Thermo SCIENTIFIC

Multiskan® EX

Thermo Scientific Multiskan® EX

User Manual

Rev. 3.3, Cat. no. 1507300

Thermo Scientific Multiskan EX, Cat. no. 51118170 (200 – 240 V) or 51118177 (100 – 120 V)
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1 Safety Symbols and Markings

These symbols are intended to draw your attention to particularly important information and alert you to the presence of hazards as indicated.

Safety symbols and markings used on the Multiskan EX

Power ON

Power OFF

SN **Serial number**

REF **Catalog number**

Date of manufacture

Consult Instructions for Use

WEEE symbol This product is required to comply with the European Union's Waste Electrical & Electronic Equipment (WEEE) Directive 2002/96/EC.

Warning markings used in the documentation

Warning: Risk of electric shock.

Warning: Biohazard risk.

Warning: Risk of injury to the user(s).

Caution: Risk of damage to the instrument, other equipment or loss of performance or function in a specific application.

Other markings used in the documentation

Note: Marks a tip, important information that is useful in the optimum operation of the system, or an item of interest.

2 About the User Manual

This User Manual has been written for the actual user (e.g., laboratory technician) and provides information on the Thermo Scientific Multiskan EX photometric microplate absorbance reader, including installation and operating instructions.

Read the manual in its entirety prior to operating the instrument.

This User Manual has been designed to give you the information you need to:

- Review safety precautions
- Install the Multiskan EX
- Carry out photometric measurement and calculation procedures
- Perform basic maintenance procedures
- Troubleshoot the instrument performance
- Maintain the instrument

This User Manual also describes features and specifications of the Multiskan EX hardware and on-board software in Chapter 9 Technical Specifications.

Chapter 6 explains the operating procedures.

The user should be familiar with the contents of Chapter 7 on maintenance.

For warranty and ordering information, refer to Chapters 10 Ordering Information and 11 Warranty Certificate.

3 Introduction to the Multiskan EX

The Multiskan EX is a standalone photometric microplate absorbance reader including internal software. The Multiskan EX can also be controlled by a computer.

Your local Thermo Fisher Scientific representative can arrange instrument training at the commissioning of the instrument for extra charge, if required.

3.1 Intended use

The Multiskan EX is a microplate photometer for measuring absorbance from suitable microplates and strips in 96-well plate format mentioned in this manual that meet the SBS standards. The Multiskan EX can be used in research or routine-test laboratories by professional personnel.

For verification of the entire system, it is recommended that Good Laboratory Practices (GLP) be followed to guarantee reliable analyses.

Use for self-testing is excluded.

If the analyzing performance is critical to the medical diagnosis, the diagnostic test result has to be ensured with internal quality contols or with an alternative test.

3.2 Principle of operation

The Multiskan EX is an eight-channel vertical light path filter photometer designed to perform standard photometric measurements.

The versatile onboard software of Multiskan EX allows end point and kinetic reading modes. Flexible cutoff calculations and curve fit algorithms give Multiskan EX increased flexibility for data manipulation in various diagnostic applications. The extended memory holds up to 64 assay protocols. It comprises the following keyboard selectable software packages (program modules): Primary EIA, Cutoff, and Cubic spline. Each package is a combination of different measurement and calculation modes (see Section 4.2). Each mode is self-prompting, which reduces the error factor and simplifies operation.

The wavelength (400 – 750 nm) is selected using maximum eight high-quality interference filters held in a filter wheel. Standard filters, i.e., 405 nm, 450 nm and 620 nm, are included in the Multiskan EX.

The readings can be processed via a serial RS-232C interface or via a parallel Centronics type printer interface.

3.3 Advantages of using Multiskan EX

The Multiskan EX provides several advantages relating mainly to the principle of operation in that it has:

- A proven optical system
- A flexible internal software
- Software for PC control
- Exceptional reliability
- An extended 3-year warranty

4 Functional Description

4.1 Measurement principle

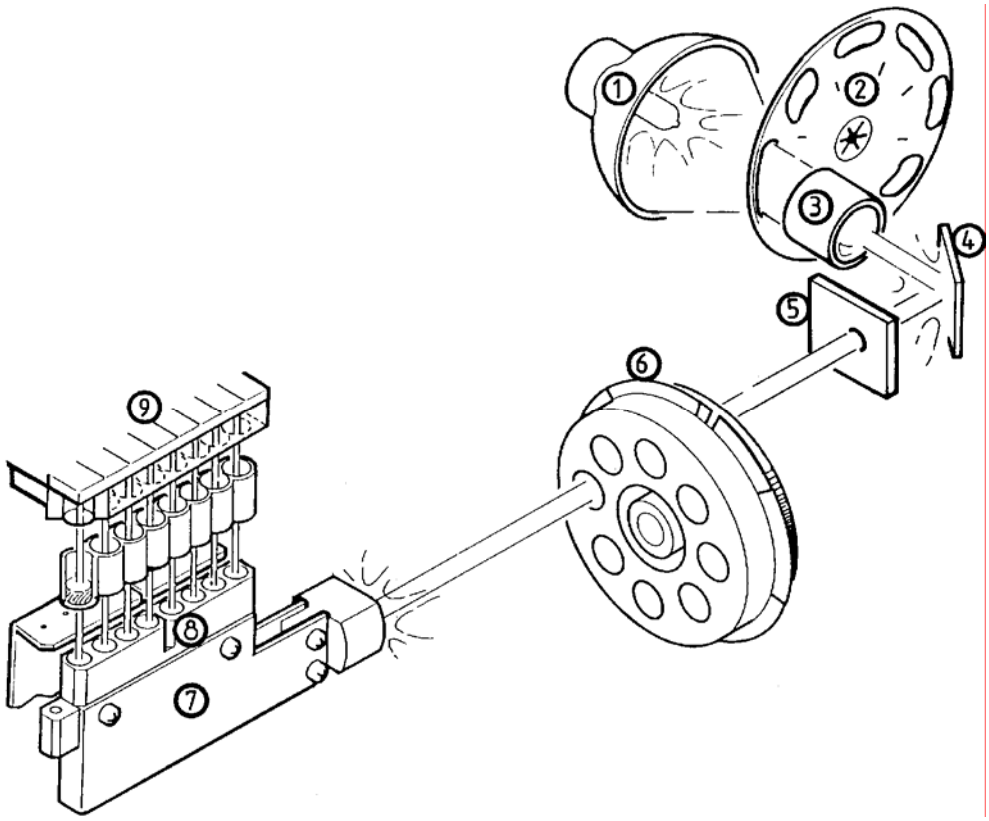
Photometric measurement

The Multiskan EX utilizes the original Thermo Fisher Scientific Oy concept of vertical photometry in which the light beam passes through the whole sample. In vertical photometry, the absorption of light is proportional to the amount of light-absorbing substance in the well.

The advantages of the vertical light path measurement are:

- Inaccurate pipetting of non-absorbing liquids does not affect the measured absorbance values.
- Evaporation of non-absorbing liquids during the reaction does not affect the measured absorbance values.
- A certain degree of non-homogeneity in the solution, for example, as a result of layering in turbidity measurements, does not affect the results.

The optical system comprises the following components (Fig. 4.1):



1. Quartz-halogen lamp
2. Chopper wheel
3. Aperture and condenser lens
4. Semitransparent mirror
5. Aperture
6. Interference filter (filter wheel)
7. Optical fiber bundle
8. Focusing lenses
9. Upper lenses and detectors

Fig. 4.1 Optical system

Light source

The light source is a quartz tungsten halogen lamp (Osram 64607A, 8V/50W), equipped with an aluminum-coated elliptical reflector.

To prolong the useful life of the lamp, switch off the instrument when it is not in use. A warm-up period of one (1) minute has to be allowed before you measure.

Chopper wheel

The chopper wheel chops the light beam to minimize electronic noise.

Semitranslucent mirror

After passing through the condenser lens, the light beam impinges on the semitranslucent mirror. Part of the visible light and all longer wavelengths pass through the mirror and the UV, whereas the rest of the visible light is reflected. This arrangement eliminates heating the interference filter and evens out the spectral intensity distribution.

Interference filter

The wavelength is selected from one to eight (1 to 8) filters held in the filter wheel.

Optical fiber bundle

After passing through the interference filter, the light beam reaches the common end of the optical fiber bundle that refracts the beam into eight (8) equal parallel beams and deflects the beams upwards.

Focusing lenses

After being refracted, the light passes through a focusing system of eight (8) lenses.

Detectors

The light beams pass through the bottom of the wells through the samples via the upper lenses to the detectors, which measure the intensity of light.

4.1.1 Vertical measurement principle

In vertical photometry the light beam enters the cuvette through its bottom (i.e., optic window) and then passes through the surface of the solution to a detector. It follows from this optical arrangement that the absorbance depends on the amount of absorbing substance in the cuvette and not on the concentration explained below.

