Molecular Devices which also provides full instrument control and statistical data analysis.

## *Component Description*

The main components of the SPECTRAmax 340PC are:

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


***Figure 1.1**: SPECTRAmax 340PC*

### The Control Panel

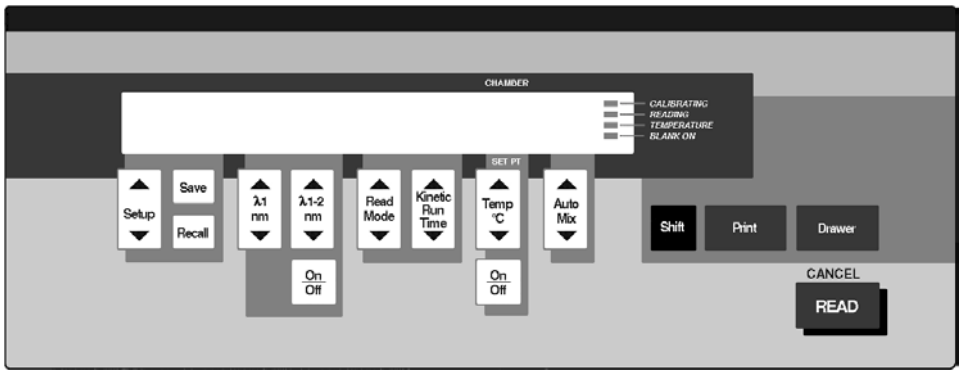



***Figure 1.2**: Control Panel*

The control panel consists of an LCD and 15 pressure-sensitive membrane keys—all the controls necessary to perform stand-alone operation of the SPECTRAmax 340PC. The control panel can be used to configure the instrument settings, store and recall assay protocols, and to initiate readings. When you press a control panel key, the SPECTRAmax 340PC begins the desired action.

**NOTE:** When using Molecular Devices' SOFTmax PRO software to control the SPECTRAmax 340PC from an external computer, the LCD will show "Remote Control" during the time SOFTmax PRO is running. During computer-controlled operation, the front control panel keys are disabled. If you quit SOFTmax PRO, the LCD returns to normal and the front control panel keys will function as before.

### LCD

The 2-×-40-character liquid crystal display shows the current instrument settings. You can change the contrast of the display to appear darker or lighter as desired. Press and hold the [Shift] key and then press the up or down arrow on the [AutoMix] key. Pressing the up (▲) arrow makes the display lighter; pressing the down (▼) arrow darkens the display.

### Keys

Most stand-alone instrument functions can be performed by pressing a single key; a few others require that you press keys in combination. The functions of the control panel keys are described below.


[Setup]

Allows you to choose from a group of assay protocols that have been saved in non-volatile memory (stored by number from 0 through 9). The settings stored under "0" are factory preset defaults and cannot be modified or deleted. At the time of shipment, settings 1 through 9 also contain the same preset defaults.

**NOTE:** Non-volatile memory is retained even if the instrument is turned off.


[Save]

Stores the instrument settings you have chosen for the assay into memory under a specific number from 1 through 9 (0 is reserved for the default instrument protocol).


[Recall]

Recalls the instrument settings previously stored using the [Save] key.


[λ 1 nm]

Selects the *measurement* wavelength. 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.


[λ1-2 nm]

Selects the *reference* wavelength. Pressing either the up (▲) or down (▼) arrow on this key *once* increments or decrements the wavelength shown in the display by 1 nm; pressing and *holding* either arrow key 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.


On/Off (λ 1-2 nm)

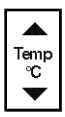
Enables/disables dual wavelength mode.


Read Mode

Selects the read mode by scrolling through the listed options. Choices are Blank, Endpoint, and Kinetic.


Kinetic Run Time

Allows you to choose the duration for a kinetic run. (Kinetic read mode must have been chosen first for this key to be active.) Choices are 1, 2, 5, 10, and 20 minutes.




Temp °C (Incubator)

Allows you to enter a set point at which to regulate the microplate chamber temperature. Pressing this 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.

**NOTE:** The temperature set point must be at least 4°C above ambient. The ambient temperature must be greater than 20°C to achieve temperature regulation of 45°C.

⚠ **CAUTION:** If the incubator is disabled, pressing the Temp °C key will *enable* the incubator.


On/Off (Incubator)

Enables/disables the incubator function.


Auto Mix

Depending on the mode chosen, pressing this key selects automatic shaking of the microplate for a preset duration at one or more points before and/or during the read cycle. Choices are On, Once, and Off.


Shift

Activates secondary functions by first pressing and holding the Shift key followed by pressing the secondary key. Labels for secondary functions are printed in red on the control panel.


CANCEL

Stops the reading in progress. CANCEL is invoked by pressing the Shift/READ key combination. CANCEL remains active when the instrument is in remote control mode.


Print

Sends the data from the most recent reading to the printer (if it is connected directly to the SPECTRAmax 340PC).


Drawer

Opens or closes 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.


READ

Pressing this key causes the microplate drawer to close automatically, if it was open, after which the selected assay read mode begins.

## Status Indicators

At the far right of the LCD are indicators as shown in Figure 1.3. These indicators will be illuminated when the SPECTRAmax 340PC is performing certain actions as described below.

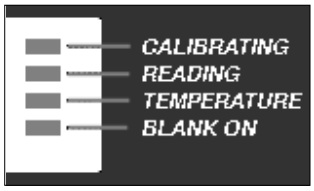



***Figure 1.3**: LCD Indicators*

| | |
|---|---|
| CALIBRATING | Illuminated during the automatic calibration cycle before the instrument reads the microplate. |
| READING | Illuminated while the instrument is reading a microplate. |
| TEMPERATURE | This indicator flashes when the incubator is turned on and the set point has not yet been reached; it is illuminated continuously (no longer flashing) when the set temperature has been reached (± 0.3°C). |
| BLANK ON | Illuminated when a BLANK pattern is active. |

