

**Model 550
Microplate Reader
Instruction Manual**

**Catalog Number
170-6750**

This Instrument is
for Laboratory Use
Only



Warranty

This warranty may vary outside of the continental United States. Contact your local Bio-Rad office for the exact terms of your warranty.

Bio-Rad Laboratories warrants to the customer that the Model 550 Microplate Reader (catalog number 170-6750) will be free from defects in material and workmanship, and will meet all performance specifications for the period of 1 year from the date of shipment. This warranty covers all parts and labor.

In the event that the instrument must be returned to the factory for repair under warranty, the instrument must be packed for return in the original packaging.

Bio-Rad shall not be liable for any incidental, special, or consequential loss, damage, or expense directly or indirectly arising from the use of the Model 550 Microplate Reader. Bio-Rad makes no warranty whatsoever in regard to products or parts furnished by third parties, such being subject to the warranty of their respective manufacturers. Service under this warranty shall be requested by contacting your nearest Bio-Rad office.

The following items are considered Customer-installable consumables: thermal printer paper and light bulbs. These parts are not covered by this warranty. All customer-installed parts are warranted only to be free from defects in workmanship.

This warranty does not extend to any instruments or parts thereof that have been subject to misuse, neglect, or accident, or that have been modified by anyone other than Bio-Rad or that have been used in violation of Bio-Rad instructions.

The foregoing obligations are in lieu of all other obligations and liabilities including negligence and all warranties, of merchantability, fitness for a particular purpose or otherwise, expressed or implied in fact or by law, and state Bio-Rad's entire and exclusive liability and buyer's exclusive remedy for any claims or damages in connection with the furnishing of goods or parts, their design, suitability for use, installation or operation. Bio-Rad will in no event be liable for any special, incidental or consequential damages whatsoever, and Bio-Rad's liability under no circumstances will exceed the contract price for the goods for which liability is claimed.

Regulatory Notices

Important: This Bio-Rad instrument is designed and certified to meet EN55011 and EN50082-1 requirements, which are internationally accepted electrical safety standards. Certified products are safe to use when operated in accordance with the instruction manual. This instrument should not be modified or altered in any way. Alteration of this instrument will result in the following:

- Void the manufacturer's warranty.

- Void the regulatory certifications.

- Create a potential safety hazard.

- This equipment is for laboratory application only.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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Section 1 Introduction

The Model 550 Microplate Reader is an eight-channel, vertical pathlength photometer that measures the absorbance of the contents of the wells of 96-well microtitration plates. It can perform single or dual wavelength measurements, and can report absorbance values to three decimal places.

The Model 550 reader can be programmed by entering commands through the membrane keypad to define assay blanks, select assay filter(s), set analysis parameters, and select report types. Six different reports can be generated: Raw Data, Absorbance, Limit, Matrix, Cutoff, and Concentration. Hard copy is produced by an on-board thermal printer.

The Model 550 reader features a built-in RS-232 serial interface device for convenient computer interfacing. The Microplate Manager® software for the Apple Macintosh®, Power Macintosh®, or IBM-compatible series of personal computers offers a complete analysis program (catalog numbers 170-6800 and 170-6617, respectively).

1.1 Accessories for the Model 550 Microplate Reader

Catalog Number	Product Description
170-6760	Replacement Lamp
170-6624	Printer Paper , Model 450/550, 4 rolls/package
170-6770	405 nm Interference Filter
170-6771	415 nm Interference Filter
170-6772	450 nm Interference Filter
170-6773	490 nm Interference Filter
170-6774	540 nm Interference Filter
170-6775	550 nm Interference Filter
170-6776	570 nm Interference Filter
170-6777	595 nm Interference Filter
170-6778	630 nm Interference Filter
170-6779	655 nm Interference Filter

Custom filters between 400 and 700 nm may be ordered. No special catalog number is required; simply specify the wavelength and the model number of the reader when ordering, *e.g.* 560 nm filter for the Model 550 Microplate Reader.

Section 2 Product Description

2.1 Contents of Shipping Carton

The shipping carton contains the following items:

1. Model 550 Microplate Reader, with 415 nm interference filter and 490 nm interference filter installed on the filter wheel
2. Power cord
3. One roll of thermal printer paper
4. Spare fuses
5. Dust cover
6. Instruction manual
7. Warranty card

The two additional filters ordered with the instrument are packaged separately and are easily installed by the customer. (See Section 5.1).

Inspect the exterior of the instrument for any signs of shipping damage. Contact your local Bio-Rad representative if any of these items are damaged or missing. In the U.S.A., call 1-800-4BIORAD. Please complete the warranty registration card and return it to Bio-Rad.

2.2 External Features

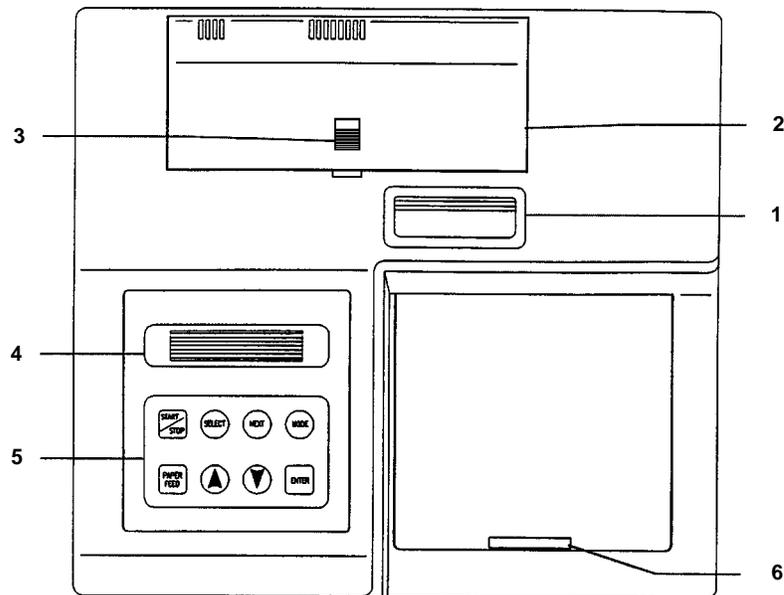


Fig. 1. Top View

- | | |
|---------------------------------|---------------------------------|
| 1. Printer slot | 4. Liquid crystal display (LCD) |
| 2. Rear cover | 5. Membrane keypad |
| 3. Release latch for rear cover | 6. Reading chamber door |

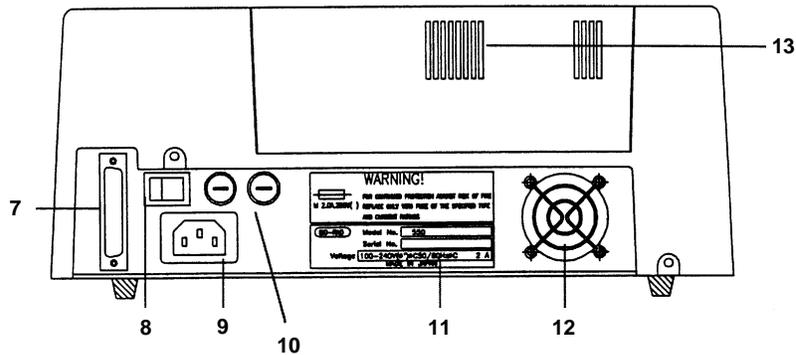


Fig. 2. Rear View

- | | |
|----------------------------|-------------------------|
| 7. RS-232 serial interface | 11. Serial Number Label |
| 8. ON/OFF switch | 12. Cooling Fan |
| 9. Power cord receptacle | 13. Cooling Vents |
| 10. Fuses | |

2.3 Membrane Keypad

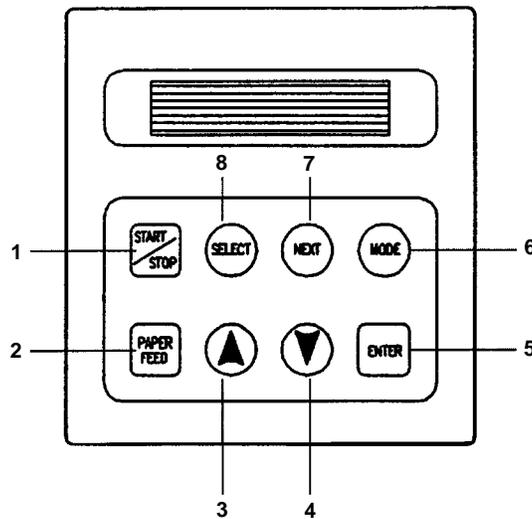


Fig. 3. Keypad

- | | |
|---------------|---|
| 1. START/STOP | Initiates plate reading using current analysis mode. Stops plate reading. |
| 2. PAPER FEED | Advances paper strip in thermal printer. |
| 3. UP ARROW | Decreases by one the number on the cursor position or moves a cursor to the preceding mode. |
| 4. DOWN ARROW | Increases by one the cursor position or moves a cursor to the next mode. |
| 5. ENTER | Completes or seals a field entry. |
| 6. MODE | Enables ARROW keys to change modes. |
| 7. NEXT | Moves the cursor to the next field. |
| 8. SELECT | Toggles a yes/no switch. If the check box is empty, the feature is turned off. If the check box is black, the feature is turned on. |