According to the Lambert-Beer's law:

$$\mathbf{A} = \varepsilon * \mathbf{l} * \mathbf{c},$$

where:

A = absorbance (**Error!**)

ε = molar absorbtivity (cm^{-1} mol^{-1} l)

l = path length (cm)

c = concentration (mol/l)

When we have:

$$\mathbf{c} = \frac{\mathbf{n}}{\mathbf{V}} \quad \text{and} \quad \mathbf{l} = \frac{\mathbf{V}}{\mathbf{a}} ,$$

where:

n = amount of the absorbing substance (mmol)

V = volume of the solution in the well (ml)

a = cross-sectional area of the well (cm^2)

By substituting **c** and **l** in the Lambert-Beer's law we will get:

$$\mathbf{A} = \boldsymbol{\varepsilon} * \frac{\mathbf{V}}{\mathbf{a}} * \frac{\mathbf{n}}{\mathbf{V}} = \varepsilon * \frac{\mathbf{n}}{\mathbf{a}}$$

and

$$\mathbf{n} = \frac{\mathbf{a}}{\boldsymbol{\varepsilon}} * \mathbf{A}$$

When **a** and **ε** are constants, the sample concentration can be calculated directly from the absorbance (**A**) when the molar absorbtivity (**ε**, in cm^{-1} mol^{-1} l) and cross-sectional area of the well are known.

4.1.2 Surface of the liquid in a cuvette

Since the free surface of the solution in the cuvette will form the "second window" through which the light passes, the properties of this surface are important for accurate measurement. It is obvious that bubbles or foam on the surface will scatter light in all directions and make photometry inaccurate. Experience shows that bubbles or foam are seldom a practical problem if proper procedures in pipetting are followed, e.g., the use of reverse technique in pipetting solutions which tend to foam easily.

Diluted aqueous solutions generally produce an even, flat surface, which functions as a second window of the cuvette in the normal way. However, in many cases considerable concentrations of protein are present, or detergents are used to avoid turbidity. In these cases the surface is concave and Fig. 4.2 demonstrates the consequence.

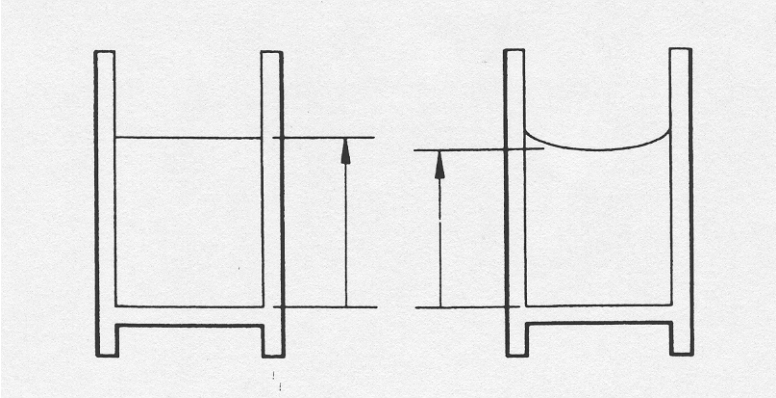
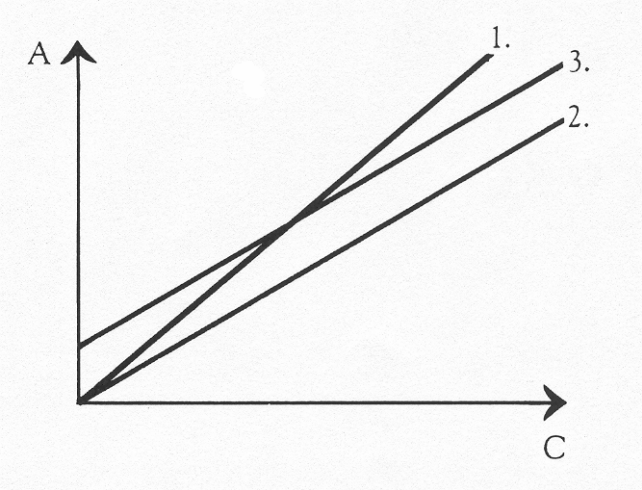


Fig. 4.2 Flat and concave liquid surfaces

The height of the column of solution will be reduced in the center of the cuvette, where almost all light passes. Although the volume remains the same,

the effective light path is shortened, and the apparent absorbance of a given amount of light absorbing substance in the cuvette is reduced. Practice shows that in most cases the absorbance is reduced approximately by a factor of 0.9. If a calibration curve is prepared, it will have a lesser slope than the "ideal" curve. This effect is shown in Fig. 4.3, curves 1 (ideal) and 2 (actual).



1. Ideal curve
2. Actual curve due to shorter height of column of the concave liquid surface
3. Standard curve due to negative lens effect of the concave liquid surface

Fig. 4.3 Calibration curves

The concave surface of the solution causes another effect also, which will affect photometry. This effect arises from the fact that the concave surface functions as a negative lens (Fig. 4.4). The cone of the light leaving the surface will be wider, and some of the light is diverted enough to bypass the detector. Surfaces with identical curvature will cause equal losses of light at the detector and equal increase in the apparent absorbances at all absorbance values. The absorbance will be increased by an additive amount, and the "standard curve" will have the same slope as the actual curve, but intersects the absorbance axis above the origin as shown in Fig. 4.3, item 3.

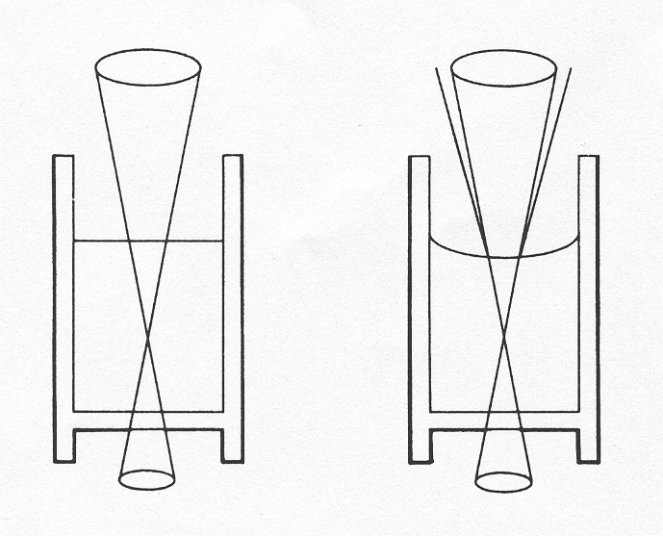


Fig. 4.4 Concave liquid surface acting as a negative lens

In practice, this phenomenon must be taken into account in all end-point determinations, but not, however, in two-point or kinetic determinations, where the result is based on the absorbance difference. The correction is made by using the *blank cuvette block with a similar surface* to the analysis cuvettes.

Because of the difference in the slopes obtained by flat and concave surfaces it is important to have *identical shapes of liquid surfaces in all cuvettes including blank, standard(s) and samples*. This is achieved by using the following standardization and calibration procedures:

1. Determinations having standard solution(s) in assay series (end-point, two-point/standard mode and two-point kinetic methods).
   - If one of the reagents contains protein or detergent, the requirements of identical surfaces in all analyses cuvettes are met.
   - If sample (= serum) is the only protein containing component in the assay, standard solution(s) and reagents being aqueous, the surface tension must be lowered by *adding detergent into the reagent* or by using *protein containing standard and blank* solutions.
2. Determination based on the use of molar absorptivity (two-point/factor mode, kinetic methods).

   In kinetic methods, i.e., in reaction rate measurements, the altered slope of substrate-absorbance dependence curve becomes critical. Therefore it is necessary to use the *corrected molar absorptivity coefficient* to obtain accurate results. In most cases the corrected value of molar absorptivity is about 90% of the literature value (e.g., 340 nm, $\varepsilon_{NADH} = 6.22$ and $\varepsilon_{corr} = 5.66$).

   The corrected values of molar absorptivities are provided in the Multiskan EX applications.

4.2 Program modules

The instrument provides the following functions initiated through the keyboard or computer interface:

- Absorbance measurement
- Shaking
- Data transfer via the parallel port. Sends measurement data and status information to an external printer.
- Data transfer via the serial port. Receives commands from the external computer. Sends data, acknowledgements and status, including appropriate error messages.

The Multiskan EX in-built software comprises program modules, which are combinations of different measurement and calculation modes. See Table 4.1.

Table 4.1 Measurement and calculation modes available in different program modules

Measurement modes	Primary EIA	Cutoff	Cubic spline
absorbance	●	●	●
dual wavelength	●	●	●
two point	●		
kinetic	●		
multiwavelength	●		
computer control	●		
Calculation modes	**Primary EIA**	**Cutoff**	**Cubic spline**
factor	●		
linear standard	●		
standard line	●		
limit	●		
double limit	●	●	
range	●	●	
column subtraction	●		
point-to-point calculation	●		
cutoff		●	
cubic spline			●

4.3 Keyboard

The keyboard of the Multiskan EX comprises 30 keys with click action switches. The keys available are presented in Table 4.2.