## The Microplate Drawer

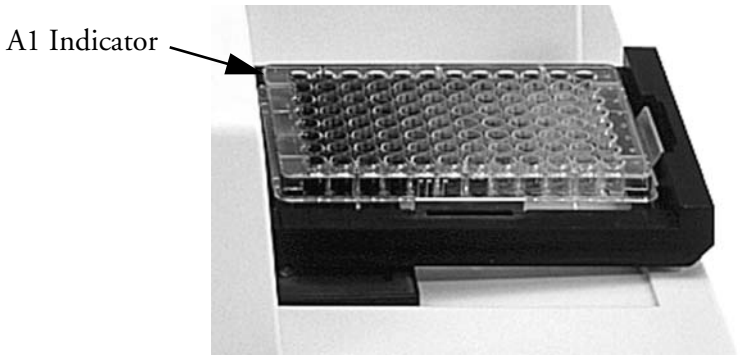



***Figure 1.4**: Microplate Drawer*

The microplate drawer, located on the right side of the SPECTRAmax 340PC, holds microplates and blanking templates. The drawer slides in and out of the microplate 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. When the incubator is off, the microplate drawer remains open at power up and after a read. When the incubator is on, the drawer closes automatically to assist in controlling the temperature of the microplate chamber. To open the drawer, press the [Drawer] key. 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. After the read, the drawer will open for about 10 seconds, allowing you to remove the plate.

**NOTE:** During a kinetic read in either stand-alone mode or under computer control, the drawer can be opened between reads by pressing the [Drawer] button when there are at least 30 seconds before the next read. The drawer will close automatically before the next read.

**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 5, “Troubleshooting”).

### ***Microplates***

The SPECTRAmax 340PC 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.

### ***Templates***

Blank pattern templates supplied with the SPECTRAmax 340PC can be used in stand-alone mode to select a blank set of wells. More information regarding the use of templates and creating blank patterns can be found Chapter 3, “Stand-Alone Operation.”

## The Back Panel

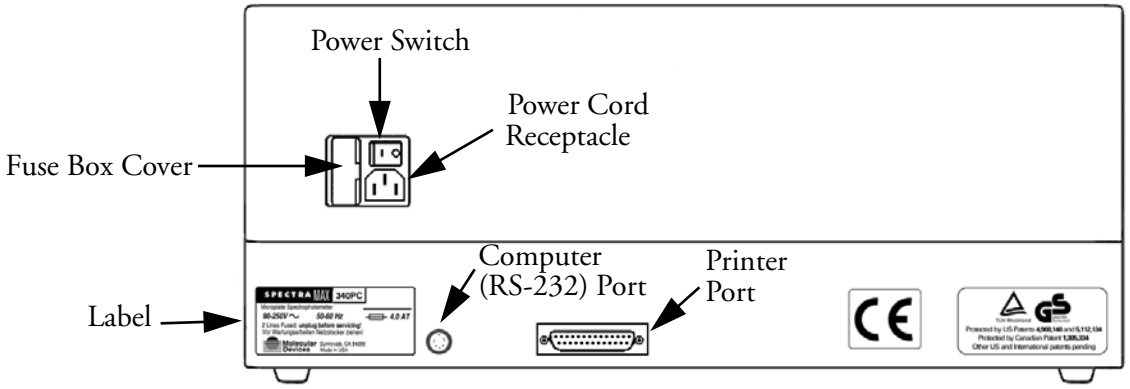



***Figure 1.5**: Components on the Back Panel of the SPECTRAmax 340PC*

The following components are located on the back panel of the SPECTRAmax 340PC:

- **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 a port on the printer.
- **Computer port** (double-shielded RS-232, for use with an external computer)—plug one end of an 8-pin DIN serial cable into this port; the other end attaches to the serial (modem) port of the computer.
- **Label**—provides information about the SPECTRAmax 340PC, such as line voltage rating, cautionary information, serial number, etc. Record the serial number shown on this label on the Warranty Card and for use when contacting Molecular Devices Technical Services.

## *Functional Description*

### Instrument Settings

Up to nine user-definable assay protocols can be saved in non-volatile memory for future use. User-defined protocols are saved by number (1-9); the protocol labeled "0" contains default parameters, set at the factory, and cannot be altered. User-defined protocols can contain the following instrument settings:

- Read mode
- Wavelength(s) (up to two)
- Automix state
- Blank pattern
- Temperature set point

Assay protocol settings that you save under numbers 1 through 9 are retained by the SPECTRAmax 340PC in non-volatile memory—they are retained even when power to the instrument is turned off. At power up, the SPECTRAmax 340PC always reverts to the default protocol 0, but the other saved settings are available.

#### ***Saving a Protocol***

To store a protocol in memory, first define the instrument settings for the protocol by setting the parameters as desired. Then press the up or down arrows on the [Setup] key until the desired number (under which to save the protocol) is displayed. Then press the [Save] key to save the current protocol in non-volatile memory under that number.

**NOTE:** If any settings were already saved under that number, they will be overwritten by this process. Before choosing a number under which to save parameters, ensure first that it does not contain data you wish to retain.

#### ***Recalling a Saved Protocol***

To recall a protocol that you saved previously, press the up or down arrows on the [Setup] key until the number of the saved protocol (from 1 to 9) appears in the display and then press [Recall].

To restore the factory-default protocol and overwrite any settings in present memory, press [Setup], choose "0," and then press [Recall]. To replace the settings for any protocol stored under numbers 1 through 9 with these factory default settings, use [Setup] to select the desired protocol number and then press [Save].

## Modes of Stand-Alone Operation

When operating the SPECTRAmax 340PC as a stand-alone system, you can obtain readings using either endpoint or kinetic mode.

### ***Endpoint***

If you wish to obtain a single set of optical density (OD) readings for each well of a microplate, select either single- or dual-wavelength operation in endpoint mode. OD data is printed in an 8-×-12 microplate format.

When the instrument is set to endpoint mode, the ten-second read cycle (for each wavelength selected) is automatically preceded by a calibration cycle requiring approximately one second.

Dual wavelength readings are taken at a measurement wavelength (λ1) as well as a reference wavelength (λ2)—you may choose both settings. The difference between these readings (λ1-λ2) is displayed for each well.

If the Automix function is selected for endpoint readings, the plate is shaken for five seconds prior to the reading.

### ***Kinetic***

Kinetic analysis at a single wavelength (λ1) can be performed for several predefined total reading times (1, 2, 5, 10, and 20 minutes) with preset read intervals. At the end of a reading, rates are reported as mOD/min for each well in an 8-×-12 microplate format.

