

Operational Manual

AccuReader

M965/965+ USB



Metertech Inc.
Version 2.11

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INSTALLATION

Unpacking

The package contains items listed below. Unpack the carton and inspect carefully. If any part is damaged or missing, contact your dealer immediately.

<u>Qty</u>	<u>Description</u>
1	AccuReader
1	Power cord
1	Operational manual
4	Four interference filters 405,450,490 and 600 nm inside the filter wheel (Lift up the machine top cover to locate the filter wheel)
1	Dust cover
1	CD for RS232 to USB driver and PC mate

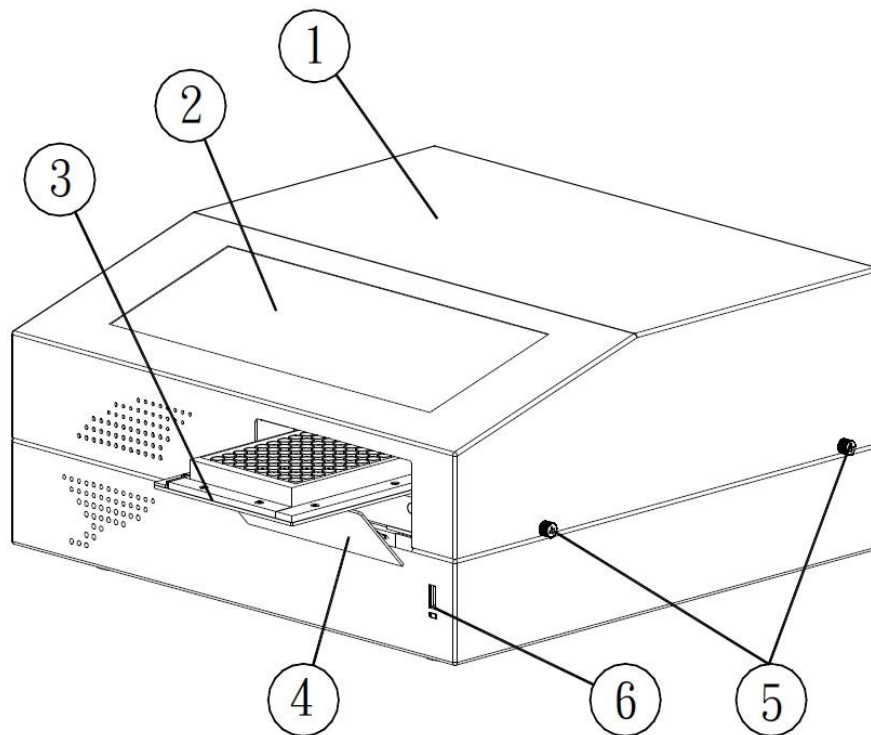
Instrument description

AccuReader is an eight-channel vertical light-path photometer with one reference channel, designed to perform end point, two points, and kinetic measurement of microplate under microcomputer control. The wavelength (400-900nm) is selectable up to maximum eight interference filters held in a filter wheel. AccuReader possesses following features:

1. Graphic dot-matrix LCD module suitable for well mapping.
2. Incubator designed by a digital temperature controller.
3. Easily mounting/dismounting mechanism between interference filters and filter wheel.
4. Lamp lightened only during measurement to extend its lifetime.
5. Protocol, data and fitted curve stored in ROM.
6. Quick plate reading in continuous and stepping motion.

Instrument front view

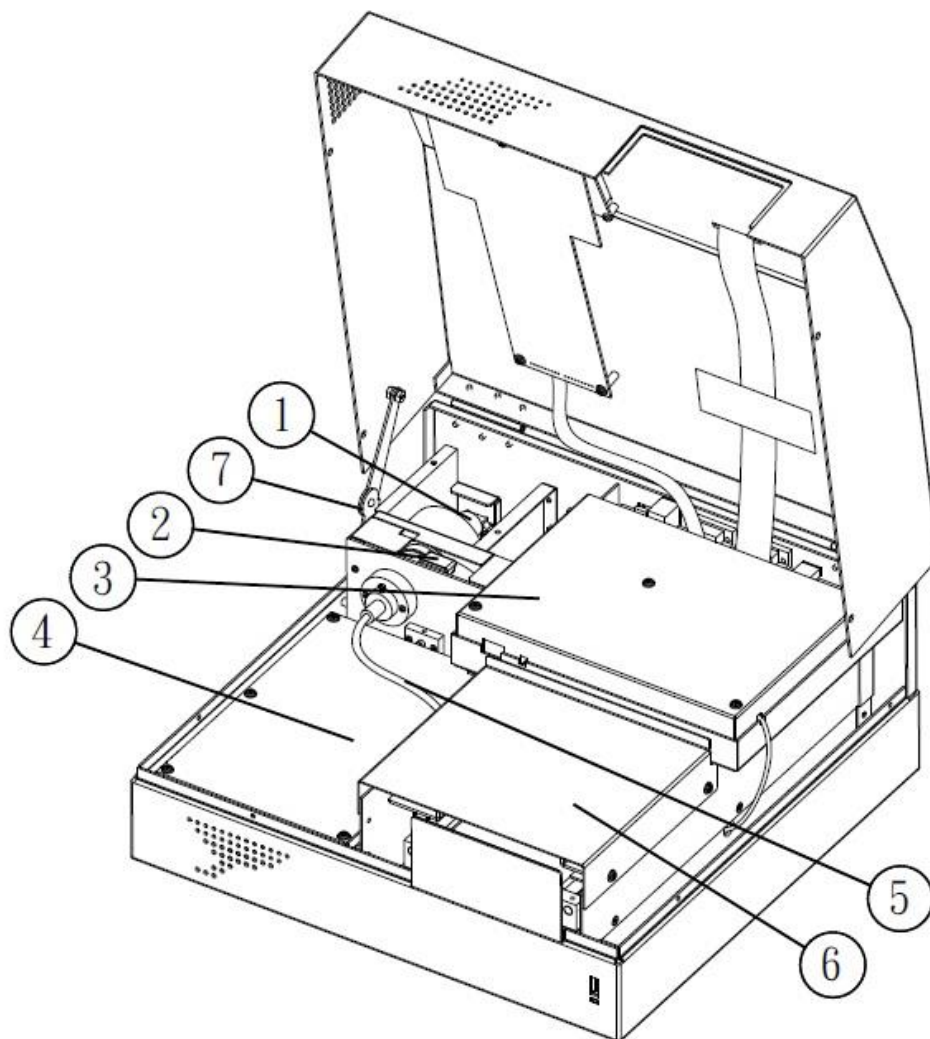
1. Top cover
2. Keyboard and LCD screen
3. Plate carrier
4. Front door opener
5. Fixing knobs
6. USB disk port



(figure 1)

Instrument internal components

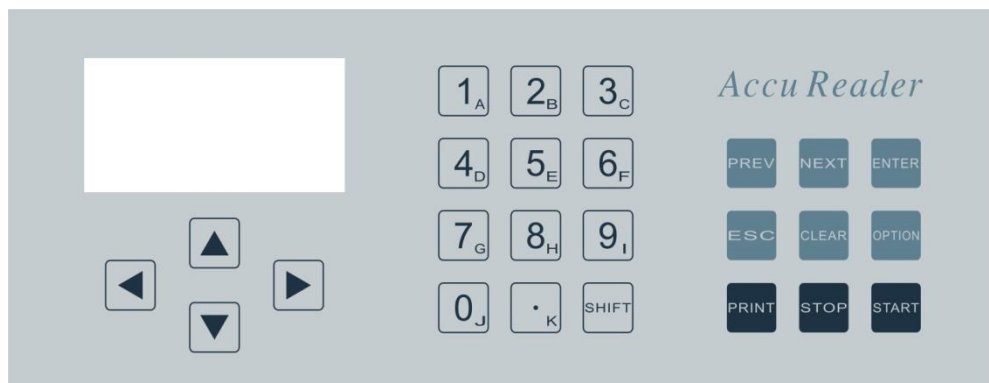
1. Lamp house
2. Filter wheel
3. Main board with cover
4. Power board
5. Fiber optic tube
6. Incubation chamber
7. Hinge