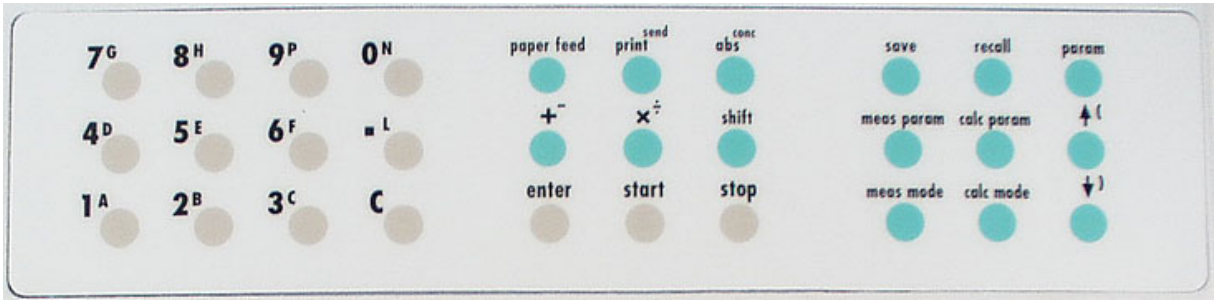


Fig. 4.5 Multiskan EX keyboard

Table 4.2 Keyboard keys

Key	Function
0 – 9 **A – H**	To enter numeric values and microplate positions or operands for cutoff equations. In equations, first press the shift key, then the letter.
P, N, L	Symbols for positive (**P**), negative (**N**) or low positive (**L**) controls to be used in cutoff equations. Press first the shift key.
■	Decimal point
C	To correct data before entering it
print/send, abs^{conc}	To print or send out absorbances or calculation results via the selected interface to the selected printer. See Sections 6.4 and 6.8.1.
paper feed	Feeds paper from the roll of an internal or external printer
+ – x ÷	Operators for cutoff equations. Press first the shift key to enter – and ÷.
shift	To take symbols at the upper right corner of the key into use
enter	To enter modes and parameters
start	To start the measurement
stop	To eject the microplate. The instrument returns to the previous logical state
save	To store user-determined programs in the memory of the instrument
recall	To recall programs stored earlier
meas mode	To select the measurement mode
meas param	To enter the measurement parameters
calc mode	To select the calculation mode
calc param	To enter the calculation parameters
param	To select the general parameters, e.g., RS format and plate movement
↑(	**Arrow (up)**: to scroll backwards in the list of modes or parameters and to change the clock display **Parenthesis (open)**: bracket used in cutoff equations
↓)	**Arrow (down)**: to scroll forwards in the list of modes or parameters and to change the clock display **Parenthesis (close)**: bracket used in cutoff equations

5 Installation

5.1 Installation check list

Table 5.1 Installation check list

Tick	Item
❑	Unpack the Multiskan EX instrument carefully with the arrows on the transport package pointing upwards. Refer to the enclosed packing instructions. Keep the original packaging and packing material for future transportation. Use of alternative packaging materials may invalidate the warranty.
	Caution: To lift the instrument, put your fingers under the bottom on both sides and lift it with your back straight, taking proper precautions to avoid injury. The net weight of the instrument is 11 kg (24 lbs.).
❑	Check the delivery for completeness. Check the enclosed packing list against order. In case of any deviations, contact your local Thermo Fisher Scientific representative.
❑	Check the transport package, the instrument and the accessories for damage during transport. Visually check all interconnections in the basic instrument. Check that there are no loose parts inside the instrument. Refer to Section 5.2.
❑	Place the instrument on a normal laboratory bench taking into account both the environmental and technical prerequisites (Section 9.1). Avoid sites of operation with corrosive vapors, smoke and dust, vibrations, strong magnetic fields, direct sunlight, draft, excessive moisture or large temperature fluctuations. Leave sufficient clearance (at least 10 cm) on both sides and at the rear of the unit.
	Warning: DO NOT operate the instrument in an environment where potentially damaging liquids or gases are present.
❑	Remove the two (2) instrument cover retaining screws (Fig. 5.2, item 6) using the Allen key provided and lift up the cover.
❑	Install the filter wheel. See Section 5.3.1.
❑	Install the lamp. See Section 5.3.2.
	Caution: DO NOT touch or loosen any screws or parts other than those specially designated in the instructions. Doing so might cause misalignment and will invalidate the instrument warranty.
	Caution: DO NOT touch the measuring circuit board by hand.
❑	Connect the printer or the computer cables according to the requirements. See Fig. 5.9, items 4 and 5.
	Caution: DO NOT insert the computer's serial cable to the printer port. This may cause unexpected problems.
❑	If applicable, check the baud rate, transmit/receive pin configuration and the handshake with DIL switches. See Section 5.4.
❑	Connect the mains supply cable to the mains input socket. See Section 5.3.3.
❑	Set up the instrument. See Section 6.9.3.
❑	Perform the operational check. See Section 5.6.

5.2 What to do upon delivery

5.2.1 How to unpack

Move the unpacked instrument to its site of operation. Unpack the Multiskan EX instrument and accessories carefully with the arrows on the transport package pointing upwards. Refer to the enclosed packing instructions. The following notes and instructions are sent with the instrument and are immediately available when you open the package:

- the Warranty Certificate card
- the packing instructions/packing list
- the User Manual
- the Transportation discrepancy report
- the Linearity test printout

Caution: DO NOT touch or loosen any screws or parts other than those specially designated in the instructions. Doing so might cause misalignment and will invalidate the instrument warranty.

To lift the instrument, put your fingers under the bottom on both sides and lift it with your back straight. The net weight of the instrument is 11 kg (24 lbs.).

Caution: When unpacking the instrument, it is recommended that two people lift the instrument together, taking proper precautions to avoid injury.

Retain the original packaging and packing material for future transportation. The packaging is designed to assure safe transport and minimize transit damage. Use of alternative packaging materials may invalidate the warranty. Also retain all instrument-related documentation provided by the manufacturer for future use.

If the optional printer has been ordered, it is included uninstalled. See Fig. 5.1. Please contact technical service for installation.

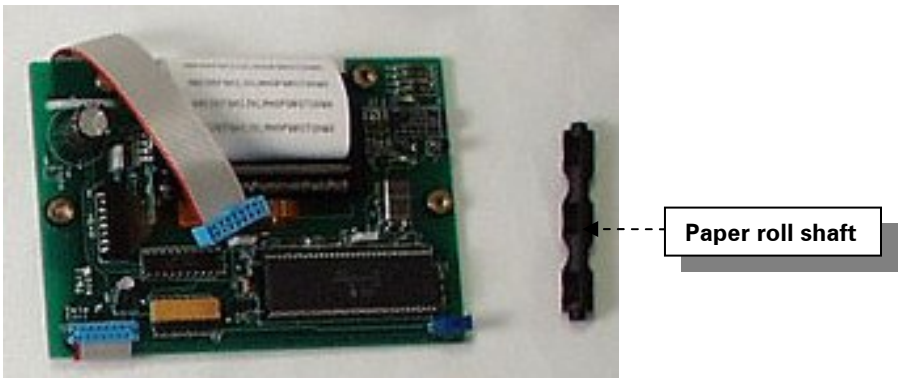


Fig. 5.1 Optional printer as delivered (all parts not visible)

5.2.2 Checking delivery for completeness

Check the enclosed packing list against order. In case of any deviations, contact your local Thermo Fisher Scientific representative or Thermo Fisher Scientific Oy.

5.2.3 Checking for damage during transport

Visually inspect the transport package, the instrument and the accessories for any possible transport damage.

If the transport package has been damaged in transit, it is particularly important that you retain it for inspection by the carrier in case there has also been damage to the instrument.

Neither the manufacturer nor its agents can be held responsible for any damage incurred in transit, but the manufacturer will make every effort to help obtain restitution from the carrier. Upon receipt of the carrier's inspection report, arrangements will be made for repair or replacement.

Visually check all interconnections in the basic instrument. Check that there are no loose parts inside the instrument.

If any parts are damaged, contact your local Thermo Fisher Scientific representative or Thermo Fisher Scientific Oy.

5.2.4 Environmental requirements

When you set up your Multiskan EX, avoid sites of operation with excess dust, vibrations, strong magnetic fields, direct sunlight, draft, excessive moisture or large temperature fluctuations.

- Make sure the working area is flat, dry, clean and vibration-proof and leave additional room for accessories, cables, reagent bottles, etc.
- Leave sufficient space (at least 10 cm) on both sides and at the back of the unit to allow adequate air circulation.
- Make sure the ambient air is clean and free of corrosive vapors, smoke and dust.
- Make sure the ambient temperature range is between +10°C (50°F) and +40°C (104°F).
- Make sure relative humidity is between 10% and 90% (non-condensing).