Kinetic analysis has many advantages when determining the relative activity of an enzyme in different types of microplate 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.

In kinetic mode, a calibration cycle requiring less than one second automatically precedes the first read cycle. During the kinetic reading, the microplate remains in the isothermal microplate chamber. The interval between read cycles is determined by the instrument based on the kinetic run time and the Automix status.

If Automix is selected for kinetic analysis, the microplate is shaken for five seconds prior to the initial reading. Thereafter the microplate is shaken for three seconds before each read cycle. This ensures that the color developing in each well is uniformly distributed throughout the well prior to each reading. The Automix function is strongly recommended for ELISAs and other solid-phase, enzyme-mediated reactions.

The SPECTRAmax 340PC calculates the rate of reaction for each well, for either positive or negative kinetic rates, using the first reading as the starting OD baseline value for each well and a limited OD excursion of 0.2 OD. The on-board, microprocessor-based, linear regression package reports the slope value for the line fit to each kinetic plot as the kinetic rate in mOD/min.

**Kinetic Run Time**
The total run time for a kinetic reading is set using the up and down arrows on the [Kinetic Run Time] key. Choices are 1, 2, 5, 10, and 20 minutes. Table 1.1 shows the intervals (in seconds) and total number of readings that occur with each total run time setting, with and without Automix™ enabled.

*Table 1.1: Intervals and Number of Readings for Total Kinetic Run Time*

| Kinetic Run Time (minutes) | No Mixing | | Mixing | |
|---|---|---|---|---|
| | Interval (seconds) | Number of Plate Reads | Interval (seconds) | Number of Plate Reads |
| 1 | 9 | 7 | 14 | 4 |
| 2 | 9 | 14 | 14 | 8 |
| 5 | 16 | 25 | 19 | 18 |
| 10 | 30 | 35 | 30 | 28 |
| 20 | 60 | 45 | 60 | 38 |

## ***Blank Pattern***

Selecting BLANK by pressing the arrows on the [Read Mode] key allows you to instruct the instrument regarding which wells should be treated as "blanks" or, taken together, as a blank pattern.

The active presence of a blank pattern is shown by the BLANK ON indicator on the LCD. The SPECTRAmax 340PC retains blank pattern information in non-volatile memory; values are recalculated for each subsequent reading. A blank pattern may be cleared by setting the active protocol to the factory presets or by reading an empty drawer in the BLANK mode.

Each time a microplate is read, the average OD or milli-OD/minute reading of the wells in the current blank pattern will be computed. This mean value is then subtracted from all the readings, including those of the individual members of the blank pattern. For wells which are members of the blank pattern, the character "#" will replace the decimal point in printouts. This feature allows subtraction of values of substrate blanks or other special calibrators.

Blank pattern information is provided to the SPECTRAmax 340PC by the use of a blank pattern template. (More information regarding the use of templates can be found in Chapter 3, "Stand-Alone Operation.") After reading the template, the instrument will print the well locations designated as members of the blank pattern.

## Wavelength Selection

In endpoint mode, you can select either single- or dual-wavelength mode during stand-alone operation of the SPECTRAmax 340PC. Dual wavelength mode is used when you wish data from both measurement and reference wavelengths to be acquired. For kinetic readings, only single-wavelength mode is available.

Typically, you should select a measurement wavelength that is near the wavelength of maximum absorption (λmax) for the chromophore/macromolecule of interest. The reference wavelength (if any) is usually set to a wavelength at which the chromophore/macromolecule shows relatively little absorption. The dual wavelength feature increases endpoint accuracy—errors arising from optical imperfections, such as scratches and plastic irregularities in the microplate, can be effectively canceled out.

The display on the control panel shows the currently selected measurement (λ1) and reference (λ2) wavelength (if any). You can change the wavelength(s) by pressing the arrows on either wavelength selection key ([λ 1 nm] or [λ 1-2 nm]) until the display shows the desired wavelength. The wavelength list will wrap around to the top when the last selectable wavelength is presented.

**NOTE:** If the measurement and reference wavelengths are the same, the instrument will beep and deselect dual wavelength.

## Temperature Regulation

The SPECTRAmax 340PC has been designed to regulate the temperature of the microplate chamber from 4°C above ambient to 45°C. Upon power up, when the incubator is off, the temperature in the SPECTRAmax 340PC microplate chamber is ambient and isothermal. Pressing the incubator [On/Off] key below the [Temp °C] (incubator) key will cause the SPECTRAmax 340PC to begin warming the microplate chamber. The temperature set point defaults to 37.0°C at start-up. With the incubator on, the temperature of the microplate chamber can be set and regulated from 4°C above ambient to 45°C.

**NOTE:** Accuracy of the temperature set point is only guaranteed 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 on the [Temp °C] (incubator) key until the desired set point is shown above the key in the display.

After activating the incubator, the microplate drawer will close (if open) after a ten-second delay and the TEMPERATURE indicator located at the right of the LCD will begin to flash and will continue flashing until the temperature within the microplate chamber reaches the set point (± 0.3°C) when it will remain illu-

minated. Typically, the microplate chamber will reach 37.0°C in less than 15 minutes. The indicator also flashes as a warning if the temperature within the microplate chamber deviates more than ± 0.3°C from the set point.

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

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

Temperature regulation and control of the microplate chamber is achieved through electric heaters, a fan, efficient insulation, and temperature sensors. The heaters are located in the microplate chamber which is insulated to maintain the temperature set point. The sensors are mounted inside the chamber and 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 microplate chamber temperature with a temperature variation of the air inside the chamber of less than 0.3°C. (Temperature uniformity within the microplate itself will depend upon its design, materials, and/or configuration.)

## Automix

The Automix function permits automatic shaking of the microplate at preset intervals, thereby mixing of the contents within each well. Automix must be selected before beginning a reading.

Selectable Automix settings are On, Once, or Off. The actions associated with these settings depend on the read mode chosen.

For endpoint mode, setting Automix to On or Once will shake the plate for five seconds and then read at all selected wavelengths.