(figure 2)

Keyboard and display layout

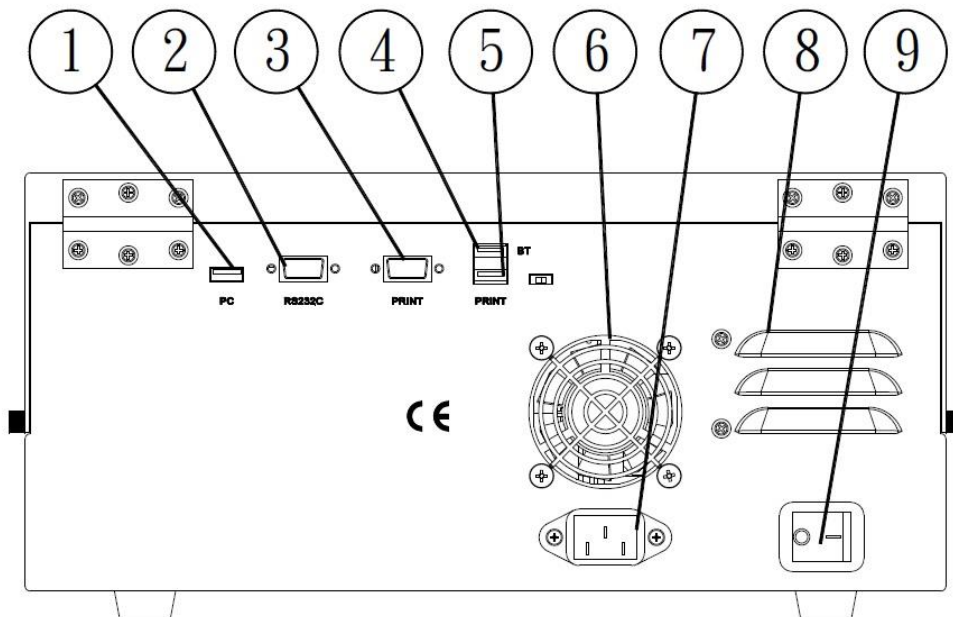
- | | |
|-----------------------------|---|
| 1. LEFT-ARROW key | Move the cursor one place to the left. |
| 2. RIGHT-ARROW key | Move the cursor one place to the right. |
| 3. UP-ARROW key | Move the cursor one place up, or input 26 English letters forward. |
| 4. DOWN-ARROW key | Move the cursor one place down, or input 26 English letters backward. |
| 5. 0-9 & . key | For entering numerical data or hot-key protocol. |
| 6. A~H subscript key | For entering well name of microplate |
| 7. OPTION key | Move plate carrier out of, or into machine while in main screen. |
| 8. PREV key | Move back to previous option, previous question , or last window. |
| 9. NEXT key | Move to next option, next question, or next window. |
| 10. ENTER key | Confirm selections or entries of fields or parameters. |
| 11. ESC key | Delete current number or letter at the cursor position. |
| 12. CLEAR key | Undo current action, or delete current entries. |
| 13. START key | Initiate plate reading with selected protocol. |
| 14. STOP key | Terminate reading process, or stop printing process, or cease protocol editing process, or leave warning message. |



(figure 3)

Rear panel layout

1. USB pc port
2. RS232C pc port
3. RS232C print port
4. Blue Tooth port
5. USB print port
6. DC fan
7. AC power input socket
8. Ventilator
9. Power switch



(figure 4)

Environmental and electrical conditions

The instrument has been designed to operate and meet the specifications on previous pages under the electrical and environmental requirements listed below.

Line voltage

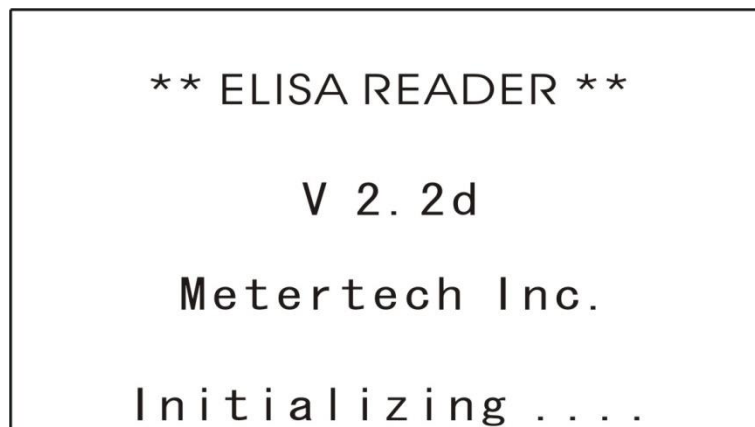
100-240Vac, 50-60 Hz

Environment conditions

Ambient temperature from 15°C to 35°C; relative humidity from 20% to 80% and maintained at +/-5%.

Powering up the instrument

1. Place AccuReader on a solid and level surface in a dry, clean environment.
2. Leave an open space at least 50mm distance from rear panel and side walls to guarantee air flow around the instrument.
3. Connect the female end of power cord into the mains power socket, and plug the power cord into a grounded wall outlet with the appropriate voltage.
4. Connect the USB/UART printer to the instrument at the print port. Turn on the power switch, waiting 3 seconds for internal power supply active, and LCD will be lighted up. The machine starts to do initialization (figure_5), and finally stay at main screen (figure_6 in next section) waiting for user input. Please follow instructions at next section for proper operation.



(figure 5)

During system initialization, several jobs are taken:
- checking external RAM condition on main board.

- checking battery status on main board.
- checking plate carrier motion.
- checking filter wheel rotation.
- tuning lamp voltage and preamp gain for mounted filters.

Note: If a warning message “**Filter# saturated**” or “**Filter# too weak**” or “**Filter empty**” shows up during lamp tuning, the instrument can still arrive at main screen. Please get into “**Machine setup**” for filter correction explained at next section.

Specifications

Wavelength range	M965+: 340 ~900nm / M965: 400 ~ 900nm
Interference filters	Max 8 selectable filters in a filter wheel 10 +/-2 nm half bandwidth filter center wavelength accuracy +/-2.0nm
Measurement range	0.000 ~ 4.000 Abs
Resolution	0.001 Abs
Accuracy	+/- 0.005 Abs or 2%, whichever is greater (from 0.000 to 3.000 Abs)
Precision	<0.2%CV from 0.000 to 2.000 Abs <0.5%CV from 2.000 to 3.000 Abs
Linearity	+/- 1% from 0.000 to 3.000 Abs
Measurement time	<5 seconds at continuous reading
Measurement mode	End point, two point, and kinetic
Light source	Halogen lamp (12V/20W)
Photodetector	9 silicon photodetectors
Shaking	Three user selectable modes(8Hz, 11Hz, and 14Hz)
Incubator	Ambient temp + 3C to 50C
Plate type	96-well plate
Display	8x21 character graphic dot-matrix LCD module
Keyboard	25 key tactile membranes
Printer interface	RS232C or USB
Internal data storage	100 sets of protocol, 50 sets of data and 20 sets of standard curve
External data storage	USB disk
Computer interface	RS232C or USB
Dimensions	W355 x D345 x H174 mm
Weight	14 Kg
Power supply	100~240V, 50/60Hz, 90W max
Operating conditions	15C to 35C, RH 90% max

Specifications subject to change without notice

OPERATION

Every time after powering up the machine, the cursor will stay at “END POINT(S)” of main screen. User can use “UP”, “DOWN”, “LEFT” and “RIGHT” keys to move cursor around the main screen.

MODE	DATA	PROT	SETUP
END POINT (S)			
TWO POINT (S)			
KINETIC (S)			
PROTOCOL			
			11:07:25

(figure 6)

To run a test, firstly make sure parameters of machine and printer are properly set up. These parameters will be saved in ROM. Secondly, a generated protocol need be called up and its content displayed on main screen. Then prepare a test plate, place it on plate carrier, and initiate the carrier motion for measurement.