The Multiskan EX does not produce operating noise at a level that would be harmful. No sound level measurements are required after installation.

Warning: DO NOT operate the instrument in an environment where potentially damaging liquids or gases are present.

5.2.5 Things to avoid

DO NOT smoke, eat or drink while using the Multiskan EX. Wash your hands thoroughly after handling test fluids. Observe normal laboratory procedures for handling potentially dangerous samples. Use proper protective clothing. Use disposable gloves. Ensure that the working area is well ventilated.

Never spill fluids in or on the equipment.

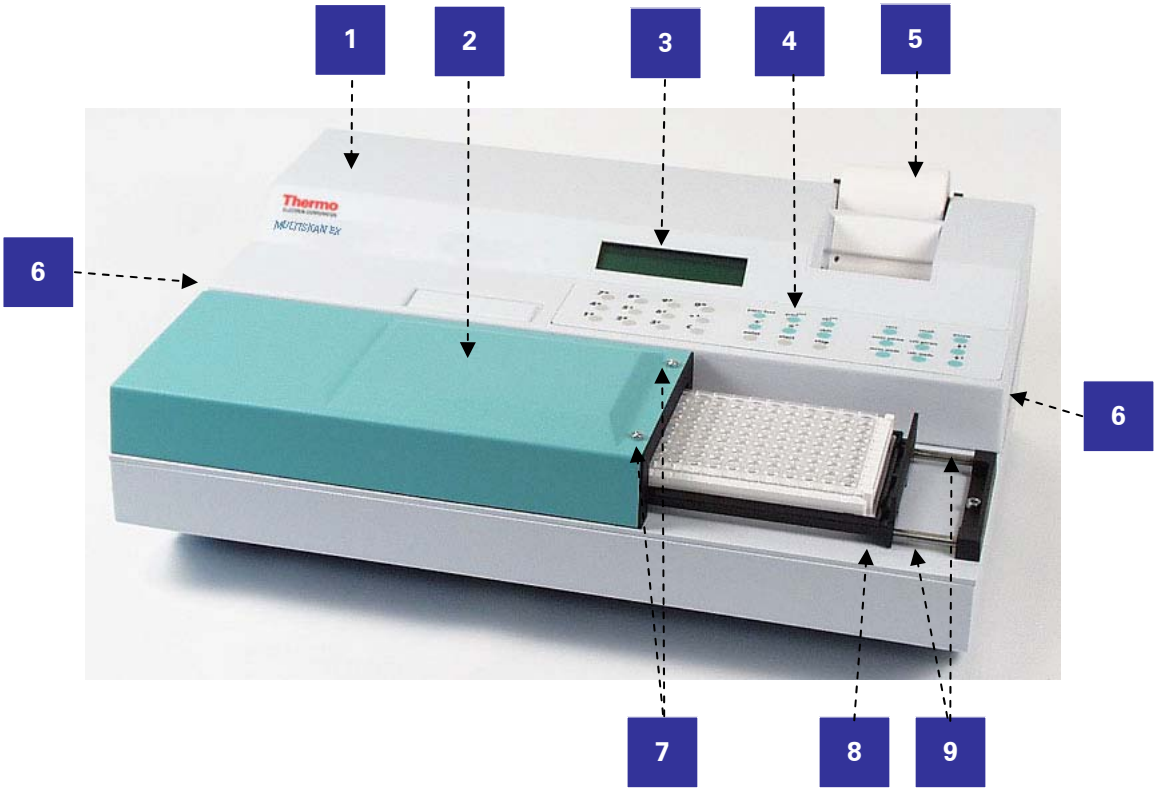
Only use the instrument for the purpose it is intended for. Refer to Section 3.1.

5.2.6 Technical prerequisites

Place the instrument on a normal laboratory bench. The net weight of the instrument is 11 kg (24 lbs.).

The instrument operates at voltages of 100 – 120 Vac, 220 – 240 Vac and the frequency range 50/60 Hz.

5.3 Instrument layout and installation



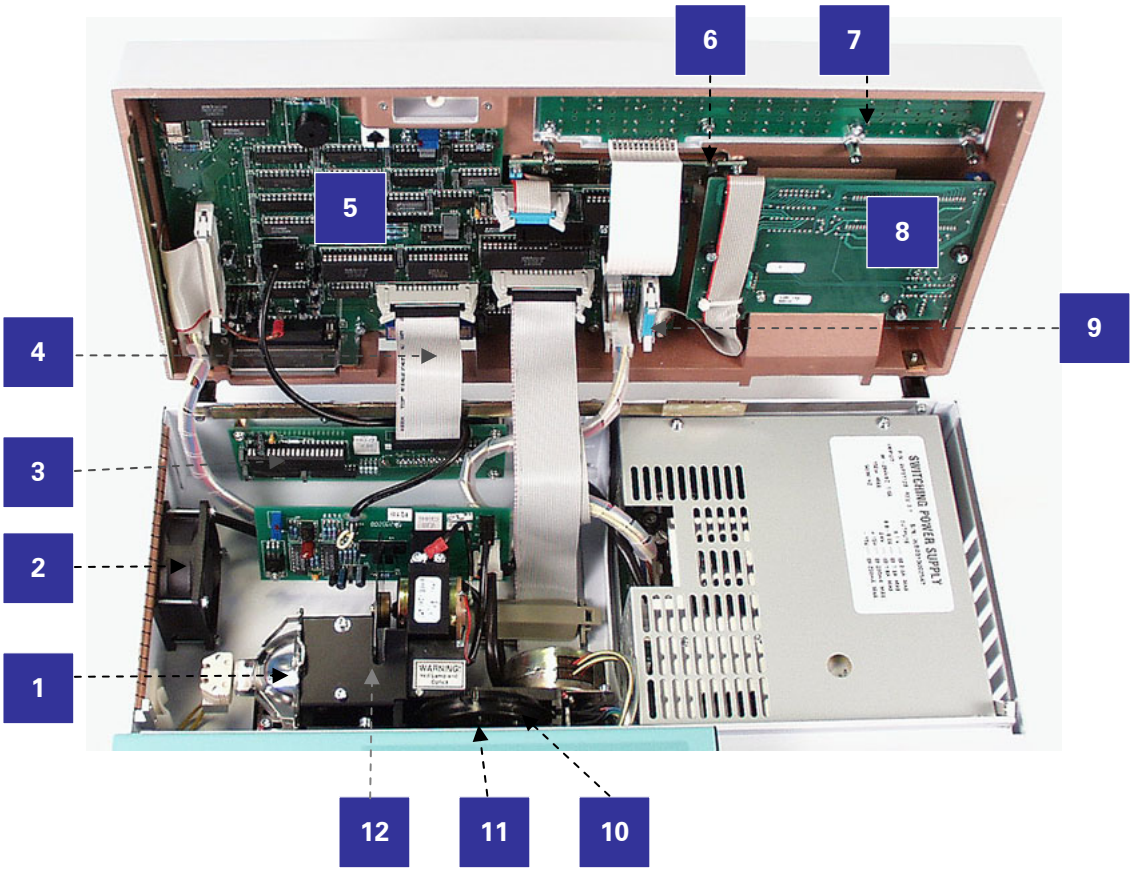
1. Instrument cover
2. Measurement assembly cover
3. Display
4. Keyboard
5. Printer (optional)
6. Retaining screws (2) of the instrument cover
7. Retaining screws (2) of the measurement assembly cover
8. Plate carrier
9. Transfer rails

Fig. 5.2 Multiskan EX front view

1. Unpack the instrument. See Section 5.2.1.
2. Remove the two (2) instrument cover retaining screws (Fig. 5.2, item 6) using the Allen key provided and lift up the cover.
3. Install the filter wheel and the lamp. See Sections 5.3.1 and 5.3.2.
4. Connect the printer or the computer according to the requirements. See Fig. 5.9, items 4 and 5.

Caution: DO NOT insert the computer's serial cable to the printer port. This may cause unexpected problems.

5. Check the baud rate, transmit/receive pin configuration and the handshake with DIL switches. See Sections 5.4.2, 5.4.3 and 5.4.3.
6. Plug into mains. See Section 5.3.3.
7. Setup the instrument. See Section 6.1.