Section 3 Instrument Set-up

3.1 Initial Start-up

1. Place the instrument on a clean, sturdy table or bench. It is important to keep the instrument in a clean, relatively dust free environment to ensure maximum performance.
2. Connect the power cord to the back of the instrument. Before connecting the instrument to the main electrical supply, check that the AC voltage is appropriate for the instrument.
3. Turn on the power switch on the rear panel. The LCD will display the version number of the on-board firmware. After about three seconds, the instrument will perform an initial self diagnosis that requires about one minute. Allow three minutes for the instrument to warm up (reach thermal equilibrium) before reading plates.
4. Install the printer paper. The thermal printer paper is treated on one side only, and must be properly installed for the printer to function. The side of the paper that faces out from the roll is the treated side.
 - a. Open the rear cover of the instrument.
 - b. Tear off a small piece of the beginning of the roll on a diagonal to form a point.
 - c. Place the roll of paper in the small pan-like holder positioned below the printer. The roll should be positioned so that it will feed from the bottom.
 - d. While pressing the PAPER FEED key, feed the pointed end of the paper into the paper feed slot in the underside of the printer until the printer grabs the paper and feeds it through the slot in the top of the instrument.
 - e. Securely close the rear compartment.

Section 4 Operation

4.1 Overview

The Model 550 Microplate Reader has built-in software that allows the user to set the locations of assay blanks, select assay filter(s), set the values of the analysis limits, and select the report types to be printed. The software communicates through the two-line, 16-character LCD and is controlled through the instrument's membrane keypad.

The display shows the current mode of the on-board software. The software has eight different modes: the PLATE READING mode, in which data are collected, and seven modes for setting the reading and reporting parameters. The user presses the MODE key to toggle between collecting data in the PLATE READING mode and setting parameters in one of the seven other modes. The modes used to set parameters are: PRINT REPORTS, SET ANALYSIS, SET REPORT TYPES, SET BLANKS, SET LIMITS, SET CUTOFF and SET CONCENTRATION. If the MODE key is pressed when the instrument is in the PLATE READING mode, the instrument will switch into the PRINT REPORT mode. The user may then step through the other six parameter-setting modes by pressing either ARROW key. When the desired mode is displayed in the LCD, the user presses the ENTER key in order to modify the mode parameters.

In general, the on-board software is operated by:

- * Pressing MODE and the ARROW keys until the desired mode is displayed.
- * Pressing the ARROW keys to choose the parameter to change.
- * Pressing SELECT to toggle among choices.
- * Pressing ENTER to seal the user's selection.

Calculations

The Microplate Reader uses Beer's Law to calculate the absorbance value of each well. Beer's Law states that absorbance is equal to the \log_{10} of the ratio of the baseline measurement intensity (I_0) to the sample measurement intensity (I).

Beer's Law

$$\text{Absorbance} = \text{Log}_{10}(I_0/I)$$

Before measuring the plate, the reader takes a reading for all eight photodiode channels. These values are recorded as the baseline measurement (I_0) values for each channel, respectively. The reader then records the sample measurement (I) value for each well, and calculates the absorbance using these values. Channel-to-channel error is significantly reduced because the I_0 value for a given channel is used only in determining the absorbance of the wells of that channel. (The I_0 values are not averaged.)

Memory Back-up

The battery back-up provides memory even after the plate reader is turned off. The following information will be saved in the memory until a new plate is read by the instrument. Note that if reading a new plate is aborted before it is finished, all the previous data remain in memory and none of the data from the new plate are retained.

1. Last plate reading data (absorbances for all 96 wells)
2. Reading mode
 - a. Single or dual wavelength
 - b. Measurement filter position
 - c. Reference filter position
 - d. Plate mixing Yes/No
3. Report types selected
4. Blank well locations
5. Limit values
6. Cutoff report parameters
 - a. Report type (Constant or Formula)
 - b. Cutoff constant value
 - c. Control well locations for formula cutoff
7. Concentration report parameters
 - a. Number of samples and sample replicates
 - b. Standard concentration values
 - c. Number of standards and standard replicates

The first time the instrument is turned on, or after a battery failure, the following default information will be held in the memory.

1. 96 absorbance values of 0.000
2. Dual wavelength reading
3. Measurement filter position is #1 and Reference filter position is #2
4. Plate mixing is inactive (No)
5. Raw data report is selected, all other types are deselected
6. No blank wells are assigned
7. Upper limit is 3.500 and the Lower limit is 0.000
8. The constant type of cutoff report is selected
9. Constant cutoff value is 0.000
10. Concentration report parameters
 - a. # STDs = 0
 - b. # Samples = 0
 - c. Replicate STDs = 1
 - d. Replicate Samples = 1
 - e. All STD concentrations = 0.000

Limits

The microplate reader displays absorbance readings with absolute values as high as 3.500. Out-of-range absorbance values, *i.e.* those with absolute values greater than 3.500, are displayed as either '*.***' or '-*.***'. For example if the absorbance is 4.500, then the display will read '*.***', and if the absorbance is -4.500, the display will read '-*.***'.

Reports

Six types of reports can be generated by the Microplate Reader: Raw, Absorbance, Matrix, Limit, Cutoff and Concentration.

- A. The RAW DATA REPORT is the uncorrected absorbance values (without blank subtraction). In single-wavelength mode, the reported value is the measured absorbance. In dual-wavelength mode, the reported value is the difference between the uncorrected readings taken with the measurement filter and with the reference filter.
- B. The ABSORBANCE REPORT is the blank-corrected absorbance values. The mean absorbance value of all of the wells designated as assay blanks is calculated and then subtracted from all 96 values of the raw data set to produce the Absorbance Report.

$$\text{Abs} = \text{Raw} - \text{mean}$$

$$\text{mean} = \sum X / n$$

$$\text{S.D.} = [\{ \sum X^2 - n*(\text{mean})^2 \} / \{ n - 1 \}]^{1/2}$$

where mean = Blank mean

S.D. = Standard deviation

$\sum X$ = Sum total of the raw absorbances for each blank

$\sum X^2$ = Sum total of the squared raw absorbances for each blank

n = Number of blanks

Notes:

1. If an out-of-range absorbance is measured in one of the blank wells, then the report will show:

Blank mean	*.***
Std. Dev.	*.***

If the out-of-range value is below -3.500, then the asterisks will be preceded by a negative sign (-).

2. If the number of blanks is zero, then the report will show:

Blank mean	0.000
Std. Dev.	0.000

3. If the number of blanks is one, the report will show:

Blank mean	Raw absorbance value of the one blank well
Std. Dev.	0.000

- C. The MATRIX REPORT provides a qualitative report of the relative magnitude of the absorbances on the plate. The absorbance range defined by the upper and lower limits (set as described in Section 4.3, Set Limit Mode) is divided into 10 equal partitions, numbered 0 through 9. The blank-subtracted absorbance value of each well is classified according to the partition of the matrix to which it corresponds, and is reported as a single digit. Wells with absorbances greater than the upper limit are represented by plus signs (+), and wells with absorbances less than the lower limit by minus signs (-).
- D. The LIMIT REPORT provides a qualitative YES/NO report. Wells with blank-subtracted absorbances between the upper and lower limits are represented with an asterisk (*), wells with absorbances below the lower limit by minus signs (-), and wells with absorbances greater than the upper limit by positive signs (+).
- E. The CUTOFF REPORT provides a qualitative score for each well compared to a cutoff value. If the absorbance of a well is within 10% (*i.e.*, +/-10%) of the cutoff value, the well is scored '+/-'. If the absorbance of a well is more than 10% greater than the cutoff value, the well is scored '+', and if the absorbance of a well is more than 10% below the cutoff value, the well is scored '-'.

The cutoff value may be assigned by either the CONSTANT method or the FORMULA method. In the constant method, the user inputs an absorbance value to be used as the cutoff, *e.g.* 1.000 O.D. By this example, all wells with absorbances between 0.9 and 1.1 will be scored '+/-', all wells below 0.900 will be scored '-' and all wells above 1.100 will be scored '+'.