MODE	DATA	PROT	SETUP
		MACHINE	DATE/TIME
		PRI	FILTER
		COM	INCUBATOR
			HEADER
			11:08:33

(figure 7)

1. Machine setup

For a brand new machine, user is to move cursor to “MACHINE” under menubar “SETUP”. Then press “RIGHT” to display sub window(figure_7). There are four parameters to be entered in this small window as described bellow.

[Date/Time] Move cursor up/down to this position and press “ENTER” to

switch to a new box. User can key in number with “0~9” or delete number with “ESC”, then “ENTER” to confirm the keyed number. Press “NEXT” or “RIGHT” to move cursor to next position for further key in. Press “PREV” anytime to return to last main window. The updated time will be shown on bottom right corner of screen.

[Filter] Move cursor to this position and press “ENTER” to enter into a new box. There are six locations to be entered, and they are related to filter wheel by F0~F7. For example, F0 is for “0” marked on wheel surface. The default filters are located at F0 and F1. Press “UP” or “DOWN” to move cursor to the filter number you want, then enter wavelength by pressing “0~9” or “ESC”, then confirm it by “ENTER”. The magnitude of wavelength must be greater than 399 nm.

Then open top cover of machine, insert the filter set at the location of wheel hole(refer to section MAINTENANCE for filter change). Press “PREV”, the machine will start do lamp tuning on each filter that was written in the window box. If there is no filter mounted there, an message “**Filter# saturated**” will tell which location of wheel has no filter. If selected filter is malfunctioned and block incident light beam, “**Filter# too weak**” may show up. Users need either mount proper one on, or delete that wavelength by pressing “CLEAR”, then press “PREV” again. Not until proper correction has been done, can it then return to main window.

[Incubator] In this new window box, select **YES** by pressing “RIGHT” or LEFT”, then pressing “ENTER”. The cursor location is to enter setting temperature from 15~50C. After confirming by “ENTER”, the bottom-left corner will display incubator temperature in real time. If no heating is necessary, select **NO** and press “ENTER” to display “**None**”. No temperature displays at the screen corner. Press “PREV” to return main window with current temperature shown at corner if incubator was set up.

[Header] In this box, user can key in test title and operator name with max 10 alphanumerical characters each. Title and name will be shown on heading of printed report. Those 26 letters are scrolled by pressing “UP/DOWN” and displayed at cursor position. Press “RIGHT/LEFT” to move cursor to next/previous position. Numeric characters are pressed on key “0~9”. Press “ENTER” or “NEXT” and jump to next item for input. Press “ESC” to delete

current displayed characters. Press “PREV” and return to main window.

2. Printer setup

Move cursor to “**PRINTER**” under menu bar “**SETUP**”, then press “**RIGHT**” to a sub-window. There are three types of printer can be selected: USB printer, UART printer and SEIKO serial printers. Move “**UP/DOWN**” and press “**ENTER**” to confirm selection with mark “**S**” on right side of that printer. Printer can also be set **ON** or **OFF** by toggling “**ENTER**”. So the printer will not print out any data if set **OFF** even though it is connected to the machine.

- Note:** -Available USB printers are: EPSON TM-T82III, Birch BP-T3xA, and APPOSTAR RTP-2264.
- Available Seiko printer is: DPU-414 (baud rate =19200).
 - Available UART printers are: EPSON TM-T82III, Birch BP-T3xA, and APPOSTAR RTP-2264 (baud rate =115200)
 - If other types of printer were connected, the graphic curve may not be printed out properly.

3. Data to PC

Move cursor to “**COMPUTER**” under menu bar “**SETUP**”, then press “**RIGHT**” to a sub-window. In PC-controlled mode, the PC mate can be communicated with the instrument either by USB or UART port. Move “**UP/DOWN**” and press “**ENTER**” to confirm selection with mark “**S**” on right side of that port. Please review the PC mate operational manual for details.

In standard-alone mode, the measured data for each test can be up loaded to pc through RS232 port only. Move cursor down again to “**XXX DATA**”, then repeatedly press “**ENTER**” to see display change among “**END DATA**”, “**RAW DATA**” and “**MIX DATA**”. User can select transferring calculated data only(end data), or unprocessed data only(raw data), or combination of end and raw data.

The data measured is stored at hyper-terminal of pc, and stored data can also be processed under Microsoft Excel. Please refer to appendix A & B for further details.

4. Data display

Move cursor to “**SHOW DATA**” under menu bar “**SETUP**”, then press

“RIGHT” to a sub-window. The measured original data(except for kinetic mode) for each test can be displayed on lcd for users to check. Move “UP/DOWN” and press “ENTER” to confirm selection with mark “S” on right side of “YES”to enable this feature.

After running a plate test, the reading of column A~H of the first row are shown on lcd. Users can press “UP/DOWN” key to increase/decrease row number, and get its column reading. If the test has more than one plate reading, press “RIGHT/LEFT” to select the plate number(wavelength also displayed) and its reading. After completing data checking, press “ESC” for next process.

5. USB disk saving

Move cursor to “SAVE DSIK” under menu bar “SETUP”, then press “RIGHT” to a sub-window. The measured data for each test can be stored in inserted USB disk. Move “UP/DOWN” and press “ENTER” to confirm selection with mark “S” on right side of “YES”to enable this feature.

6. Protocol/Data/Hot key

Before running a plate reading, related parameters need be set up under a protocol. This protocol can be saved in ROM by standard protocol programming method (described in section STANDARD PROTOCOL CREATING), or simple protocol programming without saving(explained below).

Only those raw plate data run by standard protocol can be saved in ROM(described in section DATA PROCESSING).

User can also match hard key 0~9 to stored standard protocols. It is easy and convenient to run a routine test by simply pressing assigned hard key(described in section STANDARD PROTOCOL CREATING).

7. Simple protocol programming

In this editing process, the BLANK is set as air, and all 96 wells on plate are SAMPLE no matter what kind of solution will be there. The entire plate will be read regardless actual number of well being taken.

[END POINT(S)]

Move cursor back to “END POINT(S)” under menu bar “MODE”. Press “ENTER” to start parameter setting of end point mode. In this environment, user can select motion method, main and reference filter type, shake speed and duration.

Please follow instructions in next section for proper entering/selecting above parameters. When completing input, **“Exit simple edit”** will be displayed on screen. Select **YES** to leave current editing work, or **NO** to return to the beginning of parameter input.

Note: -User can press **“PREV”** and jump back to last option during editing process.

-User can press **“STOP”** during option selection to quit current protocol editing, and return to main screen.

[TWO POINT(S)]

Move cursor to **“TWO POINT(S)”** under menu bar **“MODE”**. Press **“ENTER”** to select motion method, main and reference filter type, delta time between two measurements, shake speed and duration.

The method for entering or selecting parameter is the same as above approach.

[KINETIC(S)]

Move cursor down to **“KINETIC(S)”** under menu bar **“MODE”**. Press **“ENTER”** to select motion method, main filter type, shake speed and duration, sampling number and sampling interval, as well as well for curve display.

The method to enter or select parameter is the same as above approach.

Note: The average rate of sample reading change is calculated at this mode.

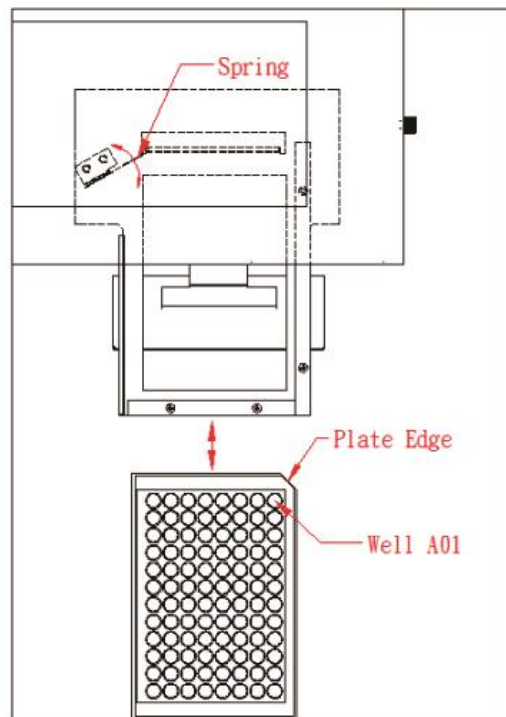
8. Start test with simple protocol

After leaving simple editing, the main screen will display those edited parameters for checking, also the plate carrier moves out of machine. If there is mistake to be corrected for parameters setting or user want leave this window, please press **“RIGHT”** or **“PREV”** key.