1. Lamp
2. Fan
3. MUCEN circuit board
4. Connector for Centronics interface, optional RS-232C interface or optional IEEE-488 interface
5. MUSCU/2A processor circuit board
6. Liquid crystal display (LCD) circuit board
7. NAPSU2 (keyboard) circuit board
8. SCANPRI2 (printer) circuit board (optional)
9. Connector for built-in printer (optional)
10. Filter wheel
11. Filter wheel slot
12. Chopper

Fig. 5.3 Multiskan EX internal view

5.3.1 Installing the filter wheel

1. Unpack the filter wheel. It is delivered in a filter wheel box. Check that all filters are clean and undamaged.

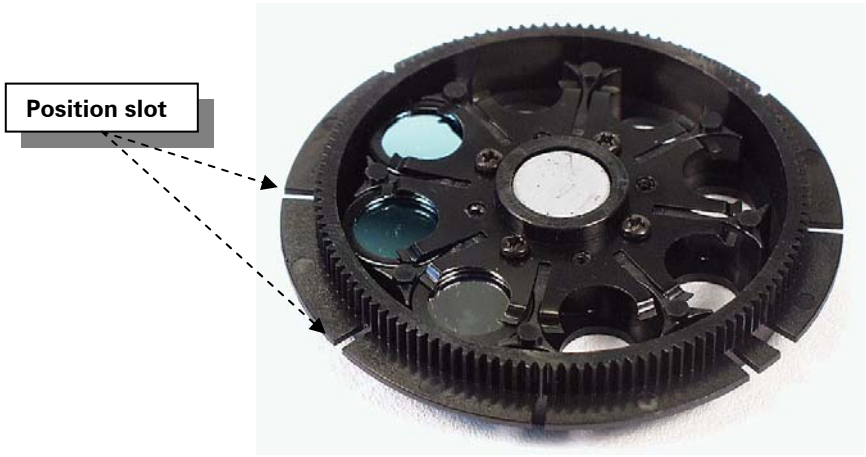


Fig. 5.4 Multiskan EX filter wheel

Caution: DO NOT touch the filters with your bare fingers.

Caution: When installing the filter wheel and the lamp, do not touch any other mechanical or electronic part.

2. Place the filter wheel into the filter slot (Fig. 5.5) so that the toothed edge faces towards the rear of the instrument. A magnet locking mechanism will automatically lock the wheel in the correct position and the optical filter position sensor will make sure that the correct filter is used during measurement.

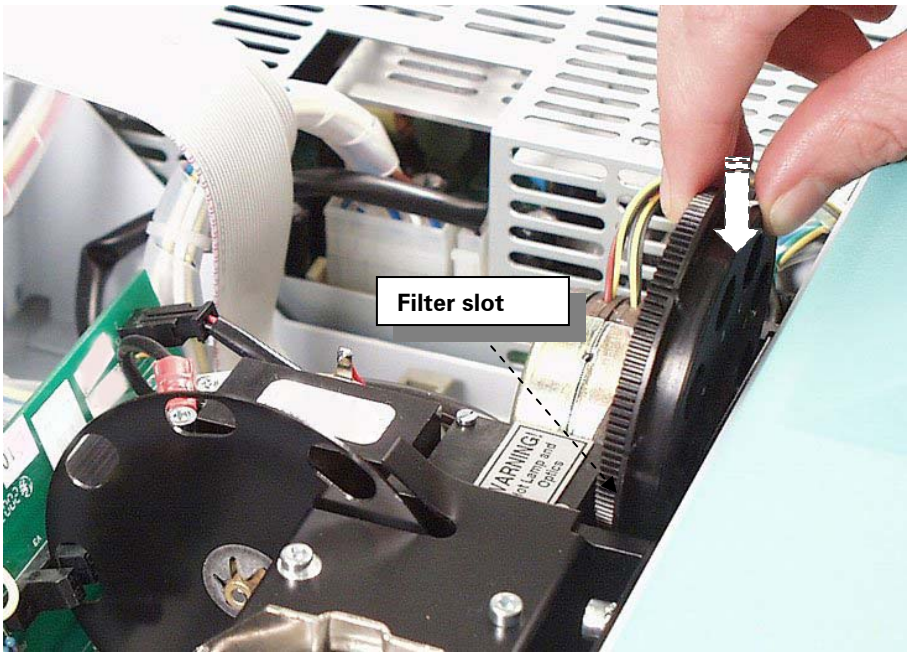


Fig. 5.5 Placing the Multiskan EX filter wheel into the filter slot

If the filter wheel seems to be "jumping" in the slot, you have inserted the wheel in a wrong way and the magnet is rejecting it. Turn the wheel over.

5.3.2 Installing the lamp

Warning: Only use the lamp approved by the supplier: Cat. no. 2400620, Lamp, quartz tungsten halogen lamp (Osram 64607A, 8V/50W).

1. Unpack the lamp.

Caution: DO NOT touch the reflecting surface of the lamp or the bulb itself.

2. Release the terminal socket wire from its transportation holder located inside the instrument.
3. Hold the terminal socket vertically and the lamp so that the claw is pointing upwards. Fit the lamp contacts to the terminal socket (Fig. 5.6). Press the lamp tightly to fit it properly (Fig. 5.7).

Caution: When fitting the lamp contacts, be careful not to bend the contacts. This might cause the bulb to detach from the lamp.

Warning: If the instrument has been in use and you need to replace a burned lamp, the lamp can be very hot. Wait for the lamp to cool down before replacing it.

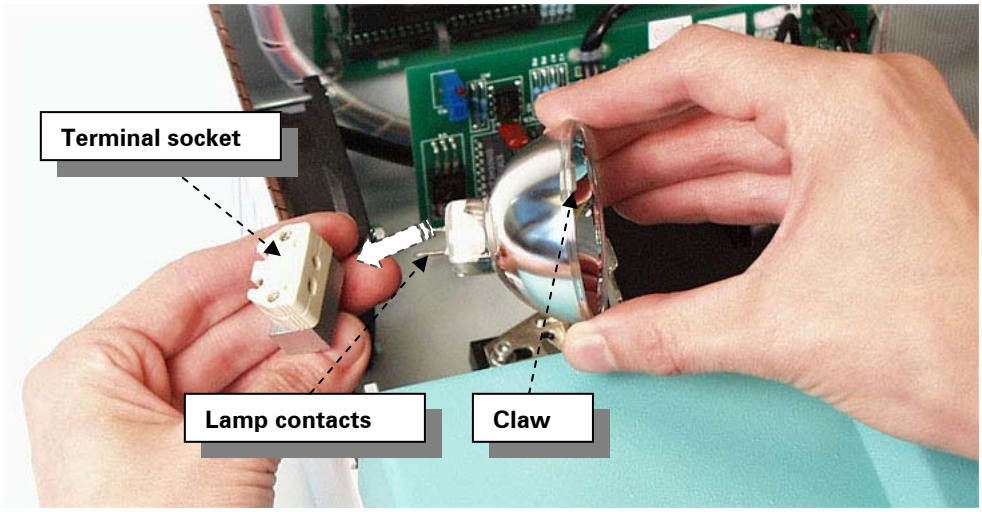


Fig. 5.6 Fitting the lamp contacts

4. Place the lamp in its place so that the claw in the lamp fits in the groove (Fig. 5.7). Push the lamp all the way down.

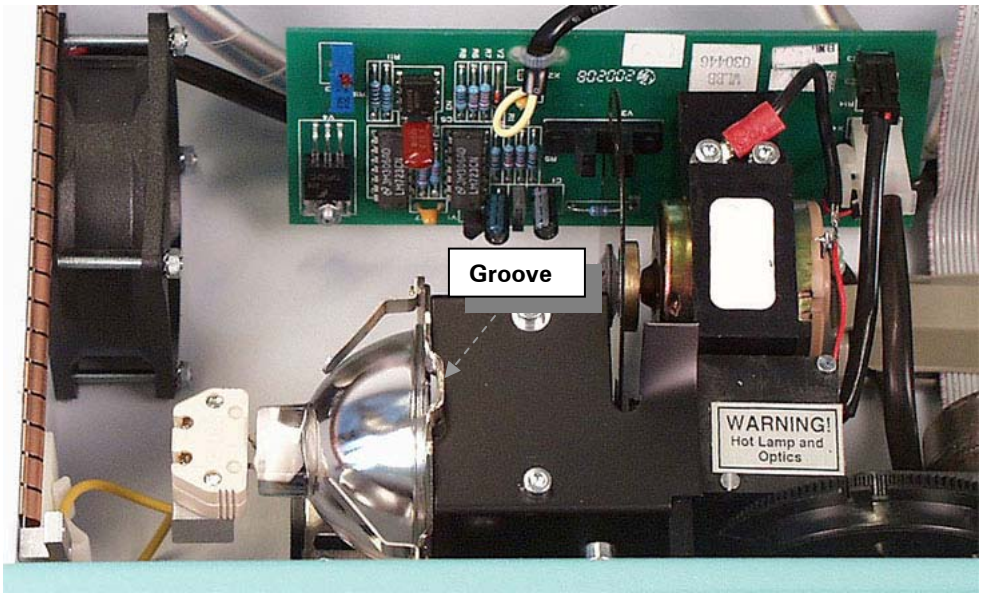


Fig. 5.7 Lamp in its place

5. Visually check that there are no loose parts inside the instrument.
6. Close the instrument cover and replace the two cover retaining screws.