When the formula method is chosen, the user prepares both positive and negative controls. As many as eight sets of controls may be chosen. The mean absorbances and standard deviations are calculated and reported for both sets of controls, and then a cutoff value is calculated by the formula:

$$\text{Cutoff value} = \text{Mean of negative controls} + 0.10 * \text{Mean of the positive controls}$$

Consider an example in which the mean absorbance of the negative controls is 0.200 and the mean absorbance of the positive controls is 1.000. The calculated cutoff value will be 0.300 (cutoff = 0.200 + 0.10 * 1.000) and wells with absorbances between 0.270 and 0.330 will be scored '+/-', wells with absorbances less than 0.270 or greater than 0.330 will be scored '-' or '+', respectively.

Notes:

1. If one of the positive or negative control wells has an out-of-range absorbance value, the values reported for positive and negative mean and standard deviation will be asterisks. If the out-of-range value is below -3.500, then the asterisks will be preceded by a minus sign (-). For example, the report may show

Pos. Mean	*.***
Pos. Dev.	*.***
Neg. Mean	*.***
Neg. Dev.	*.***
Cutoff	1.234

2. If the calculated cutoff value is greater than 3.500 or less than -3.500, then the report will show

Cutoff	*.***
or	
Cutoff	-.***

3. If the number of standards is zero for the formula method, then the report will show the positive and negative means and standard deviations as 0.000.
4. If the number of standards is one in the formula method, then the positive control mean and the negative control mean will be the absorbance values of the one positive control and the one negative control, respectively, and the reported standard deviations will be 0.000.
5. If the calculated cutoff value is 0.000, then all readings greater than 0.000 are reported as '+', all negative readings are reported as '-', and all 0.000 readings reported as '+/-'.

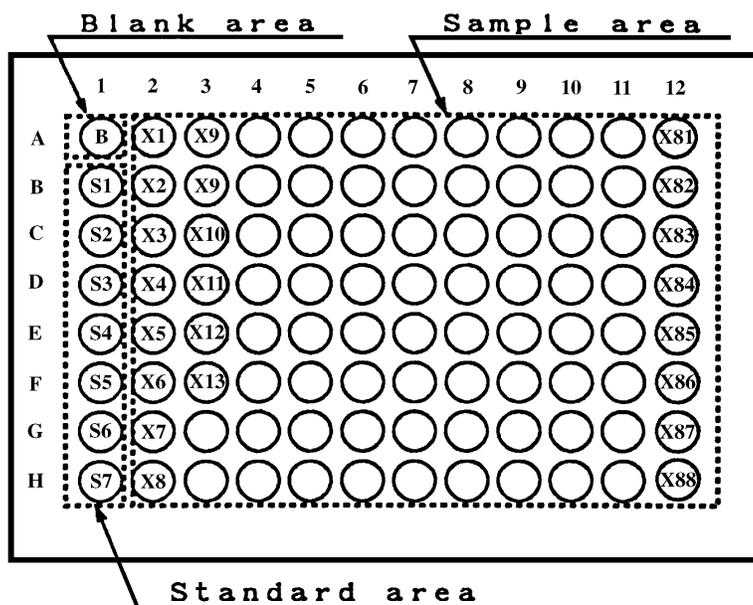
F. The CONCENTRATION REPORT lists the absorbances of the samples and then calculates concentrations of the samples based on the absorbances of a series of standards. The on-board software calculates the best fit straight line between each set of two consecutive data points in the standard curve of absorbance vs. concentration. When there is only one standard, a line is drawn between the data point and the origin to create a standard curve. When there is more than one standard, the origin is not considered a data point. Because of the way in which standard curves are calculated, standard data must be input in either ascending or descending order (see Section 4.3, Set Concentration Mode).

Consider the case when there are four standards. The software makes a plot of absorbance vs. concentration and then calculates the three equations (Eq1, Eq2 and Eq3) which describe the straight lines that join (1) the first (Conc1, Abs1) and second (Conc2, Abs2) standard data points, (2) the second and third (Conc3, Abs3) standard data points, and (3) the third and fourth (Conc4, Abs4) standard data points. The equation used by the software to calculate the sample concentration depends on the absorbance of the sample. If the sample absorbance is less than Abs1, the software extrapolates Eq1, the line determined by standard data points 1 and 2. The same equation is used to determine the unknown concentration when the absorbance of the unknown is between Abs1 and Abs2. However, Eq2 is used to determine the concentration of unknowns with absorbances between Abs2 and Abs3, and Eq3 is used to determine the concentration of all samples with absorbances greater than Abs3.

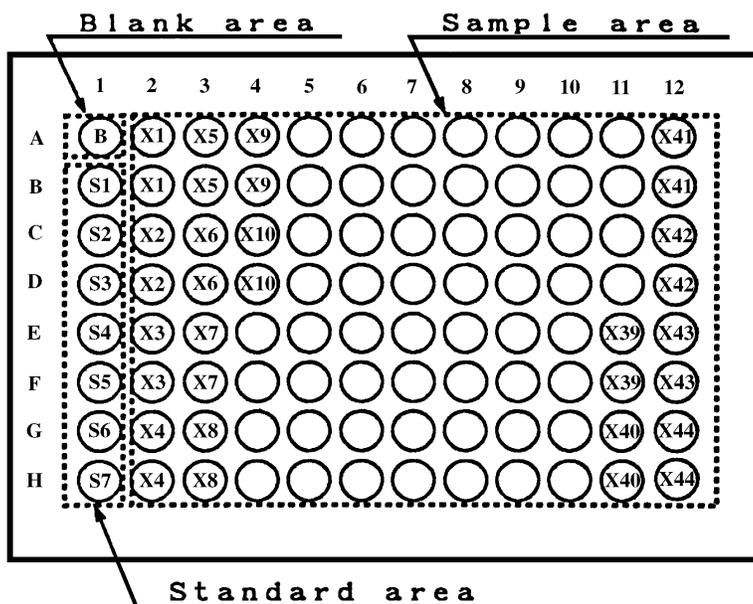
There are six pre-determined microplate formats associated with the concentration report. The assignment of the template is made by the software based on (1) the maximum number of samples, which may be set at 40, 44, 80 or 88; (2) the number of standards, which range from zero to seven; (3) the number of sample replicates, one or two and (4) the number of standard replicates, also one or two. The six different formats are shown in the figures below. Format information is summarized in the following table.

Stored Plate Format	No. of Standards	Standard Replicates	Sample Replicates	Max. No. Samples
No. 1	0-7	1	1	88
No. 2	0-7	1	2	44
No. 3	0-3	2	1	88
No. 4	0-3	2	2	44
No. 5	0-7	2	1	80
No. 6	0-7	2	2	40

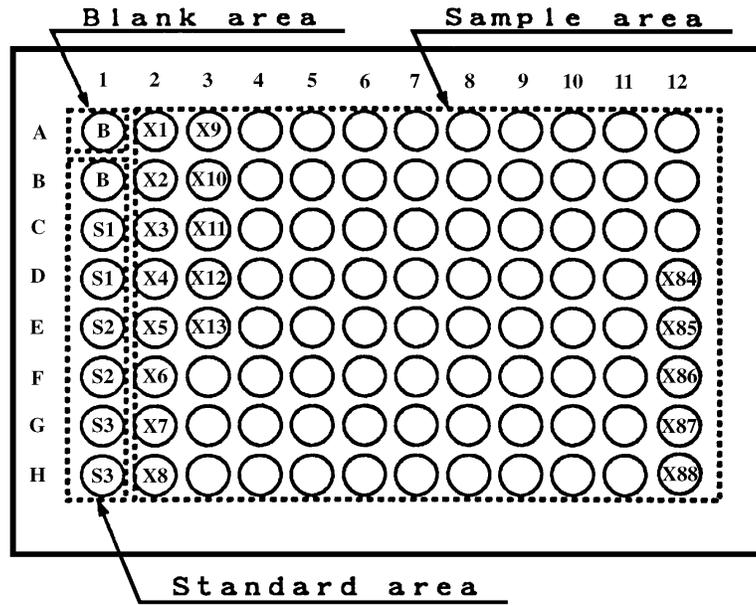
Format No. 1:



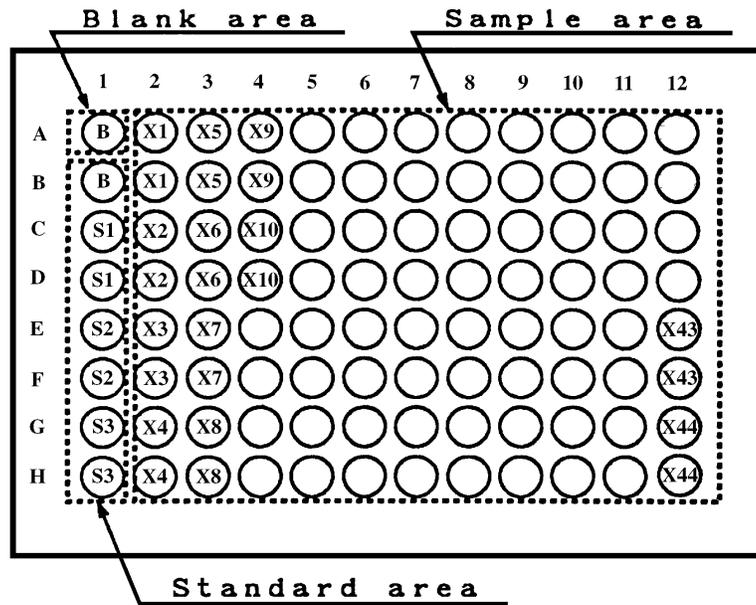
Format No. 2:



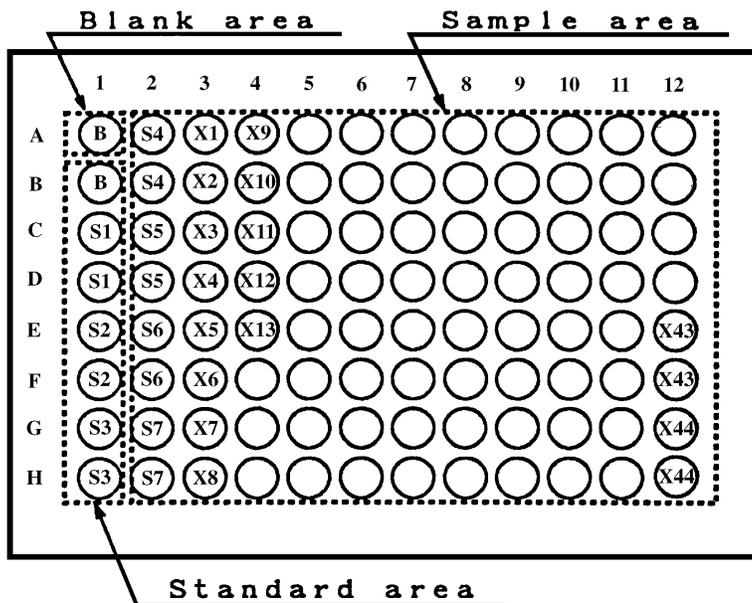
Format No. 3:



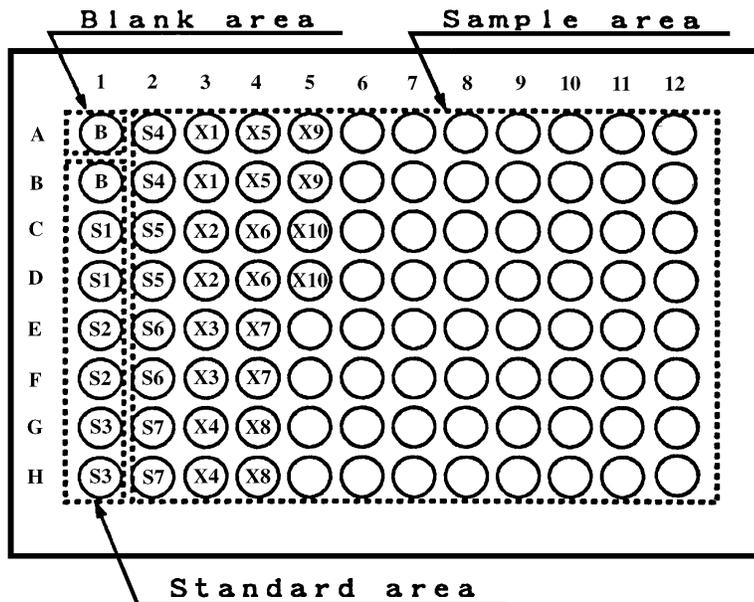
Format No. 4:



Format No. 5:



Format No. 6:



Notes:

1. Blank wells that have been defined under the SET BLANKS mode are replaced by those of the templates. In order to set blanks in the SET BLANKS mode, the number of standards and the number of samples must be set to zero in the SET CONCENTRATION mode (see Section 4.3).
2. If the standards are set to zero, then an error message will be printed on the fourth line of the Concentration report, ERROR: STDs=0.
3. If the standards are not input in ascending or descending order, an error message will be printed on the fourth line of the Concentration report, ERROR: STD Conc.

4. Under three different sets of conditions, an error may be made in calculation of the calibration curve and an error message will be printed on the Concentration report, ERROR: Calibration Curve. Despite the error message, the software does make a calibration curve and uses it to report concentrations. In all three cases, it probably indicates an error was made in preparation of one or more of the standards.
 - a. If the absorbance of any standard is measured as a negative value.
 - b. If the sign of the slopes of the different line segments changes. For example, if the standard concentrations are input in decreasing order, then normally the slopes of the individual lines joining consecutive data points would be negative. If any one segment is has a positive slope, the error is message is displayed.
 - c. If the slope of any one line segment is zero, *i.e.*, the same absorbance is measured at two different concentrations.
5. If any sample absorbance is out of range, asterisks will be printed on the Concentration report. The asterisks will be preceded by a negative sign (-) if the sample absorbance is below -3.500.

For example: Samples = 20, Repl = 2

#	Conc.	Abs.
1	***.*	*.***
2	0.020	2.550

6. If a sample absorbance is less than zero (*i.e.* a negative number), the sample concentration will be displayed with asterisks, but the actual absorbance is printed.

For example: Samples = 20, Repl = 2

#	Conc.	Abs.
1	-.***.*	-0.123
2	-.***.*	-0.234

7. If the calculated concentration is above 999.9 or below 0.000, the reported concentrations will be '***.*' or '-***.*', respectively.

For example: Samples = 20, Repl = 2

#	Conc.	Abs.
1	***.*	2.567
2	-.***.*	0.010

RS-232 Interface

This microplate reader has a built-in bidirectional RS-232 interface. This allows external computers to control the instrument. When an external computer is in control of the microplate reader, the printer is automatically deactivated and the display will indicate

**Remote
Control Mode**

The reader will remain in remote control mode until it receives an 'RL' command from the host computer or until the Start/Stop button on the microplate reader is pressed.

4.2 Quick Guide—Reading a plate:

1. Open the rear compartment and verify that the correct interference filters are properly installed in the filter wheel. See Section 5.1 for instructions on changing the interference filters. Close the rear cover.
2. Turn on the instrument. Allow one minute for the self diagnosis. Wait three minutes before reading a plate.

While the instrument is warming up:

3. Enter the SET ANALYSIS mode (Section 4.3) to:
 - a. Choose single or dual wavelength measurement
 - b. Choose the measurement and reference filters
 - c. Choose whether or not to mix
4. Enter the SET REPORT TYPES mode (Section 4.3) to choose the type(s) of reports to be generated.
5. All reports other than the Raw report require blanks. Enter the SET BLANKS mode (Section 4.3) to indicate the position of blanks.
6. The Matrix and Limit reports require assignment of upper and lower limits. If either of these reports is requested, enter the SET LIMITS mode (Section 4.3) to set the upper and lower limits.
7. The Cutoff report requires definition of the cutoff point. If the Cutoff report is requested, enter the SET CUTOFF mode (Section 4.3) to define the cutoff point.
8. The Concentration report requires that standard concentrations and locations be defined. If the Concentration report is requested, enter the SET CONC. mode (Section 4.3) to define the standards.

After warm-up is complete:

9. Press MODE until the display reads

PLATE READING

Single #x

or

PLATE READING

Dual #y, #z

The bottom line of the display will read Single #x or Dual #y, #z, depending on the choice made under the SET ANALYSIS mode.

10. Place the microplate in the reading chamber, slide the reading chamber door closed and press START.

4.3 Detailed Operation

Set Analysis Mode

In this series of screens the user chooses single or dual wavelength measurement, assigns the measurement and reference (for dual wavelength measurement) filters, and selects or deselects mixing.

1. Enter the SET ANALYSIS mode by pressing MODE until the display reads

**>PRINT REPORT
MODE**

2. Press either ARROW until the display reads

**>SET ANALYSIS
MODE**

3. Press ENTER. The display will read

Set Analysis
 D/S, **Filt and** **Mix**

4. **Dual/Single Wavelength Setting:**

- a. Use either ARROW to move the cursor under the check box next to *D/S*.
- b. Press SELECT to darken the check box next to *D/S*.
- c. Press ENTER. The display changes to read

Select D/S:
 Dual/ **Single**

- d. Use either ARROW to move the cursor under the check box next to the desired mode.
- e. Press SELECT to darken the check box next to the choice.
- f. Press ENTER to finalize the selection and the display will return to the previous screen.