When kinetic mode is chosen, setting Automix to On will shake the plate for five seconds before the initial reading and for three seconds before each subsequent reading. Setting Automix to Once will shake the plate for five seconds only before the first reading, with no mixing between kinetic readings.

When Automix is enabled, either “On” or “Once” will be displayed above the [Auto Mix] key.

**NOTE:** Use of Automix is strongly recommended for ELISAs and other solid-phase, enzyme-mediated reactions to enhance accuracy.

## Data Collection

The SPECTRAmax 340PC stores only the most recent endpoint or kinetic plate reading in a buffer memory.

⚠ **CAUTION:** Data in the buffer memory is lost when power to the SPECTRAmax 340PC is turned off. This applies even to short power outages. Do not turn the instrument off while important data remains in the buffer memory.

## Printed Data Output

During stand-alone operation, results are automatically printed as soon as a plate has been read. A new microplate can be loaded into the SPECTRAmax 340PC while the results from the first reading are being printed.

**NOTE:** If you have performed a blank reading, the blank values will be subtracted from raw OD values, and the calculated result will be shown on the printout.

### ***Default Override Control***

**NOTE:** The following override control applies **only** to stand-alone instrument operation. *Use of this control is not required when using SOFTmax PRO to control the SPECTRAmax 340PC.*

Normally the SPECTRAmax 340PC defaults to sending output to the printer. To send output to the RS232 port, switch the instrument off and touch and hold the [Print] key when you switch the instrument power back on. Hold this key down while the instrument calibrates and until the microplate drawer comes out. All output will now be sent to the RS232 port until the instrument is switched off.

## Computer Control

The SPECTRAmax 340PC 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 340PC. SOFTmax PRO is easy to use, yet is powerful and flexible, and expands the capabilities of the SPECTRAmax 340PC.

SOFTmax PRO allows you to:

- Expand the available read modes
  - Use up to six wavelengths for endpoint and kinetic readings
  - Perform spectral readings in the 340 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 entire plate or a subset of microplate strips
- Turn the incubator on or off to control the temperature in the microplate chamber
- Use PathCheck to normalize the absorbance readings in each microplate well to a 1 cm pathlength
- 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)
- Design a microplate template to simplify data reduction
  - Identify groups of wells with labels of your choice
  - Identify individual wells with unique names
  - Blank the entire plate, one or more groups, and/or individual wells
- Save instrument settings, template formats, and data analysis parameters as assay protocol files and recall them for later use
  - Rapid instrument and analysis set up for repeated microplate assays
  - Uniform analysis for equivalent microplates
- Acquire data from the SPECTRAmax 340PC
  - 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

- Display data on screen: raw values, reduced number, or raw values with reduced number
  - Raw 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 spectral 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 standard 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 or as JCAMP-DX format for use with spectral analysis software

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

## *Specifications*

Thermal specifications for the SPECTRAmax 340PC apply to flat-bottom microplates with isolated wells. All other specifications apply to standard 96-well polystyrene flat-bottom microplates.

**NOTE:** Technical specifications are subject to change without notice.

### Photometric Performance

| | |
|---|---|
| **Wavelength range** | 340–850 nm |
| **Wavelength selection** | Monochromator tunable in 1-nm increments |
| **Wavelength bandwidth** | 5 nm FWHM (full width half maximum) |
| **Wavelength accuracy** | < ± 2.0 nm across the 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 linearity (405 nm)** | 0.000 OD to 3.000 OD |
| **Photometric accuracy (microplate)** | **0–2.0 OD:** 340–850 nm <± 1.0% and ± 0.006 OD |
| | **2.0–2.5 OD:** 340–850 nm <± 3.0% and ± 0.006 OD |
| **Photometric precision (repeatability)** | **0–2.0 OD:** 340–850 nm <± 1.0% and ± 0.003 OD |
| | **2.0–2.5 OD:** 340–850 nm <± 3.0% 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

- Express data as Absorbance or %Transmittance using SOFTmax PRO
- Single wavelength reading
- Multiple wavelength (λ1-λ2 in stand-alone mode; up to six using SOFTmax PRO) optical density
- Kinetic and kinetic graphics
- Spectral scan using SOFTmax PRO (340–850 nm)

## Measurement Time

| | |
|---|---|
| **Read time (endpoint)** | • 96 wells in 12 seconds (single wavelength)<br>• 96 wells in 12 * N seconds (N wavelengths) |
| **Kinetic read intervals** | • 96 wells, 9-second minimum interval between readings (single wavelength)<br>• 1 column, 2-second minimum interval between readings (single wavelength) |

## Scan Speed

| | |
|---|---|
| **Normal scan** | 33 * K nm/min (8-well strip) (K = wavelength interval) |
| **Speed scan** | 135 * K nm/min (8-well strip) |

## Temperature regulation

| | |
|---|---|
| **Reading chamber** | Isothermal when temperature regulation is not enabled, < 1°C |
| **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 |
| **Well-to-well 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 |
| **Variation** | < 0.3°C (regulated) |
| **Temperature regulation diagnostics** | Temperature regulation system is continuously monitored and updated |
| **Evaporation** | Plate lid required to minimize evaporative cooling |
| **Recommended microplate** | Flat-bottom microplates with isolated wells and lid |

## 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) |

## General Instrument

| | |
|---|---|
| **Display** | 2-×-40-character backlit LCD with adjustable contrast |
| **Operating panel** | 15-key (plus Shift key functions) membrane keypad |
| **Memory back-up** | Stored protocols (nine maximum) and instrument calibration parameters |
| **Self-diagnosis** | Continuous on-board diagnostics |
| **Spill control** | Drawer mechanism/reading chamber assembly is protected from accidental spillage by drainage ports |
| **Calculated mean time between failures (MTBF)** | > 20,000 hours |
| **Data buffer** | Memory downloading of data buffer (100-plate maximum) |
| **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

| | |
|---|---|
| **Operating temperature** | 15 to 40°C |
| **Operating humidity** | 0 to 70%, non-condensing |
| **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** | 90–250 VAC, auto-ranging |
| **Line frequency** | 50/60 Hz |

## Regulatory

| | |
|---|---|
| **Safety** | TUV, GS, CE approved |
| **Patents** | Protected by U.S. Patents 4,968,148 and 5,112,134<br>Protected by Canadian Patent 1,305,334<br>Other U.S. and International Patents Pending |

# *Chapter 2 Installation*

## *Installation Warnings*

1) Always turn power to the instrument OFF and remove the power cord from the back of the instrument prior to any installation operation.
2) Use only the tools listed in this manual to perform the steps described in the instructions.
3) Never perform any operation on the instrument in an environment where potentially damaging liquids or gases are present.