5.3.3 Adjusting the plate carrier for different microplates

The plate carrier has been adjusted for the Microtiter 96-well plates. However, each manufacturer's plates have slightly different dimensions. The plate carrier can therefore be adjusted to suit the used plate type. Take into account he following considerations:

- The plate must not move in the x-direction at all. When the Multiskan EX is used for shaking the samples, if there is even a small gap, the plate may spill the contents.
- You must be able to insert the plate into the plate carrier easily without using force. This is especially important when using robots.
- Both ball screws must be level. The plate may otherwise stay tilted, especially when using robots.

Adjust the plate carrier using the screws on the right side (Fig. 5.8).

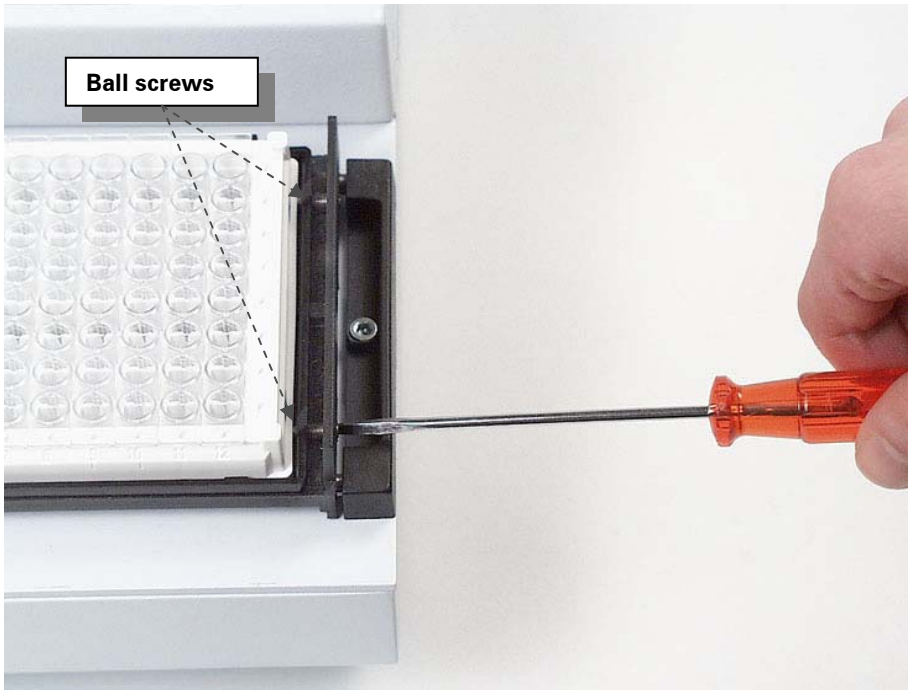
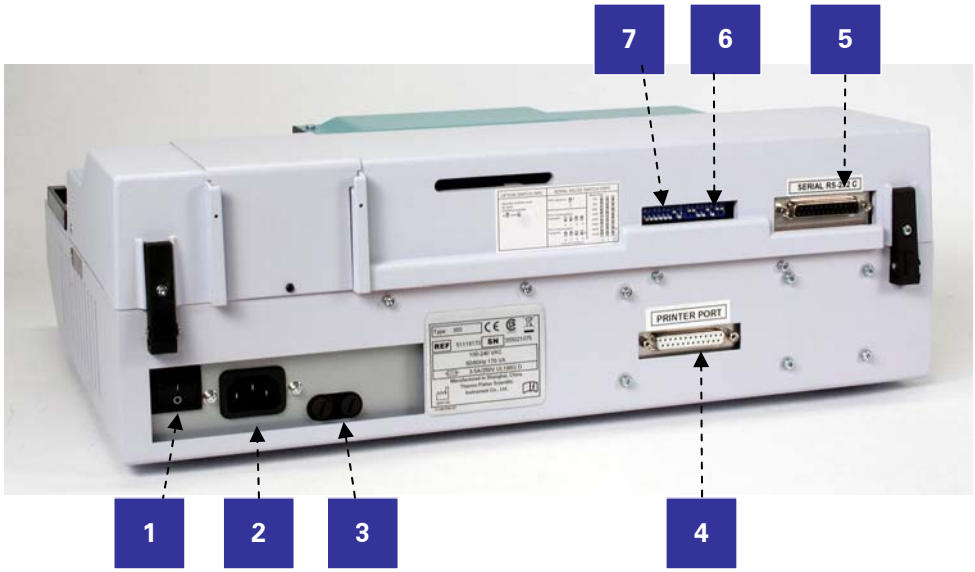


Fig. 5.8 Adjusting the plate carrier

5.3.4 Mains supply cable

Warning: Never operate your instrument from a power outlet that has no ground connection. Never use a mains supply cable other than the Thermo Scientific mains supply cable designed for your region. Make sure that the protective conductor inside or outside the instrument is never interrupted and that the protective conductor terminal is not disconnected.

1. Ensure that the mains switch (Fig. 5.9, item 1) at the back of the instrument is in the OFF (**O**) position.
2. Connect the mains supply cable to the mains input socket (Fig. 5.9, item 2) at the back of the instrument.
3. Connect the instrument to a correctly installed line power outlet that has a protective conductor that is grounded.



1. Mains switch
2. Mains input socket
3. Fuses
4. Parallel port (LPT) for an external printer
5. RS-232C interface connector for a computer
6. Serial RS-232C DIL switches
7. Secondary interface DIL switches

Fig. 5.9 Multiskan EX rear view

5.4 Connecting to a computer or a printer

Data transfer to a computer occurs via a built-in serial RS-232C interface.

Data transfer to a printer may occur via a built-in RS-232C interface or via a parallel Centronics interface.

5.4.1 Interface hardware specifications for the RS-232C interface

The hardware specifications for the interface are as follows:

1. The configuration is specified as for data terminal equipment (DTE).
2. You can select the baud rate (i.e., the speed at which data is changed between an external computer and the instrument) through the DIL switches at the rear of the instrument (see Section 5.4.2). The following baud rates are available: 150; 300; 600; 1200; 2400; 4800; 9600, and 19200. **The baud rate 9600 is set by the manufacturer.**
3. The character format is 10 bits with 1 start bit, 8 data bits, 1 stop bit and no parity. The format cannot be changed.
4. It is recommended to use the DTR/DSR handshake. The handshake type used is set by the manufacturer. You can select the desired alternative through a DIL switch at the rear of the instrument (see Section 5.4.3).
5. The transmit/receive pin configuration is: pin 2 transmits and pin 3 receives or vice versa. You can select the desired configuration through the DIL switches at the rear of the instrument (see Section 5.4.4).
   The following configuration is set by the manufacturer:
   pin 2 transmits and pin 3 receives.

The factory set DIL switch positions are given in Fig. 5.10. The position 4 in the secondary interface DIL switches (Fig. 5.9, item 7) is reserved for service use and it should always be in down position. The positions 5 to 8 in the secondary interface DIL switches are not in use and it is recommended that they are in down position.

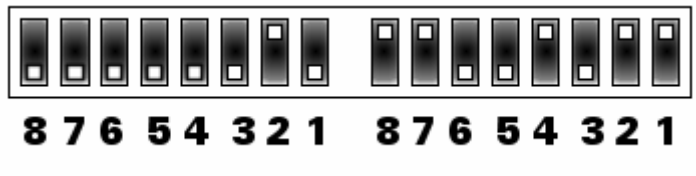


Fig. 5.10 Factory set DIL switch positions, viewed from the rear as shown in Fig. 5.9.

5.4.2 Baud rate selection

You can select the baud rate (i.e., the speed at which data is changed between the Multiskan EX and the computer) through the DIL switches 1, 2 and 3 (Fig. 5.11).

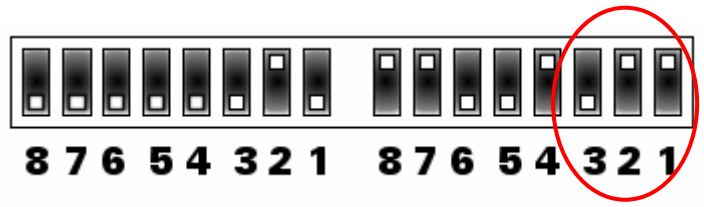


Fig. 5.11 DIL switch positions 1, 2 and 3 for baud rate selection

Table 5.2 DIL switch positions for baud rate selection

Switch position			Baud rate	
3	2	1		
down	down	down	150	
up	down	down	300	
down	up	down	600	
up	up	down	1200	
down	down	up	2400	
up	down	up	4800	
down	up	up	9600	set by the manufacturer
up	up	up	19200	

To determine which baud rate is necessary for any given computer/printer:

1. Consult the operating manual supplied with the computer (or printer)
2. Contact the dealer from which the computer (or printer) was purchased
3. Contact the computer (or printer) manufacturer.