Set Analysis
 D/S, **Filt and** **Mix**

5. **Filter selection:**

- a. Use either ARROW to move the cursor under the check box next to *Filt.*
- b. Press SELECT to darken the check box next to *Filt.*
- c. Press ENTER. The display changes to read

Set Filter:
Mes.=#x Ref.=#y

where x and y refer to filters 1, 2, 3, or 4.

- d. The cursor will be under the Measurement filter. Use either ARROW to select the filter to be used for measurement.
- e. Press NEXT to move the cursor to the Reference filter position. Use either ARROW to select the filter to be used for reference. Note: a Reference filter need only be chosen for dual wavelength measurements.
- f. Press ENTER to finalize the selection and the display will return to the previous screen.

Set Analysis
 D/S, Filt and Mix

6. **Mixing:**

- a. Use either ARROW to move the cursor under the check box next to *Mix.*
- b. Press SELECT to darken the check box next to *Mix.*
- c. Press ENTER. The display changes to read

Set Mixing:
 Yes/ No

- d. Use either ARROW to move the cursor under the desired check box.
- f. Press ENTER to finalize the selection and the display will return to the previous screen

Set Analysis
 D/S, Filt and Mix

- 7. Press ENTER again to go back to the original screen.

>SET ANALYSIS
MODE

Set Report Types Mode

Choose the reports to be generated and automatically printed from within this mode.

1. Press MODE until the display reads

**>PRINT REPORT
MODE**

2. Press either ARROW until the display reads

**>SET REPORT
TYPES MODE**

3. Press ENTER. The display changes to read

Raw **Abs** **Limit**
 Matr **Cut** **Conc**

4. To select a report type, use either ARROW to move the cursor under the check box associated with the report type, then press SELECT. The check box will darken. To deselect a choice, move the cursor under the darkened check box and then press SELECT.
5. When the check boxes next to each desired report type have all been darkened, press ENTER to seal the choices. The display will return to the previous screen.

**>SET REPORT
TYPES MODE**

Set Blanks Mode

In this series of screens, the positions of blank wells are defined or edited. Blanks are required for all reports other than Raw. Once blank positions are defined, they are retained in memory until they are edited through the Set Blanks Mode or until battery failure.

1. Press MODE until the display reads

**>PRINT REPORT
MODE**

2. Press either ARROW until the display reads

**>SET BLANKS
MODE**

3. Press ENTER. The display changes to read

<input type="checkbox"/> Clear Blanks
<input type="checkbox"/> Col <input type="checkbox"/> Row <input type="checkbox"/> Well

Note: If the display instead changes to

Err: Conc. Format
Press any key.

it is because the parameters have been set for a Concentration report and the locations of the blanks cannot be changed. In order to set blanks, go into the Set Concentration mode and set both the number of samples and number of standards to zero (see Section 4.3 Set Concentration).

4. **All previously defined blanks can be cleared simultaneously.**

- Use either ARROW to move the cursor beneath the check box next to *Clear Blanks*.
- Press SELECT to darken the check box.
- Press ENTER and the display will change to

Clear Blanks:
Are you sure?

d. To respond “yes” to the inquiry above, press ENTER. All previously defined blanks are cleared and the screen will go back one level.

<input type="checkbox"/> Clear Blanks
<input type="checkbox"/> Col <input type="checkbox"/> Row <input type="checkbox"/> Well

e. To respond “no” to the inquiry above, press any key other than ENTER. Two beeps will be heard and the screen will revert to the previous one and no change will be made to blank assignments.

<input type="checkbox"/> Clear Blanks
<input type="checkbox"/> Col <input type="checkbox"/> Row <input type="checkbox"/> Well

5. **To assign one or more complete columns as blanks:**

- Use either ARROW to move the cursor beneath the check box next to *Col*.
- Press SELECT to darken the check box.
- Press ENTER and the display will change to

Col: 1 2 3 4 5 6 7 8 9 0 1 2
<input type="checkbox"/>

- d. If a column has previously been defined as blank, its check box will be darkened. If a column is not yet defined as blank, then its check box is empty.
- e. To change the definition of a column (either to 'blank' or to 'no longer blank'), use either ARROW to position the cursor beneath the check box associated with the desired column.
- f. Press SELECT to darken empty check boxes or to empty darkened ones.
- g. Press ENTER to complete the selection of the blank columns and to return to the previous screen.

<input type="checkbox"/> Clear Blanks <input type="checkbox"/> Col <input type="checkbox"/> Row <input type="checkbox"/> Well
--

6. **To assign one or more complete rows as blanks:**

- a. Use either ARROW to move the cursor beneath the check box next to *Row*.
- b. Press SELECT to darken the check box.
- c. Press ENTER and the display will change to

Row: AB CD EF GH <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
--

- d. If a row has been previously defined as blank, its check box will be darkened. If a row is not yet defined as blank, then its check box is empty.
- e. To change the definition of a row (either to 'blank' or to 'no longer blank'), use either ARROW to position the cursor beneath the check box associated with the desired row.
- f. Press SELECT to darken empty check boxes or to empty darkened ones.
- g. Press ENTER to complete the selection of the blank rows and to return to the previous screen.

<input type="checkbox"/> Clear Blanks <input type="checkbox"/> Col <input type="checkbox"/> Row <input type="checkbox"/> Well
--

7. **To assign one or more individual wells as blanks.**

- a. Use either ARROW to move the cursor beneath the check box next to *Well*.
- b. Press SELECT to darken the check box.
- c. Press ENTER and the display will change to

Set Blank Well: <input type="checkbox"/> well A-1
--

- d. The cursor begins under the row designation. Use either ARROW to step up or down from A - H.

- e. When the desired row is chosen, press NEXT to move the cursor to the column position.
- f. Again, use either ARROW to step up or down between 1 and 12 until the desired column number is displayed.
- g. The check box on the bottom line of the display will be darkened if the chosen well is presently defined as blank. If the well is not presently defined as blank, then the check box is empty. To change the status of a well, press SELECT. If the check box had been darkened, it will be emptied, and if the check box started out as empty, it will be darkened.
- h. Press ENTER to seal the selection/editing of the blank well(s). The display will return to the previous screen.

<input type="checkbox"/> Clear Blanks <input type="checkbox"/> Col <input type="checkbox"/> Row <input type="checkbox"/> Well
--

- 8. Press ENTER to return the screen to

<p style="text-align: center;">>SET BLANKS MODE</p>
--

Set Limits Mode

If either the Matrix or Limit report is selected, then Upper and Lower limits must be defined in the Set Limits mode. The Upper limit may not exceed 3.500, nor may the Upper limit be less than the Lower limit. If either of these situations occurs, an error message will be displayed.

<p style="text-align: center;">Err: Max=3.500 Press any key</p>

<p style="text-align: center;">Err: Lower>=Upper Press any key</p>

- 1. Press MODE until the display reads

<p style="text-align: center;">>PRINT REPORT MODE</p>
--

- 2. Press either ARROW until the display reads

<p style="text-align: center;">>SET LIMITS MODE</p>
--

- 3. Press ENTER. The display changes to read

<p style="text-align: center;">Upper= 3.500 Lower= 0.000</p>
--

4. The cursor begins under the first digit of the Upper limit. Use either ARROW to change the first digit.
5. When the first digit is set, press NEXT to move the cursor to the first decimal position. Set the first decimal digit with the ARROW. Continue moving to the right with NEXT until all four digits of the Upper limit are set.
6. When the last digit of the Upper limit is set, press SELECT to move the cursor to the first digit of the Lower limit.
7. Set the Lower limit as the Upper limit with ARROW and NEXT.
8. When the Upper and Lower limits are set, press ENTER. The display will return to the previous screen.