## *Installation Cautions*

1) 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.
2) Never touch the surfaces of interference filters, optical lenses, or other optical components.

## *Unpacking*

The SPECTRAmax 340PC 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 340PC weighs approximately 29 pounds (13.2 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 340PC, 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. The packing list that accompanies the instrument describes all components that should have been placed in the packing carton. Make sure all these items are present before proceeding.

## Setting Up for Stand-Alone Use

1) Place the SPECTRAmax 340PC 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.

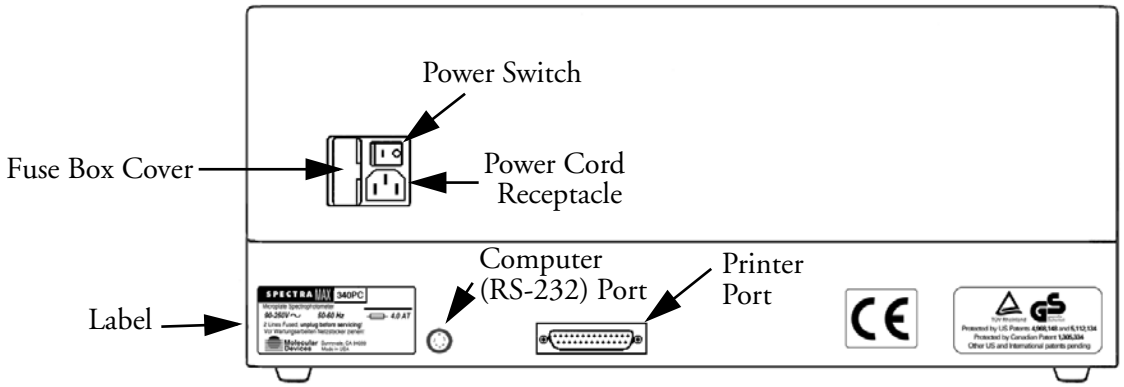



***Figure 2.1: View of Rear Panel***

3) Locate the printer port (25-pin parallel) on the rear panel. Connect one end of the cable here and the connect the other (Centronics) end to the printer.
4) Load paper into the printer according to the manufacturer's instructions and connect the printer's power cord to the power outlet.
5) Insert the female end of the power cord into the power receptacle at the rear of the SPECTRAmax 340PC. 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.
6) Turn the SPECTRAmax 340PC 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.

## Setting Up for Computer Control

1) Place the SPECTRAmax 340PC 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 above.
3) Locate the computer port (8-pin DIN) on the rear panel. Locate the appropriate cable for your computer (male DB8 to male DB8 for Macintosh or male DB8 to female DB9 for IBM-compatible PC).
4) Insert the male DB8 end into the computer (RS-232) port of the SPECTRAmax 340PC. Connect the other end to the serial port of the computer (COM1 or COM2 for IBM-compatible PC).

5) Insert the female end of the power cord into the power receptacle at the rear of the SPECTRAmax 340PC. 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.

6) Turn the SPECTRAmax 340PC 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.

# *Chapter 3 Stand-Alone Operation*

*This chapter contains operating information for the SPECTRAmax 340PC Microplate Spectrophotometer. If you are an experienced user of this instrument, you can turn to the Operation Overview on page 3-6 for a quick review of the operating steps.*

## *Prepare for a Reading*

### Turn the Instrument and Printer On

The power switch for the SPECTRAmax 340PC 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 this time also.

### Set the Temperature

If elevated temperature within the microplate chamber is desired, 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.

**NOTE:** Temperature cannot be regulated at a set point that is lower than 4°C above the ambient temperature.

The incubator can be left off for Endpoint readings where temperature control is not required and for ambient Kinetic assays.

To enable the incubator, press the incubator [On/Off] key (located below the [Temp °C] key). An indicator at the right side of the LCD will show that temperature control is on and the microplate drawer will close (if open) after a delay of about 10 seconds.

To change the temperature set point, press the up or down arrows on the [Temp °C] key until the desired temperature 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 [On/Off] key again. When the incubator is off, the drawer will open and the temperature within the microplate 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 microplate chamber temperature.

### Choose a Read Mode

#### *Using a Blank Pattern*

If your microplate has wells containing reagent blanks, you can enter a blank pattern. In stand-alone mode, the locations of blank wells are provided to the SPECTRAmax 340PC by using a blank pattern template.

One packet of blank pattern templates is provided with the instrument. Pick up a template by the center tab and use a common lab marker (black works best) to

mark the blank wells on the template as shown in Figure 3.1. Templates can also be constructed from microplates or from microplate lids with marked well location. Fill selected microplate wells with an optically dense solution (OD > 0.500) or blacken microplate lids at selected sites with a glassware marking pen.

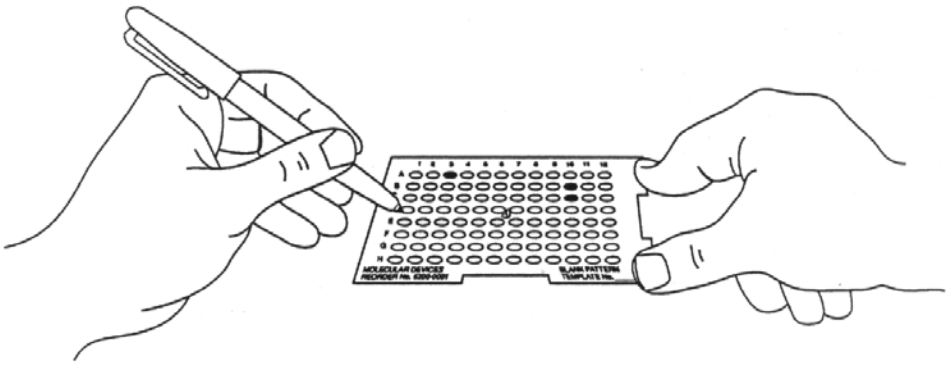


***Figure 3.1: Preparing the Blank Pattern Template***

When you have prepared the blank pattern, press the [Read Mode] key to scroll through the list of modes until BLANK appears.