5.4.3 Handshake selection

DTR / DSR handshake

The DTR/DSR hardware handshake makes it possible for two devices connected via the RS-232C line to check readiness before exchanging data or commands.

DSR, Data Set Ready (pin 6)

When the DSR handshake is used, the high (positive) state indicates that the printer or computer is ready to accept a data character. The low (negative) state indicates that the printer or computer is busy and not ready to accept a data character. Thus before sending each character, the Multiskan EX waits until the other device sets the DSR line to the high state.

The DSR handshake is switched ON or OFF through DIL switch 4 (Fig. 5.12).

Fig. 5.12 DIL switch position 4 for handshake selection

Table 5.3 DIL switch position for handshake

Switch 4 position	Handshake
up	enabled (set by the manufacturer)
down	disabled

When the DSR handshake is switched OFF, the Multiskan EX does not test the DSR before sending each character.

The state of the DTR (pin 20) can always be checked by a computer regardless of the fourth DIL switch.

5.4.4 Transmit / receive pin configuration

In order to make a connection between the Multiskan EX and the computer easier, pin 2 can be selected to transmit or receive and pin 3 to do vice versa.

The configuration is selected through the DIL switches 5, 6, 7 and 8 (Fig. 5.13).

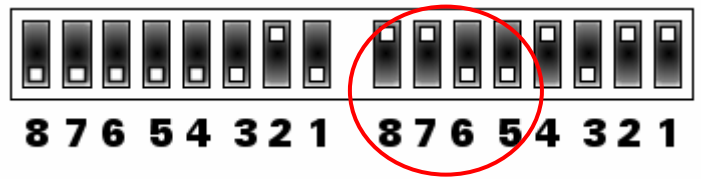


Fig. 5.13 DIL switch positions 5, 6, 7 and 8 for transmit / receive selection

Table 5.4 DIL switch positions for transmit / receive selection

Switch position				Transmit / receive pin
8	7	6	5	
up	up	down	down	pin 2 transmits and 3 receives (set by the manufacturer)
down	down	up	up	pin 2 receives and 3 transmits

5.4.5 Parallel Centronics type printer interface

Data transfer via a parallel Centronics type printer interface is performed through the Centronics interface (Fig. 5.9, item 4).

When using the Centronics interface, the secondary interface DIL switches 1, 2 and 3 (Fig. 5.14) should be positioned as follows:

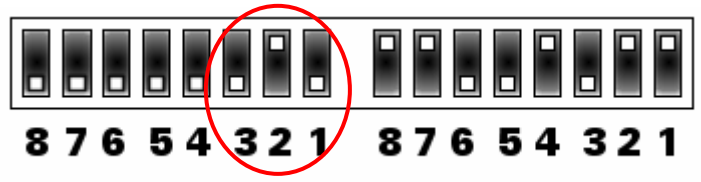


Fig. 5.14 Secondary DIL switch positions 1, 2 and 3 for Centronics type printer interface

Table 5.5 Secondary DIL switch positions for Centronics type printer interface

Switch position			
3	2	1	
down	up	down	Centronics type printer interface in use (recommended)
down	up	up	The results are sent simultaneously via the Centronics and RS-232C interfaces.

5.4.6 Signals connected to the DB-25 connector

The following signals are connected to the DB-25 connector at the rear of the instrument (Fig. 5.9, item 5):

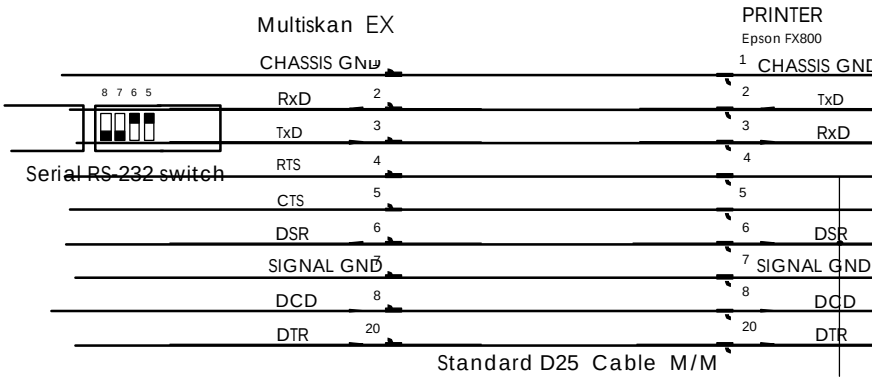
Table 5.6 Data signals connected to the DB-25 connector

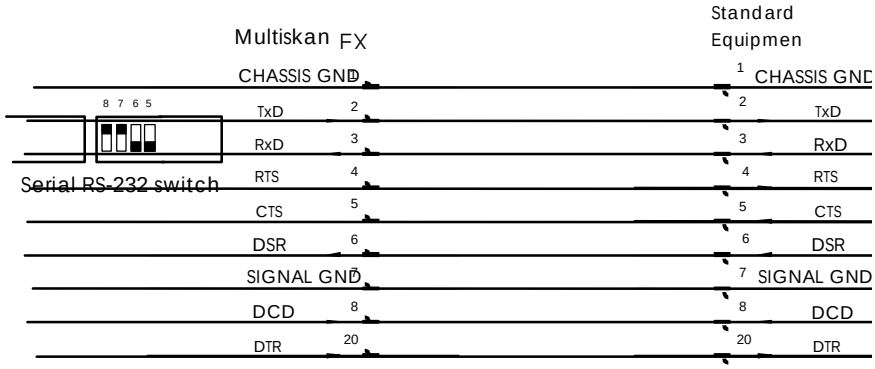
RS-232C port DB-25 connector	
Pin no.	**Signal name**
2	TxD or RxD
3	RxD or TxD
6	DSR
7	GND
20	DTR

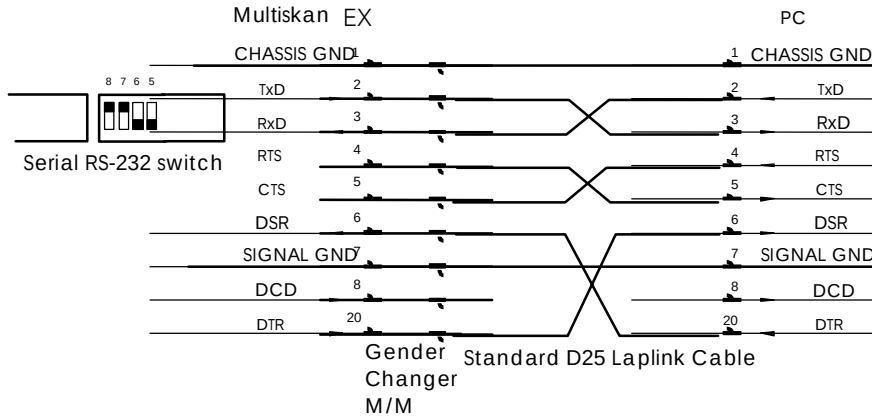
Signal description:

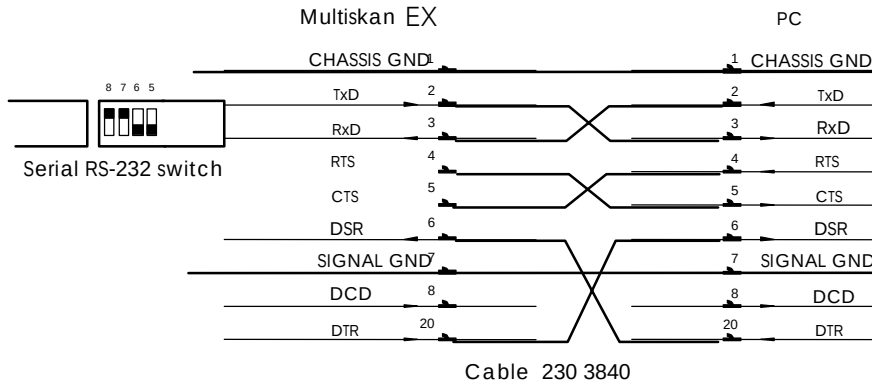
2. TxD, Transmit Data output (or RxD, Receive Data input)
3. RxD, Receive Data input (or TxD, Transmit Data output)
6. DSR, Data Set Ready. The input tells the Multiskan EX that the printer or computer is ready.
7. GND, signal ground
20. DTR, Data Terminal Ready. The DTR is in the high state when the Multiskan EX is ready to receive a command.

5.4.7 Interface connections









5.5 Computer Control

In the primary EIA program, you can use an external computer to substitute the keyboard use of the Multiskan EX.

Note: Operate the instrument only with software and hardware specifically designed or selected for it. The instrument does not verify the logic flow of the received commands. Thermo Fisher Scientific assumes no liability for the use of third-party software applications.