Place the 96-well plate on plate carrier, and make sure the marked edge(well **A01**) of plate is facing front-right direction while sliding in(figure_8). Press **“START”** and the machine will retract the plate carrier for measuring. When completing test, the machine will move it out again and wait for another test/input. The printer then start to print data with message **“Printing...”**, and it can be stopped any time by pressing **“STOP”**. An error message **“Printer error”**

will show up if printer is not properly set up. Press “STOP” and eliminate this message and proceed to next operation.

- Note:**
- During plate measuring process, user can press “STOP” to quit current work and the plate carrier will be moved out right away.
 - Toggling “OPTION” key allow plate carrier to be moved out of /into machine, only when main screen is displayed.
 - When error message (please refer to page 38) is displayed, press “STOP” for next operation.



(figure 8)

9. Start test with standard protocol

If user want to run a protocol stored in ROM, move cursor down to “**PROTOCOL**” under menu bar “**MODE**”. Press “ENTER” and select required protocol in listed table.

Press “UP/DOWN” to move cursor at current screen, or press “RIGHT” to next screen if more than 12 sets of protocol are saved. Press “ENTER” to confirm selection, and parameters of this protocol are displayed under menu bar (figure_9). The plate carrier is also moved out of machine. Press “UP/DOWN” to check more parameters covered by cursor.

The following procedure for running a test by selected protocol is the same as that in simple protocol test above.

At the end of measurement test, the screen shows “**Save current data?**” if the protocol was preset as manual saving of data. User can make decision by checking the printed data. Maximum seven alphanumeric characters of data name can be keyed in if **YES** was selected.

MODE	DATA	PROT	SETUP
Protocol: P25_AABB001			
Mode: Kinetic			
Motion: Continuous			
Filter: M1_405			
			11:10:24

(figure 9)

If a standard curve was fitted in the test, the screen also shows “**Save standard curve?**”. By checking the printed curve and equation, user can let the machine save this curve by a given name with selectable ID(01~99), or just leave there without saving(refer to page 24 for curve name definition). The saved name will be displayed on screen for user to remember. After that, press “STOP” and return to main screen.

- Note:** - Totally 20 sets of standard curves can be saved in ROM. The first saved one will be deleted if curve ROM is full. User may find these curves at quantitative editing of protocol, or from “**STD CURVE**” under menu bar “**DATA**” in section DATA MANAGEMENT.
- If users just created/modified a protocol following instructions in next section, they can start to run a test directly.

10. Start test with hot key

When the display is showing main screen, user can press key 0~9 to initiate a test if the pressed key was related to stored protocol(described in section

PROTOCOL MANAGEMENT).

The content of protocol will be displayed under menu bar. The rest of following test procedure is the same as above.

STANDARD PROTOCOL CREATING

At the main window, move cursor to “NEW” under menubar “PROT”. Then press “ENTER” to start a new protocol creating procedure (figure_10). The details are explained step by step below. After finishing programming job, user

can start measurement as described in last section.

Note: For the beginner to operate this machine, it's suggested that he start from simple protocol programming as described at last section.

MODE	DATA	PROT	SETUP
		NEW	
		EDIT	
		PRINT PROT	
		PRINT MAP	
		UTILITIES	>
37.00			11:22:45

(figure 10)

[Measure mode] user can select one among end point, two point and kinetic modes for current protocol. Press “UP/DOWN” to move cursor, then press “ENTER” or “NEXT” to next step.

[Plate motion] Select plate carrier motion either by continuous or stepping method. Available keys are the same as above step.

Note: -Continuous motion has quicker reading, however stepping motion get better reading for flat bottom well with high OD samples.
-For U-bottom or round-bottom well, continuous motion get better reading than stepping motion for all measurable OD range.

[Enter stepping delay] if stepping motion is selected, user can key in delay time between each row reading of plate. Press “0~9” and “ESC” to enter proper number within the range hinted at the bottom of LCD screen. Press “ENTER” or “NEXT” and confirm displayed number. The default delay time is 200 msec for liquid sample surface stabilization.

[Need incubation?] If the plate need be heated during measurement, select **YES**.

[Incubation temp] This option will come up only if the above step is **YES**. Press “0~9” and “ESC” to enter proper number within the range hinted at the bottom of LCD screen. Press “ENTER” or “NEXT” and confirm displayed number.

[Main filter_1] Press “ENTER” and enter a new window box. Press

“UP/DOWN” to move cursor among displayed filters. Press “ENTER” to select it, and return to previous window. Press “NEXT” to next step.

[Main filter_2] This option will show up only at two point mode. Select the filter with the same procedure as above step.

[Need refer. filter?] If there need be a reference filter during measurement, select **YES**.

[Refer. filter_1] This option will come up only if the above step is **YES**. Select the reference filter with the same procedure as that of main filter.

[Refer. filter_2] This option will come up only at two point mode. Select the reference filter with the same procedure as that of main filter.

[Enter time interval] This option is for two-point mode only. Enter the time duration between first measurement and second measurement.

[Need shaker?] If the plate needs shaking before reading, select **YES**.

[Shake time] This option will come up only if the above step is **YES**. Enter proper number and go to next step.

[Shake speed] Three speeds are available for shaking. The shaking frequency of high speed is 14hz, medium speed is 11hz, and low speed is 8hz.

[Starting method] When plate moving into the machine and before initiating reading, it may need stay there for a short period, or observe OD change to threshold of designated well, then start plate measurement. There are three options to select: immediate, delay time, and OD check.

[Delay time] If the above option was chosen as delay time, user need to key in number here.

[Which well to check?] If the above option is OD check, enter well number here. The first letter is entered by subscript under key 1~8(i.e. A~H), then press right key to move cursor to next position. Enter numeric value by key 0~9, then enter RIGHT/LEFT/0~9 key. Finally, press “ENTER” to confirm.

[ABS trend] Select **INCREASE** or **DECREASE** if the abs value of above well is gradually increasing or decreasing with respect to time.

[OD limit] This is the threshold of above abs trend. Once greater/less than this limit, the machine starts to read plate.

[How many samples?]Enter the maximum number of sample to be put in

		T	T													[A01]
		T	T													
		T	T													
		T	T													A: Samp
		T	T													: Auto
		T	T													: 13

figure 11a: 6 samples(column), 2 replicates(row)

		T	T	T	T	T	T									[A01]
		T	T	T	T	T	T									

figure 11b: 6 samples(row), 2 replicates(column)

		T	T													[A01]
		T	T													
		T	T													
		T	T													
		T														A: Samp
		T														: Auto
		T														: 13
		T														
		T														

figure 11c: 6 samples(column), 2 replicates(column)

		T	T	T	T	T	T	T	T	T						[A01]
	T	T														

figure 11d: 6 samples(row), 2 replicates(row)

plate for current protocol.

[How many replicates?] Enter the number of replicate for each sample.
[Sample auto mapping?] Select auto/manual mapping of samples by **YES/NO**.
[Sample direction] If the above answer is **YES**, user can select auto mapping direction for all samples. **COLUMN** allow sample number be arranged in column direction.
[Replicate direction] For auto sample mapping, the replicate direction of each sample is selected here.

Note: Please refer to figure_11 above for well mapping in different directions. There are six samples with 2 replicates each on the microplate. Samples are set to be started at well A03 and filled the plate automatically.

***** KINETICS *****

[Enter measuring no.] This option is for kinetic mode only. User is to enter total sampling number of entire process.

[Enter time interval] This option is for kinetic mode only. User is to enter time interval between two successive samplings.