If the incubator is on and the drawer is closed, open the drawer by pressing the [Drawer] key. The drawer will remain open for approximately 10 seconds, after which a beeping sound will alert you that the drawer is closing automatically. Load the template in the drawer, matching template well A1 with drawer position A1, making sure the template is flush on all sides and lies flat. Touch the [READ] key any time after the template is properly positioned in the drawer.

When reading is complete, the instrument will print a display of the well locations that have been designated as members of the blank pattern. Blank wells will be represented on the printout by the character "#." All other wells will be indicated by a single dot character (".").

The blank pattern may be stored as part of an assay protocol.

If a blank pattern has not been saved, it may be cleared by reading an empty drawer in BLANK mode, or by recalling the factory default protocol. To change or clear the blank pattern for an assay protocol, recall the protocol and temporarily switch the read mode to BLANK. To change the blank pattern, read the new blanking template; to clear the blank pattern, read an empty drawer. To save the new settings, switch back to the original read mode and press the [Save] key.

## ***Endpoint Mode***

Use the up or down arrows on the [Read Mode] key to scroll through the list until you select Endpoint (shown in the LCD).

### ***Kinetic Mode***

Use the up or down arrows on the [Read Mode] key to scroll through the list until you select Kinetic (shown in the LCD).

**Kinetic Run Time.** After choosing Kinetic mode, you must specify the total time for the reading. Press the up or down arrow on the [Kinetic Run Time] key until the desired total run time is displayed. In stand-alone mode, choices are 1, 2, 5, 10, and 20 minutes.

## Select the Wavelength(s)

You can select either single or dual wavelength operation for Endpoint mode or single wavelength Kinetic mode during stand-alone operation. In Endpoint mode, dual wavelength is used when you want data from both a measurement and reference wavelength to be acquired by the SPECTRAmax 340PC.

**Single Wavelength Selection.** Select the measurement wavelength by pressing the up or down arrows on the [λ 1 nm] key on the control panel. The LCD will show the currently selected measurement (λ1) wavelength. The wavelength list will wrap around to the top when the last selectable wavelength is presented.

**Dual Wavelength Mode Selection.** Select dual wavelength mode by pressing the [On/Off] key below the [λ 1-2 nm] key on the control panel. The LCD will show the currently selected reference (λ2) wavelength. Change the wavelength by pressing the arrows on the [λ 1-2 nm] key until the desired wavelength is displayed. The wavelength list will wrap around to the top when the last selectable wavelength is presented.

**NOTE:** If you select the same setting for your measurement and reference wavelengths, the SPECTRAmax 340PC will produce only a single wavelength reading.

## Save/Recall Instrument Settings

If desired, you can save the currently selected instrument settings in memory for future use. Up to nine protocols can be saved, numbered 1 through 9.

To save the current instrument settings, press the [Setup] key until the desired number (1 through 9) appears in the display. Press the [Save] key to record the settings under that number.

⚠ **CAUTION:** The instrument does not inform you regarding whether or not a protocol has been saved previously under a certain number. You should keep a record of the protocols and numbers under which they are saved so that you don't accidentally overwrite a previously saved setting.

To recall parameters saved previously, press the [Setup] key until the number (1 through 9) of the saved protocol appears in the display. Press the [Recall] key to use the parameters stored under that number.

## Read the Microplate

**BIOHAZARD:** The underside of the microplate must be dry prior to placing it in the drawer. If the microplate has fluid on the underside, dry it using a paper towel (or equivalent) and then place it in the drawer. Alternatively, place a clear Mylar sheet (such as a Molecular Devices blank pattern template) beneath the microplate before inserting it in the drawer.

If you are reading filter-bottom microplates, fluid may drip off the filter membrane. **You must place a clear mylar sheet (such as a Molecular Devices blank pattern template) beneath the microplate when inserting it in the drawer.**

These precautions are necessary to prevent fluid from dripping from the microplate onto any lenses when the microplate is in the reading chamber and to minimize potential exposure to biohazardous fluids to yourself and other users of the instrument.

After selecting the read mode, setting the temperature (if desired), and choosing the wavelength(s), insert the filled microplate into the drawer, matching well A1 with position A1 in the drawer. Make sure the microplate is flat on the drawer bottom. Touch the [READ] key to begin reading the microplate. The SPECTRAmax 340PC will automatically calibrate for less than two seconds (four seconds if dual wavelength has been selected), send a header for the reading to the printer, close the drawer (if it was open), and read the microplate according to the selected instrument settings.

The CALIBRATING status indicator on right side of the display will be illuminated during calibration, followed by illumination of the READING status indicator during the reading. When reading is complete, the drawer will open, allowing you to remove the microplate. If the incubator is on, the drawer will close again after approximately 10 seconds. If you return to the SPECTRAmax 340PC and find the drawer closed after a microplate has been read, press the [Drawer] key. When the drawer opens, you can remove the microplate.

You do not have to wait for the printer to finish before loading another microplate.

## Operation Overview

The following steps provide a quick reminder of the basic operating procedures required to perform an assay using the SPECTRAmax 340PC.

1) Turn on the printer and make sure it is properly connected.
2) Turn on the power switch of the SPECTRAmax 340PC (located on the back panel). The microplate drawer will open automatically.
3) If you wish to regulate the temperature inside the microplate chamber, touch the [On/Off] key below the [Temp °C] (incubator) key to bring the microplate 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.

4) 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 the up or down arrows on the [Temp °C] key.

5) Select the desired measurement wavelength by pressing the arrows on the single [λ 1 nm] key. Scroll up or down through the list of wavelengths shown in the LCD using the up or down arrows on the key until the desired measurement wavelength is highlighted.

6) To use a reference wavelength in Endpoint mode, press the [On/Off] key beneath the dual wavelength key ([λ 1-2 nm]). A listing of the reference wavelengths will appear on the LCD; you can scroll up or down through this list using the up or down arrows on the [λ 1-2 nm] key until the desired reference wavelength is highlighted.