>SET LIMITS
MODE

Set Cutoff Mode

1. Press MODE until the display reads

>PRINT REPORT
MODE

2. Press either ARROW until the display reads

>SET CUTOFF
MODE

3. Press ENTER and the display will change to

C/F Set Const
 Set Formula

4. There are two types of Cutoff reports: Constant and Formula (described in Section 4.1).
 - a. Use either ARROW to move the cursor under the check box for C/F.
 - b. Press SELECT to darken the check box.
 - c. Press ENTER. The display changes to

Select C/F
 Const / Formula

5. In this screen, choose the type of cutoff report desired.
- Use either ARROW to move the cursor under the appropriate check box.
 - Press SELECT to darken the check box.
 - Press ENTER to seal the selection. The display will revert to the previous screen

C/F Set Const
 Set Formula

6. If the choice in step 5 was Formula, skip to step 9. **If the choice in step 5 was Const:**
- Move the cursor under the check box next to *Set Const*.
 - Press SELECT to darken the check box.
 - Press ENTER. The display will change to

Set Constant:
Cutoff = 0.000

7. The cursor will start beneath the first digit of the cutoff value. Use the ARROW to select the first digit, then use NEXT to move to the other digits. After the last digit is set, press ENTER. The screen will revert to

C/F Set Const
 Set Formula

8. Press ENTER again to finish defining the cutoff. The display will change to

>SET CUTOFF
MODE

9. **If the choice in Step 5 was Formula:**
- Use either ARROW to move the cursor beneath the check box next to *Set Formula*.
 - Press SELECT to darken the check box.
 - Press ENTER to seal the choice. The display will change to

Formula: #x
 STDs Pos Neg

where x represents the number of positive and negative controls currently selected.

10. If it is not necessary to change the number of controls, skip to Step 12. To change the number of positive and negative controls:

- a. Use either **ARROW** to move the cursor to the check box next to *STDs*.
- b. Press **SELECT** to darken the check box.
- c. Press **ENTER**. The display will become

Set Formula:
 STDs = x (0~8)

where x is the current number of controls

11. Use either **ARROW** to change the number of controls to any number between 0 and 8, inclusive. Press **ENTER** to seal the selection. The screen will change back to

Formula: #x
 STDs **Pos** **Neg**

12. The positions of each positive and negative control must be identified for the reader. To first define the positive controls:

- a. Use either **ARROW** to move the cursor under the check box next to *Pos*.
- b. Press **SELECT** to darken the check box.
- c. Press **ENTER**. The display will change to

Set Pos.:
#1/y well A-1

where y represents the total number of controls.

13. The cursor will start under the #1 position. The position of standard #1 will be set first.

- a. Press **NEXT** to move the cursor to the row position. Use either **ARROW** to change the row to describe the location of the first control.
- b. Press **NEXT** to move the cursor to the column position. Use either **ARROW** to change the column to describe the location of the first control.
- c. Press **NEXT** to return the cursor to the # position. Use either **ARROW** to change the '1' to '2'.
- d. Continue using **NEXT** and **ARROW** to define the locations of each of the positive controls. After the location of the last positive control is defined, press **ENTER**. The display will change back to

Formula: #x
 STDs **Pos** **Neg**

14. Negative control locations are defined just as those for positive controls.
 - a. Use either ARROW to move the cursor under the check box next to *Neg*.
 - b. Press SELECT to darken the check box.
 - c. Press ENTER. The display will change to

Set Neg.:
#1/y well A-1

again where y is the number of controls.

15. Follow the steps as in 13 to define the positions of the negative controls. When finished, press ENTER and the display reverts to

Formula: #x
 STDs **Pos** **Neg**

16. Press ENTER twice more to return the display to

>SET CUTOFF
MODE

Set Concentration Mode

1. Press MODE until the display reads

>PRINT REPORT
MODE

2. Press either ARROW until the display reads

>SET CONC.
MODE

3. Press ENTER and the display will become

E STD **E Sample**
 Print Format

4. Editing Standards

- a. Use either Arrow key to move the cursor under the check box next to E STD.
- b. Press SELECT to darken the check box.
- c. Press ENTER. The display will change to

STDs **Std Repl**
 Std Conc

- d. **First set the number of standards** by using either ARROW to move the cursor under the check box next to *STDs*.
- e. Press SELECT to darken the check box.
- f. Press ENTER. The display will change to

Set STD:
STDs = x (0~7)

where x is the currently selected number of standards.

- g. The cursor will be under the x position. Use either ARROW to change the number to the desired number of standards (0 - 7) and then press ENTER. The screen changes back to

STDs **Std Repl**
 Std Conc

- h. **To set the number of replicate readings for the standards**, use either ARROW to move the cursor under the check box next to *Std Repl*.
- i. Press SELECT to darken the check box.
- j. Press ENTER and the screen will change to

Set STD Repl:
REPL = y (1~2)

where y is the current number of replicates.

- k. The cursor will be under the y position. Use either ARROW to change the number of replicates and then press ENTER. The display will revert to

STDs **Std Repl**
 Std Conc

- l. **To enter the concentrations of the standards**, use either ARROW to move the cursor under the check box next to *Std Conc*.
- m. Press SELECT to darken the check box.
- n. Press ENTER and the screen will change to

Set STD Conc:
#1/z Conc = 000.0

where z is the number of standards defined in step g above.

- o. The cursor will start under the #1 standard. Its concentration will be set first.
- p. Press NEXT to move the cursor to the first digit of the concentration. Use either ARROW to change the number to the correct one.

- q. Press NEXT to move the cursor to the second digit. Use either ARROW to set the second digit.
- r. Repeat step q until all four digits are set correctly.
- s. Press NEXT to return the cursor to the # position. Use either ARROW to change the '1' to '2'.
- t. Continue using NEXT and ARROW to set the concentrations of each standard. When all the standards have been defined, press ENTER twice and the display will revert to

<input type="checkbox"/> E STD <input type="checkbox"/> E Sample <input type="checkbox"/> Print Format
--

Note: If during the setting of concentrations of the standards, the error message

<p align="center">Err: Conc. Values Press any key</p>

appears, it indicates that the standard concentrations are not being input in an ascending or descending manner.

5. Editing Sample Parameters

- a. Use either ARROW to move the cursor under the check box next to *E Sample*.
- b. Press SELECT to darken the check box.
- c. Press ENTER. The display will change to

<input type="checkbox"/> SAMPLEs <input type="checkbox"/> Sample Repl
--

- d. To set the number of samples, use either ARROW to move the cursor next to *SAMPLEs*.
- e. Press SELECT to darken the check box.
- f. Press ENTER and the screen will change to

<p>Set Sample: SAMPs = xy (0~88)</p>
--

where xy represents the currently defined number of samples.

- g. The cursor will be under the x position. Use either ARROW to set the x digit.
- h. Press NEXT to move the cursor to the y position. Use either ARROW to set the y digit.
- i. Press ENTER to seal the choices. The display will revert to

<input type="checkbox"/> SAMPLEs <input type="checkbox"/> Sample Repl
--

- j. To set the number of replicates for each sample, use either ARROW to move the cursor under the check box next to *Sample Repl.*
- k. Press SELECT to darken the check box.
- l. Press ENTER and the screen will change to

Set STD Repl:
REPL = y (1~2)

where y is the currently set number of sample replicates.

- m. Use either ARROW to set y to the desired number of replicates and then press ENTER twice to return the screen to

E STD **E Sample**
 Print Format

- 6. Printing the Concentration format. The concentration format printout will indicate the locations of the blanks, the standards, and the samples. It also prints the concentrations of the standards.
 - a. Use either ARROW to move the cursor under the check box next to *Print Format*.
 - b. Press SELECT to darken the check box.
 - c. Press ENTER. Printing will begin immediately.
 - d. When printing is completed, the screen will return to.

>SET CONC.
MODE

Printing Reports

All reports selected in the SET REPORT TYPES mode will be printed automatically at the end of plate reading. Since the memory buffer stores plate data until another plate is read, other reports may be generated after a plate is read. Once another plate is read, all previously stored data are lost. If a plate reading is aborted before completion, the stored data are saved and none of the new data are saved. It is also possible to print a report showing system configuration. The data include: the location of blanks, reading mode, limit settings, cutoff settings, concentration settings, and sample positions.

- 1. To print additional data reports
 - a. Enter the SET REPORT TYPES mode and select the additional reports desired (See above).
 - b. Press MODE until the display shows

>PRINT REPORT
MODE

c. Press ENTER and the screen will change

<input type="checkbox"/> Print Reports
<input type="checkbox"/> System Config.

d. Use either ARROW to move the cursor under the check box next to *Print Reports*.

e. Press SELECT to darken the check box.

f. Press ENTER and the printer will begin printing. When printing is completed the screen returns to

>PRINT REPORT
MODE

2. Printing the system configuration.

a. Press MODE until the display shows

>PRINT REPORT
MODE

b. Press ENTER and the display changes to

<input type="checkbox"/> Print Reports
<input type="checkbox"/> System Config.

c. Use either ARROW to move the cursor under the check box next to *System Config.*

d. Press SELECT to darken the check box.

e. Press ENTER and the display will change to

<input type="checkbox"/> Ana <input type="checkbox"/> Repo <input type="checkbox"/> Blk
<input type="checkbox"/> Limt <input type="checkbox"/> Cut <input type="checkbox"/> Conc

f. Use either ARROW to move the cursor under the check boxes next to the desired reports.

g. Press SELECT to darken the check box. More than one check box may be darkened to get more than one report.

h. When all desired reports have been selected, press ENTER. The reports will be printed immediately. When printing is finished, the screen returns to

>PRINT REPORT
MODE

Section 5 Instrument Service by the User



Caution: Electrical shock hazard! Always disconnect the instrument from the AC power source before opening the service compartment.