[Which well to display data&curve] This function allows real-time data and curve to be displayed on screen while executing kinetics, so user can make decision from data variation whether to complete this measurement or quit the work right away. The displayed curve can be printed out.

The first letter is entered by subscript under key 1~8(i.e. A~H), then press right key to move cursor to next position. Enter numeric value by key 0~9, then enter right/left key/numeric key. Finally, press “ENTER” to confirm.

[Kinetic calculation] There are six calculation methods for the obtained kinetic data, and can be categorized by rate change, max abs and time to max rate/abs. Press “UP/DOWN” to move cursor from current window, or move to “**next page**” and press “ENTER” to next window for other selections. Once cursor was moved to the required calculation method, press “ENTER/NEXT” to select it, and go to next step.

Note: Calculation methods are listed as:

- average rate
- maximum rate
- maximum abs
- total delta abs
- time to maximum rate

-time to maximum abs

***** QUANTITATIVE *****

[Need quantitative?] If current test requires quantitative assay, select **YES**, or go to step**[Need cutoff?]** by **NO**.

[Quantitative assay] There are four options here to select by “UP/DOWN/ENTER/NEXT”. They are described under titles {1.curve on plate}, {2.stored curve}, {3.standar line}, and {4.concentration factor}.

{1. CURVE ON PLATE}

[Select data fitting] If“**CURVE ON PLATE**” was selected at above step, standard solution with known concentration need be prepared for current test. Concentration and read abs can be fitted by seven different curves. i.e.

- Linear regression
- Quadraticpolynomial
- Cubic polynomial
- Point to point
- Cubic spline
- Two-parameter logit-log
- Four-parameter logistic

Select one among them by “UP/DOWN/ENTER/NEXT”.

[Select X-axis scale] The horizontal axis of fitted curve on printed report can be either linear or log10 scale.

[Select Y-axis scale] The vertical axis of fitted curve on printed report can be either linear or log10 scale.

[Quantitative standard no] Enter the total number of standard to be put in plate for current protocol.

[Quantitative replicate no] Enter the number of replicate for each standard.

[Standard auto mapping?]Select auto/manual mapping of standard by **YES/NO**.

[Standard direction] If the above answer is **YES**, user can select auto mapping direction for all standards. **COLUMN** allow standard number be arranged in column direction.

[Replicate direction] For auto standard mapping, the replicate direction of each standard is selected here.

Note: Please refer to figure_11 above for well mapping

[Select standard type] User can select concentration or dilution of standard. At this time, only concentration is available.

[Enter concentration] In this new window, all concentrations are displayed here. Enter the concentration of each standard with magnitude ≥ 0.0001 . User is to press “UP/DOWN” to scroll the cursor in current and next/previous page. Press “1~9” and “.” to input concentration value, then confirmed by “ENTER”. Press “NEXT” for following step.

{2.STORED CURVE}

[Stored curve] This option is only active when there are standard curve equations being saved in ROM. If this option is selected, a list of saved curves is displayed for user to select. User can press “UP/DOWN/RIGHT” to locate the curve, then press “ENTER” to confirm and go to next step.

The selected equation will be applied to sample concentration calculation.

Note: The curve name of stored equation has following types:

- Cxx_LINEAR
- Cxx_QUADRATIC
- Cxx_CUBIC
- Cxx_POINT
- Cxx_SPLINE
- Cxx_LOGIT-LOG
- Cxx_LOGISTIC

Where **xx** is serial number ranging from 01 to 99.

{3.STANDARD LINE}

[Standard line] If **STANDARD LINE** was selected at quantitative assay, user can key in coefficient **A&B** of displayed equation. All sample concentration calculation of current plate is based on it. Use “UP/DOWN” to move cursor, and “0~9”&“.” to enter number. Entered number is confirmed by pressing “ENTER”. Press “NEXT” for next step.

{4.CONC. FACTOR}

[Enter conc. factor] This option is similar to above step, but with only one factor to be keyed in.

***** CUTOFF *****

[Need cutoff?] Select **YES** for sample qualitative analysis, or go to step **[Well**

mapping method] by **NO**.

[Cutoff methods] There are three options here to select by “UP/DOWN/ENTER”key.

[SINGLE LIMIT] Only one threshold value can be entered by numerical keys and “ENTER” to confirm.

[Threshold label] If the sample value is greater than above threshold value, its label(or name) can chosen as “+” or “-“ by “UP/DOWN/ENTER/NEXT” key. For those samples smaller than threshold, their labels are reversed.

[DOUBLE LIMIT] Two threshold values can be keyed in, and high threshold need be greater than low threshold..

[Threshold label] If the sample value is greater than above high threshold, its label(or name) can chosen as “+” or “-“ by “UP/DOWN/ENTER/NEXT” key. For samples smaller than low threshold, their labels are reversed. Those values between high and low threshold are labeled “*”.

[CALCULATION] User can use simple equations to calculate threshold limit.

[Enter threshold no] Enter the number of threshold equations with range from 1 to 4.

[Enter coefficient] There are three coefficients a, b and c, to be entered for each equation. Values are entered by numerical keys and “ENTER” for confirmation. User can move cursor by “UP/DOWN’ key. After complete keying in three factors, press “NEXT” to next equation.

The calculated result of threshold equations need be arranged in decreasing sequence, i.e. equation 1 > equation 2 > equation 3 > equation 4.

[Label of limits] The labels between each threshold are displayed. These label sequence can be reversed by selecting “**REVERSE**” and pressing “ENTER”. Selecting “**CONFIRM**” and press “ENTER” for next step.

*** WELL MAPPING ***

[Well mapping method] In this screen(figure_12 below), a grid representing 96-well plate is lying on left side. User can move around the cursor by “UP/DOWN /LEFT/RIGHT”, and the coordinate of cursor is shown on upper-right corner of screen. The upper-left corner is position A01 which is the same as that of well plate. Keep on pressing key “1”(or its subscript A) will change well type among Blank, Positive, Negative, Sample and Control. The serial no and auto/manual mapping of each type are also shown below it.

If the well is preset as auto mapping, item B & C disappear. For manual mapping,

toggle key “2”(or its subscript B) allow user to select well arrangement direction(column/row), and toggle key “3”(or its script C) is to select well replicate direction(column/row).

-Create mapping

To start a well mapping, first select the well type by pressing “1”, then press “2” and “3” to select direction if the well is manual mapping.

For manual mapping, move cursor to the location where you want to set the first well, then press “ENTER” to confirm that position and the cursor becomes “#”. If you need more than one well, press “RIGHT/DOWN” to expand cursor zone, or after that to reduce zone by pressing “LEFT/UP”. If the total well number in the zone is you expect, then press “ENTER” again. The cursor zone now is filled with letter(**Z, P, N, T, or C**) and one cursor. Also below the well coordinate, an abbreviation(well type _serial no _replicate no) for the well being taken by cursor is displayed(**Z01-1** in the figure below). The next serial number to be set for the selected well is also displayed(**9**) down “**Manu**”.

Figure_12 shows an example by manual mapping of well. The printer output(figure_13) of this mapping is rotated 90 degrees clockwise with respect to LCD screen setting.

#	C	C	T	T	T							[A01]
Z	C	C	T	T	T							Z01-1
Z	C	C	T	T	T							
Z	C	C	T	T	T							A: Blank
Z	T	T	T	T	T							: Manu
Z	T	T	T	T	T							: 9
Z	T	T	T	T	T							B: M-COL
Z	T	T	T	T	T							C: R-ROW

figure 12: 8 blanks(column), 4 standards(column) with 2 replicates (row), and 32 samples(column).