7) To set a blank pattern prior to reading the microplate, darken the well areas corresponding to the blank wells using a blanking template or fill the same wells of a microplate with anything having an OD greater than 0.5 OD. Set the read mode to BLANK using the up or down arrows on the [Read Mode] key. Place the blank template in the open drawer and press the [READ] key. This blank pattern will be used for all subsequent readings until a new blank pattern is set. New blank values will be recalculated for each reading.

8) Set the read mode to either Endpoint or Kinetic using the up or down arrows on the [Read Mode] key. For a Kinetic reading, press the up or down arrows on the [Kinetic Run Time] key to set the total time for the Kinetic reading.

9) Set Automix to On, Once, or off by pressing the [Auto Mix] key.

10) If you are performing Kinetic analysis, add substrate at this time.

11) Load the prepared microplate into the drawer, being sure to match well A1 with the A1 mark on upper left-hand corner of the drawer. Press the [READ] key. To cancel the reading, press and hold the [Shift] key and then press the [READ] key.

# *Chapter 4 Maintenance*

## 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 340PC Microplate Spectrophotometer, 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 power switch off and remove the power cord and any computer/printer cables from the back of the instrument 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 340PC. 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 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 340PC 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 the 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.

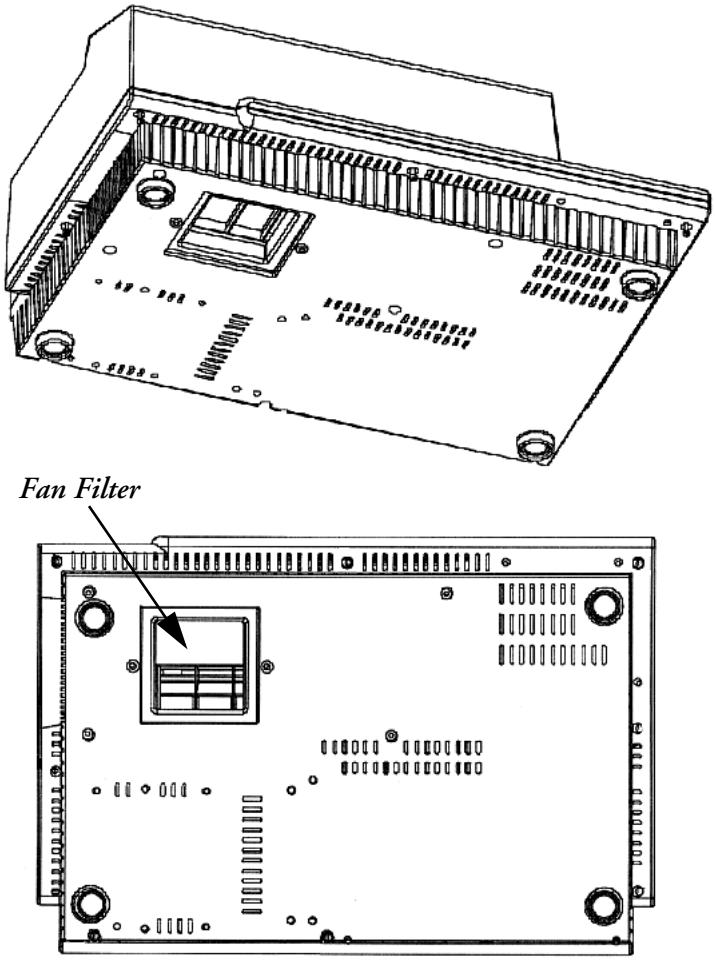



***Figure 4.1**: Underside of SPECTRAmax 340PC Showing the Location of the Fan Filter*

## *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 in to a functioning power outlet and to the receptacle at the rear of the SPECTRAmax 340PC. If power failed while the SPECTRAmax 340PC 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 in the original carton. The U.S. and metric fuses are identical except for physical size. They may be taped to the back of the SPECTRAmax 340PC.

If you no longer have spare fuses, you may obtain new ones from Molecular Devices (part numbers: 4601-0013, U.S., 4601-0014, 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).

1) Switch power to the instrument off and then remove the power cord from the outlet and from the SPECTRAmax 340PC power cord receptacle.
2) Remove the printer cable and computer cable (if connected) from the back of the SPECTRAmax 340PC.
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) is the power cord receptacle. As shown in Figure 4.2, insert a small, flat-blade screwdriver into the slot behind the tongue at the right of the black plastic cover. Gently pry the cover open. It will begin to slide forward.

***Figure 4.2**: Pry Open the Fuse Box Cover*

5) Continue gently prying the fuse box forward until you can pull it free of the instrument. When removed, the fuse assembly will appear as shown in Figure 4.3.

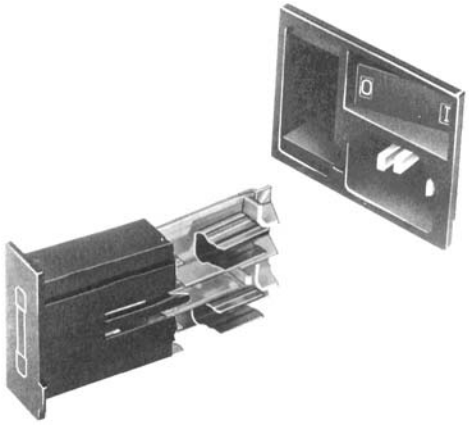


***Figure 4.3**: Removing the Fuse Box*

6) Once the fuse box is out, you will see a holder inside containing two fuses. Pull the fuse holder out of the box (see Figure 4.4).

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.