Caution: The lamp may be very hot! Use caution, and allow the lamp to cool before attempting service.

5.1 Installing Interference Filters

1. With the power off, open the rear cover of the instrument by sliding the release latch on the top rear of the unit toward the rear of the unit.
2. Locate the filter wheel between the lamp and the left side of the instrument. Note that the filter wheel has four filter positions.
3. Rotate the filter wheel until the desired filter is at about the 2:00 o'clock position. Grasp the filter firmly with the thumb and the index finger of your right hand and rotate the filter counter-clockwise 90° to remove it from the filter wheel.
4. Install the new filter by holding the filter between your index finger and thumb of your right hand. Rotate the desired filter position in the wheel to the 2:00 o'clock position. Line up the two prongs on the filter with the two slots in the filter wheel. Turn the filter 90° clockwise to install.

5.2 Changing the Lamp

1. Open the rear cover of the instrument by sliding the release latch on the top rear of the unit toward the rear of the reader.
2. Remove the two screws that hold the black lamp cover in place. Lift the cover up and away from the instrument.
3. Press down on the spring wire that holds the lamp in place. This will allow the lamp to be pulled free from the lamp housing.
4. Holding the ceramic base in one hand and the lamp housing in the other, carefully pull the lamp free of the base.
5. Carefully insert the new lamp firmly in the ceramic base. Apply even pressure when inserting the lamp so that the bulb does not become misaligned in the reflector housing. Also, be careful not to touch the bulb or the inside of the reflector housing during installation.
6. Position the lamp in the bezel and hold the lamp in this position until it is secured with the spring wire.
7. Replace the lamp cover.
8. Close the rear cover.

Section 6

Troubleshooting and Error Messages

The Model 550 Microplate Reader constantly monitors several vital functions and will display appropriate messages on the LCD when an error condition is encountered.

1. LCD appears blank on power up.
 - a. Power switch is not turned on. Turn on the power switch on the rear panel.
 - b. Unit is not plugged into AC outlet or power cord is not attached to the instrument. Check power cord connections at outlet and on the rear panel of the instrument.
 - c. The AC outlet is non-functional. Check circuit breakers or fuses.
 - d. Instrument has blown a fuse. Check both fuses on the rear panel of the instrument, and replace if necessary. Replace only with the same type fuse. If the instrument continues to blow fuses, discontinue use and contact your Bio-Rad service representative immediately.
2. Instrument displays “Error Light Bulb” message indicating that the bulb is burned out.
 - a. Lamp is not emitting light. Check whether lamp is emitting light. Replace lamp as described in Section 5.2.
 - b. Lamp is emitting light. Check alignment of the lamp in the bezel. Check the alignment of bulb in the glass reflector. Align or replace lamp if necessary.
3. Printer will not print on command.
 - a. Printer paper is not installed properly. Verify that the paper is properly installed. Refer to Section 3.1 for details.
4. Plate carriage jams during reading, and “Error Plate Carriage” is displayed.
 - a. Plate is not seated in carriage properly. Press the STOP button immediately. Position the plate carefully in the carriage, making certain that it is properly seated.
5. LCD displays “Error Filter Missing.”
 - a. A filter is missing from the wheel. Install a filter in the empty position. See Section 5.1.
 - b. The filters are not properly seated. Check that all filters are installed properly. See Section 5.1.
6. Wells have color, but absorbance values seem low.
 - a. Incorrect filter used for measurement and/or reference wavelength. Check wavelength used in analysis. Read plate in single wavelength mode at all wavelengths to verify that the proper filter was used. The measurement wavelength should produce the highest absorbances. The reference wavelength produces the lowest absorbances.

- | | |
|--|--|
| b. The best measurement wavelength filter for the substrate in use has not been installed in the filter wheel. | Check references for the substrate you are using, or determine the best measurement wavelength by analyzing the substrate product on a scanning spectrophotometer. Custom filters are available from 400 to 700 nm. |
| c. The filters have been switched in the wheel. | Check that the filters are installed in the correct position. |
| 7. LCD displays “Error Filter Wheel”, indicating that the filter wheel is not turning freely. | Turn off the instrument, open the rear cover, and inspect the filter wheel. Turn by hand to verify that the wheel is moving freely. Make sure that all the filters are properly installed and firmly seated. Contact your local Bio-Rad representative if the filter wheel is jammed or if the problem persists. |
| 8. “Error Reader Memory” displayed. | Reader memory erased. Possible battery backup failure. Contact your local Bio-Rad service center or local representative. |
| 9. “Error Photo Sensor” displayed. | Contact your local Bio-Rad service center or local representative. |
| 10. “Error Printer Hardware” displayed. | Contact your local Bio-Rad service center or local representative. |

Section 7 Specifications

7.1 Instrument Specifications

Operating panel	Membrane keypad with 2 arrow and 6 function keys
Display	2 lines x 16 characters LCD
Printer	20 column, 5 x 7 dot matrix, thermal, built-in
Computer interface	Bi-directional, RS-232 serial communication port
Report types	Raw, Absorbance, Matrix, Limit, Cutoff, and Concentration
Mixing capability	Yes
Photometric methods	Single & dual wavelength
Photodetectors	8 silicon photodiodes
Light source	Tungsten halogen 20 watt, 5000 hour life
Spectral range	400 nm to 700 nm
Filter capacity	Four
Interference filters	Bandwidth 10 nm, center wavelength ± 3 nm
Standard filters	415 nm and 490 nm
Optional filters	405 nm, 450 nm, 540 nm, 550 nm, 570 nm, 595 nm, 630 nm, 655 nm
Reading speed	25 seconds single wavelength and 50 seconds dual wavelength
Indication range	0.000 to 3.500 O.D.
Resolution	0.001 O.D.
Accuracy	$\pm 1.5\%$ or 0.015 O.D. at 1.000 O.D. for single wavelength reading $\pm 2.0\%$ or 0.020 O.D. at 1.000 O.D. for dual wavelength reading
Linearity	$\pm 2.0\%$ from 0.000 to 3.000 O.D. at 405 nm
Reproducibility	$\pm 1.0\%$ or 0.005 O.D. in the range 0.000 to 3.000 O.D.
Inter-channel variation	Less than 1.5% or 0.010 O.D. for 0.000 to 3.000 O.D.
Stability and drift	Automatic calibration before each plate reading
Compatible plates	Polystyrene flat, U- and V-bottom, and PVC flex plates
Data storage buffer	Data from last plate read, and reports
Warm-up time	3 minutes
Assay blanks	User-defined or stored assay template
Memory back-up	5 year lithium battery
Self-diagnosis	Checks lamp, battery, filter wheel, and plate transport
Line voltage	100-240 volts AC at 47 - 63 Hz
Power consumption	75 volt amps max.
Dimensions	316 x 286 x 130 mm (W x D x H)
Weight	5 kg
Operating temperature	5 to 35 °C
Storage temperature	-20 to 50 °C
Operating and storage humidity	0 - 95% non-condensing

7.2 RS-232 Interface Specifications

The following specification describes the syntax and language required for computer control of the reader. In addition, the Model 550 reader will perform passive unidirectional data transmission. The instrument will automatically transmit the data in ASCII code after each reading if it is properly connected to a host computer. See the “RTPLATE” command for an example of ASCII output.

Note: This automatic output will be of Measurement O.D. minus Reference O.D. when in Dual Wavelength mode (*i.e.* only one set of 96 numbers).