H	G	F	E	D	C	B	A	
BLK08	BLK07	BLK06	BLK05	BLK04	BLK03	BLK02	BLK01	01

SAM04	SAM03	SAM02	SAM01	STD04	STD03	STD02	STD01	02
SAM08	SAM07	SAM06	SAM05	STD04	STD03	STD02	STD01	03
SAM16	SAM15	SAM14	SAM13	SAM12	SAM11	SAM10	SAM09	04
SAM24	SAM23	SAM22	SAM21	SAM20	SAM19	SAM18	SAM17	05
SAM32	SAM31	SAM30	SAM29	SAM28	SAM27	SAM26	SAM25	06
...	...	...	...	...	...	...	...	07
...	...	...	...	...	...	...	...	08
...	...	...	...	...	...	...	...	09
...	...	...	...	...	...	...	...	10
...	...	...	...	...	...	...	...	11
...	...	...	...	...	...	...	...	12

figure 13: printed mapping of above LCD screen setting

For auto mapping, move cursor to the location where you want to set the first well, then press “ENTER”. The well type(only sample and standard are allowed in auto mapping) user just picked will fill in the grid with preset number. The serial number of these wells is arranged according to predefined direction.

Note: Letters laid on grid are: Z for blank, P for positive control, N for negative control, T for sample, and C for standard(calibrator).

-Delete mapping

If the current mapping need be changed or deleted, firstly move cursor to any well position with well type which need be deleted. Then press “CLEAR” to show all wells with same type in reverse image. Thirdly either press “CLEAR” to delete selected area, or press “ESC” to cancel this action.

After complete mapping job, press “NEXT” or “PREV” to next or previous step. **[Printing options]** User can determine printed report content of current protocol after execution here. Press “UP/DOWN” to move cursor from current window, or move to “**next page**” and press “ENTER” to next window for other selections. Once cursor was moved to an option without “N”(this option is **Not**available) at right side, press “ENTER” to select it, and a star mark “*”is shown at right side.

The number of “N” appeared on window depends on the measurement mode and its related options that user selected for current protocol.

User can select more than one option at the same time, so the printer will also

print all them out. If current option is not needed, press “ENTER” to remove the star mark. After complete selection, press “NEXT” to next step.

Note: Available printing options are:

- protocol summary
- plate map
- raw abs matrix
- blanked result
- calibration curve
- residuals of standard concentration
- concentration matrix
- kinetic curve
- kinetic matrix

[Key in protocol ID] Each protocol has its unique protocol id number. User can enter new id number from 0 to 99 by pressing “0~9” or just press “NEXT” to keep original number at protocol modification.

[Key in protocol name] Maximum seven alphanumeric characters can be entered for protocol name. Those 26 letters are scrolled by pressing “UP/DOWN” and displayed at cursor position. Press “RIGHT/LEFT” to move cursor to next/previous position. Numeric characters are pressed on key 0~9. Press “ENTER” after entering name or “NEXT” without correcting name and jump to following step. Press “ESC” to delete current displayed characters.

[Save protocol?] Previous input options can be saved in ROM under above id and name. If no saving is taken, current protocol still can initiate the plate reading after leaving editing job.

[Auto save plate data] This option will show up only when above protocol has been saved. If the data measured by current protocol need be stored in ROM automatically after each test, select **YES**. Or the machine will ask user to make choice after each measurement(refer to last section for **starting test**).

Note: data name by auto-saving method is defined as Pxx_MDYHMS

Where xx is protocol id, M is month, D is day, Y is year, H is hour

M is minute, and S is second. The time when the data was taken is its name.

[Leave protocol edit?] Select **YES** to leave current editing job, and following

instruction at last section for **starting test**, or **NO** and return to the beginning of parameter input.

Note: - User can press “PREV” and jump back to last option(step) during editing process.

- If no modification is required for any option, press “NEXT” and jump to next option(step).
- In new protocol creating, user can press “STOP” to quit and return to main screen at any option selection.
- In editing an existed protocol, press “STOP” during option selection, will jump to option “**Save protocol?**” and continue remaining work.

PROTOCOL MANAGEMENT

Standard protocols generated by last section are saved in ROM with maximum 100 sets. These protocols can be modified, deleted, copied to another name, and printed out.

Protocol edit

At the main window, move cursor to “**EDIT**” under menubar “**PROT**”(refer to figure_10 in last section). Then press “**ENTER**” to get into another window. All generated protocols are listed here. Each protocol is represented by **XX_YY**; where **XX** is id number, and **YY** is protocol name.

Move cursor around in current window by pressing “**UP/DOWN**” or “**RIGHT**” if protocol number is more than 12. If you have picked the one to be modified, press “**ENTER**”.

In the next window, select **YES** to confirm it(or **NO** and return to main window). The following procedure is the same as creating protocol described in last section. However, all default values of related parameters are replaced by current protocol.

Protocol print

At the main window, move cursor to “**PRINT PROT**” under menubar “**PROT**”. Then press “**ENTER**” and the printer will output created protocol parameters(not include simple protocol) that was latest displayed on screen. The printer may output nothing even if machine stored protocols.

Map print

At the main window, move cursor to “**PRINT MAP**” under menubar “**PROT**”. Then press “**ENTER**” and the printer will output well mapping of generated protocol (not include simple protocol) that was latest displayed on screen. The printer may output nothing even if machine stored protocols.

Protocol copy

At the main window, move cursor down to “**UTILITIES**” under menubar “**PROT**”, then press “**RIGHT**” key to a sub window. Select “**COPY**” and press “**ENTER**” to enter another window.

Move cursor around in current window by “**UP/DOWN**” or “**RIGHT**” if protocol number is more than 12. If you picked the one to be copied, press “**ENTER**”.

Key in id and name for new protocol, and new id can not be the same as stored protocol. After complete this process, the protocol list will come back again. User can check whether the protocol just generated is located at last line of screen or not. User can make another copy here, or press “**PREV**” and return to main screen.

Protocol delete

At the main window, move cursor down to “UTILITIES” under menubar “PROT”, then press “RIGHT” to a sub window. Move to “DELETE” and press “ENTER” to enter another window.

Move cursor around in current window by “UP/DOWN” or “RIGHT” if protocol number is more than 12. If you picked the one to be deleted, press “ENTER” and that protocol disappeared. User can delete another protocol here again, or press “PREV” and return to main screen.

Hot key

At the main window, move cursor down to “UTILITIES” under menubar “PROT”, then press “RIGHT” to a sub window. Move to “HOT_KEY” and press “ENTER” to enter another window with hot key table.

Select required number(0~9) by “UP/DOWN”, then press “ENTER” and enter protocol table. Select the protocol, then press “ENTER” and get back to hot key table. The selected protocol id is showing after picked number. Press “PREV” to return to main screen, or repeat current work.

User can delete any protocol id existed in hot key table by press “CLEAR”.

Note: If user deletes the selected protocol by the method explained above, and get back to this hot key table. He will find out the protocol id after assigned hot key number is replaced by “N.A.” message. It means this hot key number is no longer available for the deleted id. User can press “CLEAR” to erase this message, and select other protocol id.

DATA MANAGEMENT

The raw data obtained by standard protocol execution are saved in ROM with maximum 50 sets. These data can be processed, deleted, copied to another name, and printed out.

MODE	DATA	PROT	SETUP
	PROCESS		
	PRINT		
	COPY		
	DELETE		
	STD CURVE	>	
37.00			11:50:04

(figure 14)

Two kinds of data name may be used for saving. One is named by auto saving method(refer to page 29 for definition), and the other by manual saving(refer to page 17).

Data post-process

At the main window, move cursor to “PROCESS” under menubar “DATA”, and press “ENTER” to enter another window with data files listed.

User can select the desired curve by “UP/DOWN” key, or “RIGHT” key if curves are more than one page, then press “ENTER”. The machine will start process it by a stored protocol with the same id as data file has. After process is completed, the printer will output the result if it was set **ON**. If this protocol was deleted, the machine stop working, and screen will display “No Proto !!”.

User may modify this protocol(maintain the same id) to get different processed result from the same raw data.

Data copy

At the main window, move cursor to “COPY” under menubar “DATA”, and press “ENTER” to enter another window with data files listed.

Select the required raw data, and press “ENTER” and enter new window for entering new data name. After key in alpha-numeric letters, press “ENTER” and get back to data table. The new generated data file is at last line of listed table. Press “PREV” to get back to main screen, or repeat copying job.