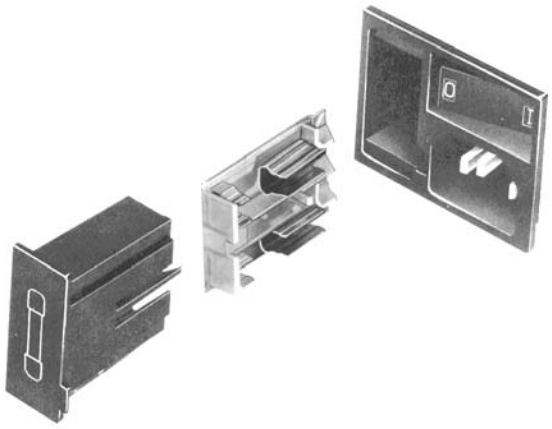


***Figure 4.4**: The Fuse Box and Holder with Fuses Removed*

8) Insert new SLOWBLOW-rated fuses into the fuse holder. Either end of the fuse may be forward.
9) Insert the fuse holder into the fuse box, making sure that the fuses face toward the right (toward the tongue on the cover) as you insert it. Slide the fuse holder all the way into the box.
10) 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.
11) Reconnect the power cord to the instrument and to the wall outlet and reconnect other cables previously disconnected.

## *Long-Term Shutdown*

If you will not be using the SPECTRAmax 340PC for an extended period of time, clean the *external* surfaces of the instrument and cover it with the SPECTRAmax dust cover.

## *Moving the SPECTRAmax 340PC*

If you need to relocate the SPECTRAmax 340PC, follow these steps.

⚠ **WARNING:** The SPECTRAmax 340PC weighs approximately 29 pounds (13.2 kilograms). To avoid injury, it is recommended that two people lift the instrument together, using proper lifting techniques.

1) Remove any microplate from the drawer then close the drawer.
2) Turn off the power switch and unplug the power cord from the source and from the receptacle on the back of the instrument.
3) Depending on the distance that you will be moving the instrument, you may wish to repackage the SPECTRAmax 340PC in its original shipping carton. Otherwise, carry the instrument or place it on a rolling cart to transport it.
4) Ensure that the new location meets the proper specifications as described in Chapter 2, “Installation.”

# *Chapter 5 Troubleshooting*

This chapter lists error codes that may be seen, followed by their most likely causes and remedies. Maintenance procedures are described in Chapter 4. For problems with the SPECTRAmax 340PC that are not listed here, in the U.S., contact Molecular Devices Technical Services group at 1-800-635-5577; elsewhere, call your local representative.

**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 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 *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.

#### *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 a 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 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 in that 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 list to see if there is something that you can do to change the condition of the instrument to prevent the fatal error. 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 power up, 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 5.1: Error Codes, Messages, and Notes about the Errors*

| Error Code | Error Message | Notes |
|---|---|---|
| 100 | command not found | Command string was not recognized by the instrument. |
| 101 | invalid argument | Command Argument does not match specified parameters or syntax. |
| 102 | invalid data | Command argument is out of acceptable range. |
| 103 | too many arguments | Too many arguments after a specific command. |
| 104 | not enough arguments | Not enough arguments for a given command. |
| 105 | input line too long | Too many characters in the input line. |
| 106 | command error, system busy | Instrument could not perform the given command because it was busy doing another task. Example: Request a wavelength while the monochromator is in motion. |
| 107 | command error, measurement in progress | Instrument could not perform the command because a measurement was in progress. |
| 108 | command error, no data available | A request to the instrument to transfer data when there's no data in the buffer. |
| 109 | data buffer full | Too many data sets in the buffer. Can be caused by setting up a long kinetic run and disconnecting the computer or when SOFTmax Pro is preempted by another application. |
| 110 | error buffer full | More than 65 errors in the buffer. |
| 205 | user generated bus error | Result of improper use of certain commands. |
| 209 | receive buffer overflow | Caused by an external device sending too much data over the serial port and ignoring flow control. |
| 210 | serial port parity error | Parity bit error detected with incoming serial data. |
| 211 | serial port overrun error | Caused by host computer sending too much data and ignoring the flow control signal. |
| 300 | temp sensor faulty | Unable to read a reasonable thermistor value. Thermistor is faulty or disconnected, Main board problem, or ambient temperature is out of range. |

*Table 5.1: Error Codes, Messages, and Notes about the Errors*

| Error Code | Error Message | Notes |
|---|---|---|
| 301 | safe temperature limit exceeded | A temperature of over 50°C was detected on one or more of the 4 thermistors. Temperature will be shut off and remain off until power up reset is completed successfully. |
| 302 | low light measurement | Not enough light detected to make an accurate measurement. |
| 310 | Signal level saturation | Make sure nothing is blocking the door from shutting completely. |
| 317 | LCD time-out | LCD front panel is bad or disconnected. |
| 400 - 499 | Errors in Non-Volatile Memory | Contact Molecular Devices Technical Support. |

For all other error messages (codes not listed here), please contact your local Molecular Devices representative for assistance.

## Warning Messages

*Warning* messages are printed below data on the printout. A warning message indicates a situation that requires attention but is not sufficient to stop or prevent a reading, such as low memory, entries being out of range, or operations that could result in loss of data. Warning messages are generally self explanatory. For assistance regarding warning messages, contact your local Molecular Devices representative.

## Opening the Drawer Manually

If an error occurs while the drawer is closed and you need to remove a microplate, 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 thumbnail, locate the groove in the upper left side wall of the door. Open the door and use your index finger to 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 only be taken if the first two options have failed to open the drawer.

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

# *Appendix A Printers and Cables*

## *Compatible Printers*

In general, to be compatible with the SPECTRAmax 340PC, a printer must be able to emulate Epson graphics mode. This 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.

Please contact your local Molecular Devices representative for information regarding recommended printers.

## *Cables*

Molecular Devices recommends that you use high-quality, double-shielded cables to connect the SPECTRAmax 340PC 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 male 36D.

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

Macintosh: Male DB8 to male DB8

IBM Compatible: Male DB8 to Female DB9

# *Appendix B Accessories Available for Use with the SPECTRAmax 340PC*

| | **Part Number** |
|---|---|
| SPECTRAtest Validation Package | 0200-2405 |
| Cable, RS-232, Macintosh to instrument (8-pin DIN/8-pin DIN) | 9000-0091 |
| Cable, RS-232, PC to instrument (9-pin/8-pin DIN) | 9000-0149 |
| Cable, parallel printer (25-pin, Centronics) | 9000-0145 |
| Power Cord | 4400-0002 |
| Fuse, 4-amp Time Delay | 4601-0013 |
| Fuse, 4-amp (5 × 20 mm) Time Delay | 4601-0014 |
| Blanking Templates | 6200-0001 |

# *Index*