1. SIGNALS
 - TXD: transmit data
 - RXD: receive data
 - DTR: data terminal ready
 - DSR: data set ready
 - CTS: clear to send
 - RTS: ready to send
 - SIGNAL GROUND (SHIELD GROUND to hood / chassis ground)
2. TRANSMISSION
 - Baud rate 9600
 - Data width 8
 - Stop width 1
 - Parity None
3. DATA
 - All data must be transmitted in ASCII.
 - The READER command interpreter must be “case blind” (no distinction between upper or lower case ASCII characters).
 - All READER commands can be distinguished from each other by the first two characters of the command.
4. SIGNAL ASSIGNMENT

Pin #	READER Signal type	Host Signal Pair
1	SHIELD GROUND	SHIELD GROUND
2	TRANSMIT DATA	RECEIVE DATA
3	RECEIVE DATA	TRANSMIT DATA
4	REQUEST TO SEND	CLEAR TO SEND
5	CLEAR TO SEND	REQUEST TO SEND
6	DATA SET READY	DATA TERMINAL READY
7	SIGNAL GROUND	SIGNAL GROUND
20	DATA TERMINAL READY	DATA SET READY

	Shield ground	1	
	Transmit data	2	
	Receive data	3	
Host	Data set ready	6	Model 550 Reader
Computer	Signal GND	7	
	Data terminal ready	20	
	Clear to send	5	
	Request to send	4	

7.3 Command Language for the Model 550 Microplate Reader

SYNTAX: <device name><space><command>[<space><command args.>] <cr>

device name: “EIA. READER” -Model 550 Microplate READER

1. <command>: “ID”-request device ID. 550 READER id; “550”; no arguments
<response>: “ERE” <space><error code><space><id><cr>
<ID>: “0550”: Model 550 Microplate READER ID code]
2. <command>: “AQ” - Acquire remote control of the device and lock front panel key pad; no arguments
When acquired, the reader will be in the Remote Control mode. The LCD will display Remote Control mode, and the printer will automatically be deactivated. The reader will stay in the remote control mode until the release (RL) command is received or the STOP button on the front panel is pressed.
<response>: “ERE” <space><error code><cr>
3. <command>: “RL”- Release remote control of the device and release front panel key pad; no arguments
<response>: “ERE” <space><error code><cr>
4. <command>: “RS”- Reset device to power up configuration local mode; no arguments
<response>: “ERE”<space><error code><cr>
5. <command>: “MR”- Transmit maintenance report; no arguments
<response>: “ERE” <space><error code><cr><mrecords><cr>
<>: maintenance records;
“On/off:” <#on/off><cr> :Number of times the reader was turned on.
“Hours:” <#hours><cr> :Number of hours the reader was on.
“Plates:” <#plates><cr> :Number of plates read.
Note: <#on/off>,<#hours> and <#plates> are 4 ASCII encoded decimal values. This information is kept in battery backup RAM.
6. <command>: “RM”- Reset maintenance report values; no arguments
<response>: “ERE” <space><error code><cr>
7. <command>: “RWELL”- Read a plate well; arguments <c1>, <rw>, <s/d>
<cmd args>: cl - Column number ASCII encoded decimal (1-12)
rw - Row number ASCII encoded decimal (1-8)
wp1 - Measurement filter position ASCII encoded decimal (1-4)
wp2 - Reference filter position ASCII encoded decimal (1-4)
Optional; only present for Dual wavelength reading
<response>: “ERE” <space><error code><space><abs. val1>
<space><optional abs. val2 for reference wavelength><cr>
<abs. val1>: Absorbance values at measurement wavelength (ASCII encoded floating point format) ex.” 1.234”
<abs val2>: Absorbance values at reference wavelength (ASCII encoded floating point format) ex.”1.234”

8. <command>: “RPLATE” - read plate; arguments <mix>, <wp1>,<wp2>
 <cmd args>: mix - Mixing time before reading (in seconds) ; ASCII encoded decimal (0-9)
 wp1 - Measurement filter position; ASCII encoded decimal (1-4)
 wp2 - Reference filter position; ASCII encoded decimal (1-4)
 Optional; only present for Dual wavelength reading
 <response>: “ERE” <space><error code><space><abs. data><cr>
9. <command>: “RTPLATE” - retransmit the last plate read; no arguments
 <response>: “ERE” <space><error code><space><abs. data><cr>

Absorbance Data

<abs. data>: <header><filter info>< Mes.data><cr> or <header><filter info>
 <Mes. data><cr><Ref.data><cr> Ref. data present for dual wavelength readings.

<header>: “BIO-RAD MODEL 550 READER”<cr>

<filter info>: “Mes. filter:” <wp1><cr>
 “Ref. filter:” <wp2><cr> - Present for Dual wavelength reading

<Mes. data>: “. begin” <cr><8 rows of 12 wells of abs. values><checksum><cr>
 “.end” <cr>
 Measurement wavelength absorbance values are in ASCII encoded floating point format. Each absorbance value is separated by a space. Row1=wells (A1-A12), Row2=wells (B1-B12), Row8=wells (H1-H12).

<Ref. data>: “. begin” <cr><8 rows of 12 wells of abs. values><checksum><cr>
 “.end” <cr>
 Reference wavelength absorbance values are in ASCII encoded floating point format. Each absorbance value is separated by a space. Row1=wells (A1-A12), ROW2=wells (B1-B12,Row8=wells (H1-H12)

<checksum>: The checksum is a two byte sum in ASCII encoded decimal (0-255) of all the ASCII characters transmitted in the measurement or reference data block. The checksum does not include the character string “.begin”<cr> in the checksum calculations.

The following is an example of both <Mes. data> and <Ref. data>:

```

“. begin”<cr>
“ 0.101 0.102 0.103 0.104 0.105 0.106 0.107 0.108 0.109 0.110 0.111 0.112”<cr>
“ 0.201 0.202 0.203 0.204 0.205 0.206 0.207 0.208 0.209 0.210 0.211 0.212”<cr>
“ 0.301 0.302 0.303 0.304 0.305 0.306 0.307 0.308 0.309 0.310 0.311 0.312”<cr>
“ 0.401 0.402 0.403 0.404 0.405 0.406 0.407 0.408 0.409 0.410 0.411 0.412”<cr>
“ 0.501 0.502 0.503 0.504 0.505 0.506 0.507 0.508 0.509 0.510 0.511 0.512”<cr>
“ 0.601 0.602 0.603 0.604 0.605 0.606 0.607 0.608 0.609 0.610 0.611 0.612”<cr>
“ 0.701 0.702 0.703 0.704 0.705 0.706 0.707 0.708 0.709 0.710 0.711 0.712”<cr>
“ 0.801 0.802 0.803 0.804 0.805 0.806 0.807 0.808 0.809 0.810 0.811 0.812”<cr>
<checksum><cr>
“. end”<cr>

```

Note: Absorbance values greater than 3.000 shall be transmitted as an asterisk.

Error Codes

- “0000” - No error
- “8071” - Invalid Command
- “8072” - Parameter Out of Range
- “8073” - Device Not In Remote Mode
- “8074” - Device Busy
- “8075” - Not assigned
- “8076” - Not assigned
- “8077” - Light Bulb Burned Out
- “8078” - Hardware Error
- “8079” - Memory Error
- “8080” - Not assigned
- “8081” - Not assigned

Note: Until the Model 550 Reader receives the “AQ” command, the reader will be unable to accept any other command and will only respond with the error code of “8073”- Device Not In Remote Mode.

Once the reader accepts the “AQ” command, the mode will be turned into the “Remote Mode” and then the front key pad will be locked until pressing “START/STOP” key or accepting “RL” command.

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Brazil Ph. 55 21 507 6191 **Canada** Ph. (905) 712-2771, Fx. (905) 712-2990 **China** Ph. 86-10-8201-1366/68, Fx. 86-10-8201-1367
Denmark Ph. 45 44 52-1000, Fx. 45 4452 1001 **Finland** Ph. 358 (0)9 804 2200, Fx. 358 (0)9 804 1100 **France** Ph. 01 47 95 69 65, Fx. 01 47 41 9133
Germany Ph. 089 318 84-177, Fx. 089 318 84-123 **Hong Kong** Ph. 852-2789-3300, Fx. 852-2789-1257 **India** Ph. (91-124)-6398112/113/114, Fx. (91-124)-6398115
Israel Ph. 03 951 4124, Fx. 03 951 4129 **Italy** Ph. 34 91 590 5200, Fx. 34 91 590 5211 **Japan** Ph. 03-5811-6270, Fx. 03-5811-6272
Korea Ph. 82-2-3473-4460, Fx. 82-2-3472-7003 **Latin America** Ph. 305-894-5950, Fx. 305-894-5960 **Mexico** Ph. 52 5 534 2552 to 54, Fx. 52 5 524 5971
The Netherlands Ph. 0318-540666, Fx. 0318-542216 **New Zealand** Ph. 64-9-4152280, Fx. 64-9-443 3097 **Norway** Ph. 47-23-38-41-30, Fx. 47-23-38-41-39
Russia Ph. 7 095 979 98 00, Fx. 7 095 979 98 56 **Singapore** Ph. 65-2729877, Fx. 65-2734835 **Spain** Ph. 34-91-590-5200, Fx. 34-91-590-5211
Sweden Ph. 46 (0)8-55 51 27 00, Fx. 46 (0)8-55 51 27 80 **Switzerland** Ph. 061-717-9555, Fx. 061-717-9550 **United Kingdom** Ph. 0800-181134, Fx. 01442-259118