Data delete

At the main window, move cursor to “DELETE” under menubar “DATA”, and press “ENTER” to enter another window with data files listed.

Select the required data file, and press “ENTER” to delete it. Press “PREV” to

get back to main screen, or repeat deleting job.

Data print

At the main window, move cursor to “**PRINT**” under menubar “**DATA**”, and press “**ENTER**” to enter another window with data files listed.

Select the required data file, and press “**ENTER**” to print it out (make sure printer was set up correctly). Press “**PREV**” to get back to main screen, or repeat printing job.

Standard curve

At the main window, move cursor to “**STD CURVE**” under menubar “**DATA**”, and press “**RIGHT**” to enter a small window for “**PRINT**” and “**DELETE**” function.

Select “**PRINT**” and press “**ENTER**” to get a window showing all names of saved calibration curves up to maximum 20 sets. Please refer to section STANDARD PROTOCOL CREATING for the definition of curve name.

User can select the desired curve by “**UP/DOWN**” key, or “**RIGHT**” key if curves are more than one page. Press “**ENTER**” to print out the content of this curve for review. Press “**PREV**” to get back to main screen, or repeat printing job.

Select “**DELETE**” and press “**ENTER**” for saved curves erasing. Make sure not deleting those curves which have already been selected by existed protocols.

MAINTENANCE

Routine care

Very little maintenance is required to keep the instrument in good working condition. The interior should be kept as dust free as possible and the plate carrier cleaned regularly; wipe off spilt chemicals immediately.

WARNING: Do not remove the cover of the instrument.

CAUTION: Do not allow moisture to leak into the instrument.

The exterior of the instrument can be cleaned periodically as follows:

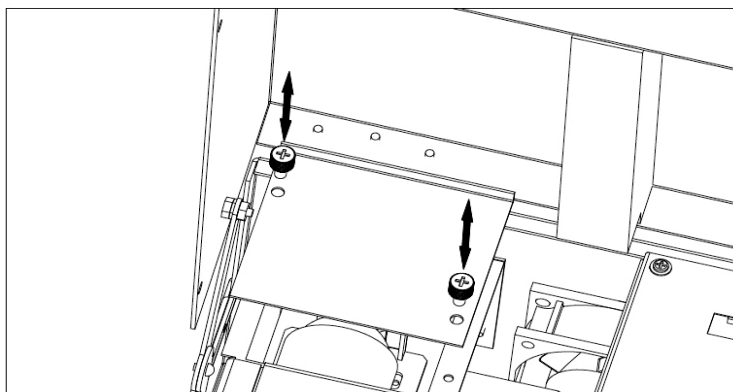
- ◆ Switch off first the instrument and disconnect from the mains supply.
- ◆ Using a lint free cloth dampened with a weak solution of detergent and water, wipe the exterior surface of the instrument as necessary.
- ◆ Dry the surface with another soft cloth.

Lamp replacement

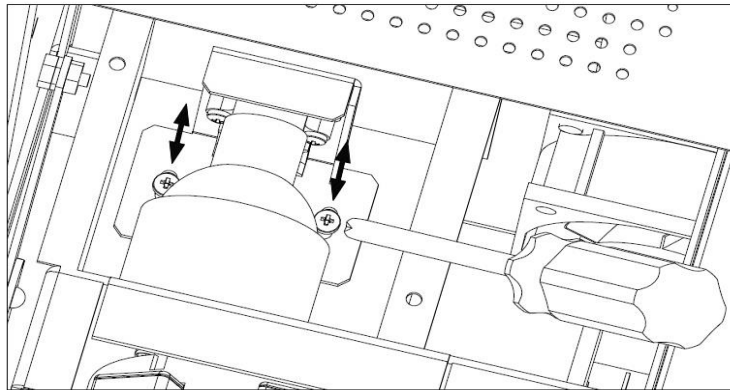
CAUTION: Switch off and disconnect the instrument from the mains supply and allow the lamp to cool down at least 10 minutes before proceeding.

WARNING: Do not touch inner surface of lamp cup with bare fingers.

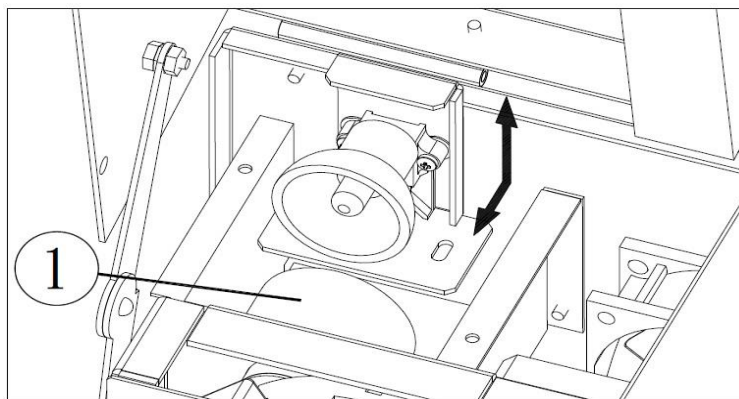
1. Turn off and unplug the instrument.
2. Allow the lamp to cool for at least 10 minutes.
3. Loose four knobs on both sides of machine, and lift up completely the top cover.
4. Open the lamp cover on top of lamp house by loosening two knobs in counterclockwise direction (figure_15a).
5. Use cross-type screw driver to remove two screws down at base of lamp support (figure_15b).
6. Pull out and up slowly the old lamp and lamp support from black tube (#1 in figure_15c) and housing. Be careful the lamp cable not getting stuck while pulling up.
7. Remove old lamp from socket fixed on lamp support as shown in figure_15d.



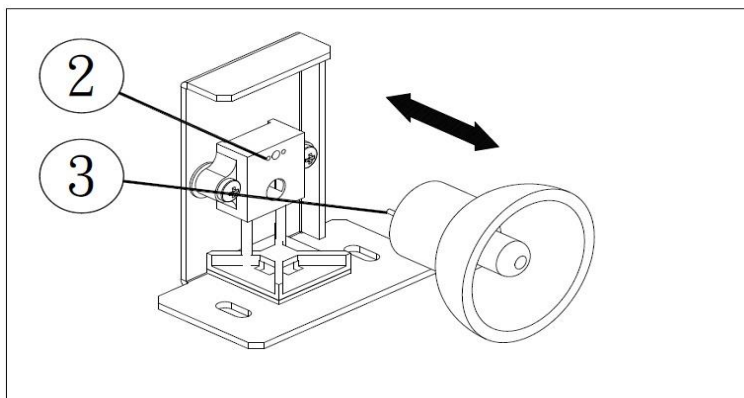
(figure 15a)



(figure 15b)



(figure 15c)



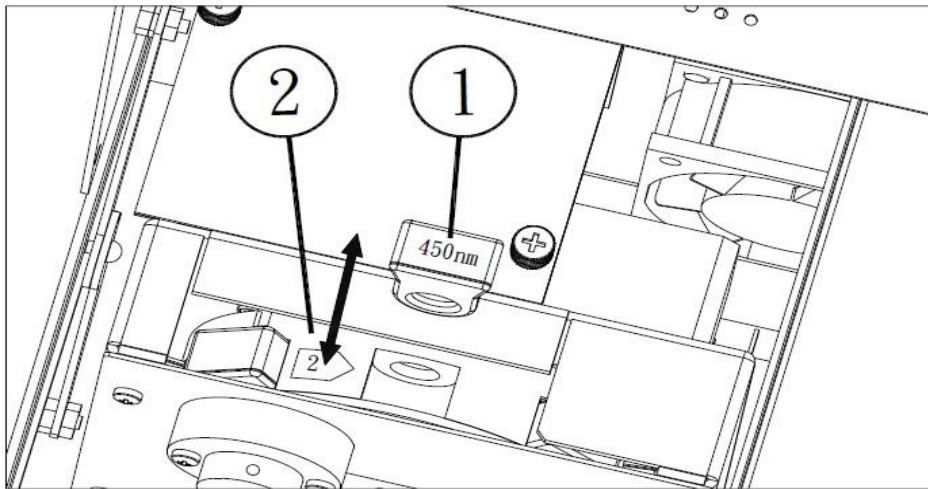
(figure 15d)

8. Plug a new lamp(#3) securely into the holes(#2) of socket. Position lamp cup and lamp support roughly in front of black tube and put two screws back into original holes. Do not tighten them yet. Check and adjust lamp cable, so the cable would not get jammed or twisted.
9. Pull lamp support and lamp cup in the horizontal direction, so the circular edge of cup fit into black tube completely. Fasten those two screws now.
10. Put the lamp cover back to top of housing, and tighten two knobs again.

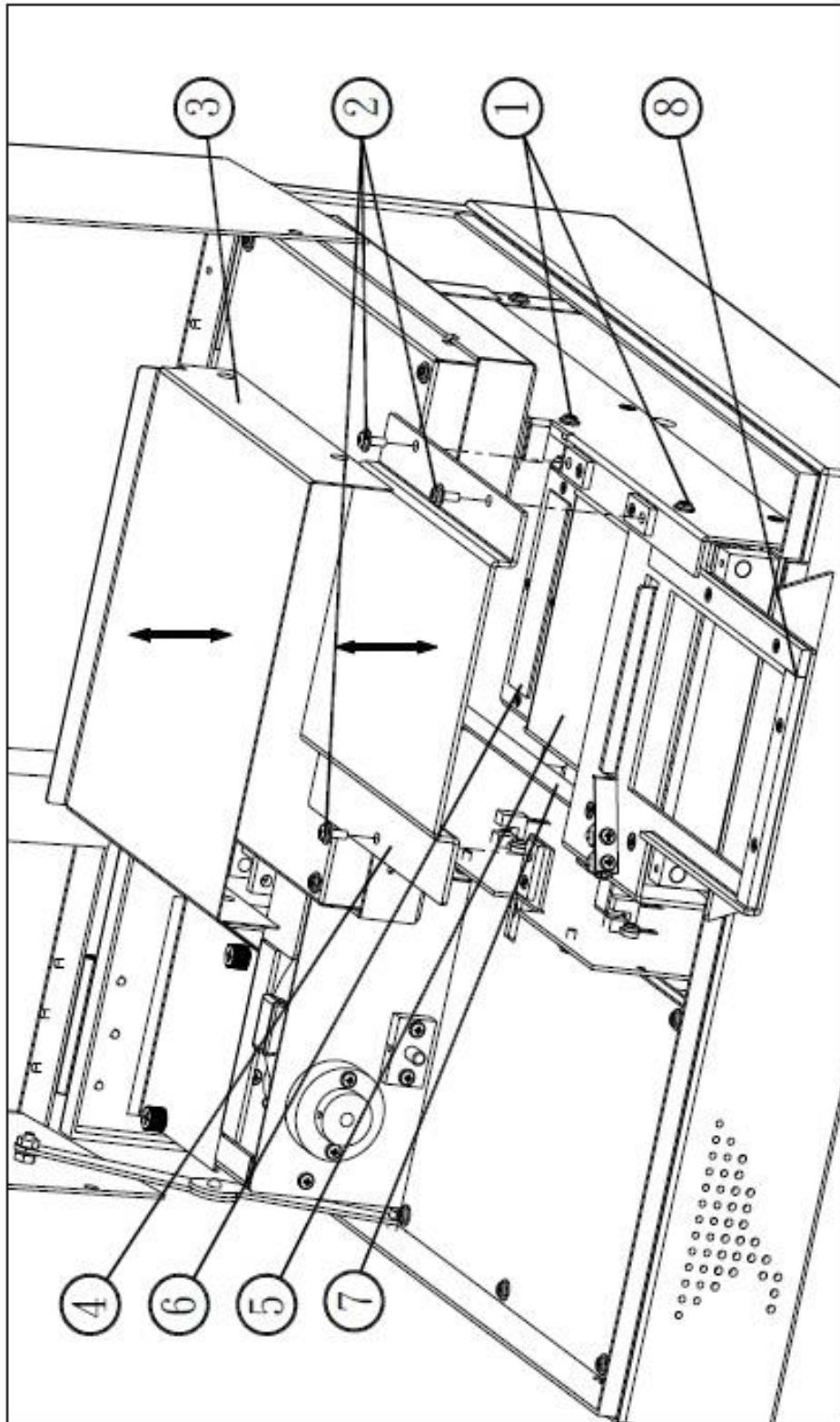
Filters change

WARNING: The filter holder can be changed while power is on. Do not touch any other electronic components to reduce risk of shock.

1. Loose four knobs on both sides of machine, and lift up completely the top cover.
2. Rotate the filter wheel by hand until the wheel hole number to be used is shown right up on left side of wheel hole(#2 in figure_16).
3. If there is filter holder at this hole, remove it by pulling straight up. Then insert a new filter holder with its wavelength characters(#1) oriented in the direction as shown in this picture. The filter hole won't accept filter holder if it is reversely inserted.
4. For a successful insertion, the filter holder is not easy to be removed, and won't drop or loose during wheel rotation.



(figure 16)



(figure 17)

Optical-mechanical parts cleaning

WARNING: The machine need be periodically cleaned on its optical parts. The contaminant, dropped from test samples and sticking on optical-mechanical parts, may reduce reading accuracy and affect plate motion smoothness. .

1. Turn off and unplug the instrument.
2. Open up the top cover of machine as mentioned above.
3. Loose four screws(#1 in figure_17 above) on both sides of heater cover(#3). Then remove the heater cover carefully from the machine.
4. Loose and remove three screws(#2) on top of top heating plate(#4). Move plate up slowly and turn it over to left side of machine. Then lay this plate down on top of heat sinks.
5. There are wires connected between heating plate and machine. Please be cautious not to break or tear off these wires from the plate.
6. Pull plate carrier(#8) far out of machine slowly, so users can easily reach the optical glass(#6).
7. Use a soft clean cloth or cotton rod dipped with alcohol to clean the surface of glass.
8. Then also clean top surface of plate carrier, surface of top and bottom heating plates(#5), as well as rails(#7) on both sides of carrier.
9. Put top heating plate back to original position and tighten it by three screws.
10. Mount the heater cover above top heater plate. Then push this cover inward at horizontal direction, and make sure no air gap between walls.
11. Tighten four screws, then pull front door opener out and pull down top cover of machine, finally fix four knobs on both sides.

Messages

This paragraph lists messages for errors or abnormal conditions or warning during machine operation.

RAM error The external ram is not operating properly, call for service.

Filter empty There is no filter existed in filter wheel. Insert required filter.

Filter# saturated

There is no filter at the position # of filter wheel. Insert new one at that position.

Filter# too weak

The filter at the position # of filter wheel or the lamp is malfunctioned. Insert new one at that position, or clear filter setting at machine setup, or change a good conditioned lamp.

Battery error The battery on the main board is out of condition or removed. Turn off machine, and insert a proper one.

Filter not setup Filter setting has not been executed at machine setup. Do it.

Printer error Printer is not connected to machine or not powered up.

No proto The appointed protocol for data to be processed did not exist.

Proto memory full

Total number of protocol in ROM exceeds 100 sets. Delete old or useless ones before further protocol creation.

Curve not existed

The standard curve selected by current protocol was deleted. Edit this protocol again with another stored curve.

Threshold sequence error

The calculated results of threshold equations are not arranged in decreasing order. Correct their coefficients again with proper magnitude in cutoff setting.

Well not mapped

None of sample(T) and standard(C) is placed on the microplate during well mapping process. User must fill in either one for proceeding to next step.

Mathematic error

While executing quantitative function, keyed in standard concentration of designated well is not related to the absorbance of that well (ex., the standard OD is ≤ 0.005 or \leq lower asymptote). Press "STOP" to eliminate this message, and correct the standard mapping in protocol setting.

Filter wheel error

The wheel motor, or photo interrupter, or motor driver may be malfunctioned.

Plate motion error

The stage motor, or photo interrupters, or motor driver may be malfunctioned.

Note: When error messages are displayed, please press "STOP" for next operation.