Computer control takes place via the RS-232C interface.

Start the computer mode by selecting measurement mode 6 (computer control). The computer can also start the computer mode by sending an R command after the instrument displays READY and the instrument has set the DTR to the high state.

Press either the **stop** key or send a Q command to return to keyboard use.

5.5.1 Computer control commands

In the computer control mode, the Multiskan EX responds to the following commands:

Table 5.7 Computer control commands

Command	Function
R	Starts the computer control
F1...F8	Filter selection
FMnn...n	An individual filter is selected for each column. (n = filter number, numbers from 1 to 8 can be selected)
E0	Selection of a continuous plate movement
E1	Selection of a stepping plate movement
C	The current program module number is sent.
Cn	Selection of program module, n = 1 – 3, where 1 = Primary EIA module 2 = Cutoff module 3 = Cubic spline module

Note: After selecting a new program module, autocalibration takes place (25 s). A new **R** command has to be entered now in order to return to the computer control.

A	Air blank
B	Reagent blank on column defined by command S
P	Measuring the whole plate and sending the results via the interface in microplate format
PM	Measuring the whole plate using an individual filter for each column and sending the results via the interface in microplate format
Pn	Measuring the whole plate n times (n = 1 – 99) and sending the results via the interface in microplate format
Mn	Measuring n columns commencing from the starting column (n = 1 – 12)
Sj	Determining the relative starting column (j = 1 – 12)

Continued

Table 5.7 Computer control commands

Command	Function
I	Initializing the starting column so that the absolute starting column is 1 Example: I LF S2 LF M4 LF (columns 3, 4, 5 and 6 are measured)
O	Driving the plate out and initializing the starting column so that the absolute starting column is j Example: O LF S2 LF M4 LF (columns 2, 3, 4 and 5 are measured)
X1	Set the shaking speed to maximum. This speed is selected as default.
X2	Set the shaking speed to 66% of the maximum.
X3	Set the shaking speed to 33% of the maximum.
Zn	Shaking of the microplate; n is the shaking time in seconds (n = 00 – 60) Example: a shake of 5 s is entered as Z05.
T	Date and time
N	Serial number
V	Version number of the software
Q	Returning to keyboard use

The commands T, N and V can also be used while the instrument displays READY.

Each command must be terminated by LF (line feed). The Multiskan EX disregards spaces before the command. Up to 48 extra characters between the command and LF will be ignored.

5.5.2 Acknowledgement messages in Primary EIA program module

The Multiskan EX acknowledges each command by sending a message. The following messages are used:

OK	The action has been successfully performed.
ER1	Error (see Section8 Troubleshooting).
ER3	An invalid command that the Multiskan EX was not able to understand.

The P and PM commands are acknowledged by sending values for the measured wells. The data flow to the computer is a follows:

DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF
DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF
DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF
DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF
DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF
DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF
DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF
DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA DATA CRLF

where

CRLF	=	carriage return and line feed, and
DATA	=	6 characters, where the first character can be a space or a minus sign and the remainder can be digits or decimal points.

The V command sends the text MULTISKAN VERSION X.Y (where X can be 1...9 and Y can have 1 to 8 characters) as an acknowledgement message.

The T command is acknowledged by sending XX. XXX 20XX XX:XX:XX (example: 19. MAR 2003 20:42:03).

The N command is acknowledged by sending SERIALX...X, where X can be 0...9, - or space (example: SERIAL352-00001).

5.5.3 Availability of computer control commands

Table 5.8 Availability of computer control commands in different program modules

Command	Meaning	MOD 1 Primary EIA	MOD 2 Cut Off	MOD 3 Cubic Spline
R	Start remote control	●	●	●
Fn	Filter n = 1..8	●	●	●
FMnn	Multifilter nn 12 pcs	●	–	–
En	Measurement mode n=0, 1	●	●	–
C/Cn	Module change n=1..3	●	●	●
A	Air blank	●	●	–
B	Column blank	●	●	–
P/Pn	Plate measure n=1..99	●	●	–
PM	Multifilter measure	●	–	–
Mn	Column measure n=1..12	●	–	–
Sj	Set column j=1..12	●	●	–
O	Initialize column = 0	●	●	–
I	Initialize column = 1	●	●	–
Xn	Mixing speed n=1..3	●	●	●
Zn	Mixing n=00..60	●	●	●
T	Date and time	●	●	●
N	Serial number	●	●	●
V	Software version	●	●	●
Q	Quit remote control	●	●	●

5.6 Operational check

Before you take the instrument into use, make time to perform the following operational check:

1. Connect the printer. Refer to 6.8.1. If the printer is not in use, check that the printer settings are set to off.
2. Switch the instrument on using the power switch at the rear of the instrument (Fig. 5.9, item 1).

   When the instrument is switched on, wait about one (1) minute for the instrument to warm up.
3. Start the preinstalled measurement program in the instrument memory:

   Press **start**
4. Check that the plate carrier moves under the measurement assembly cover (Fig. 5.2, items 9 and 2), that the instrument starts the measurement and that after measurement the plate carrier returns to the original position. No error messages should appear on the display.

   1 PRIMARY EIA
   READY! 12:30

If the instrument does not function properly, contact Thermo Fisher Scientific's service department.

Note: The printer destination is set to external printer as default. If no printer is connected to the instrument, the message NO CENTRONICS PRINTER is displayed. Follow the instructions presented in Section 6.8.1 to set the printer destination according to the instrument configuration.

If you want to perform a verification of the instrument performance, a Thermo Scientific Multiskan Verification plate, Cat. no. 24072800, is available.

6 Operation

6.1 Operation check list

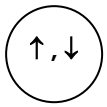
The section on operation will contain an outline of the points mentioned in the check list below.

Table 6.1 Operation check list

Tick	Item
	Make a program:
❑	Program the measurement parameters
❑	Program the calculation parameters
❑	Save the program
	Measure a program:
❑	Recall the program
❑	Start the measurement
❑	**Print the results**
❑	**Shut down the instrument**

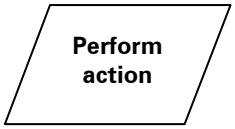
The following symbols are used in the flowcharts below:

Press the key.



You can scroll the list of programming parameters forwards and backwards with the arrow keys. You can also use the number keys to directly select the desired parameter.

Shows the text on the instrument display.

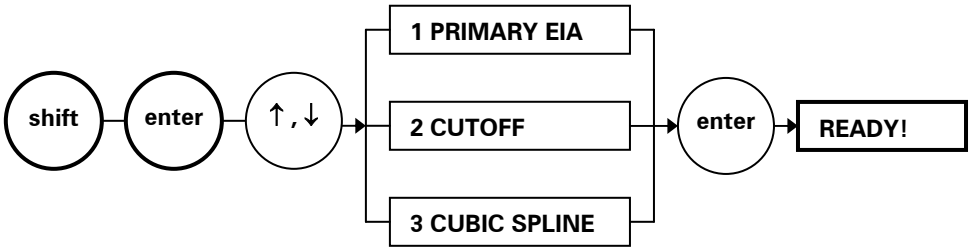


Indicates the actions you should take.

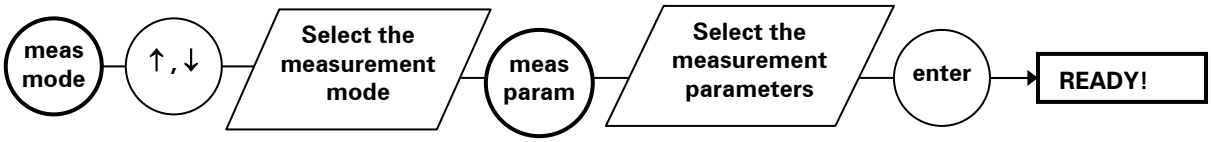
You find a table showing all programming parameters and a detailed description of the different measurements and calculations in Section 6.9.

6.2 Making a program

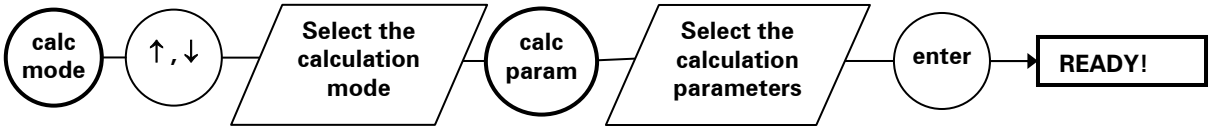
1. Select the program module. See Table 4.1.



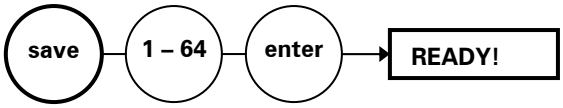
2. Select the measurement mode and measurement parameters.



3. Select the calculation mode and calculation parameters.



4. You have now made a program. Save it to the instrument memory.

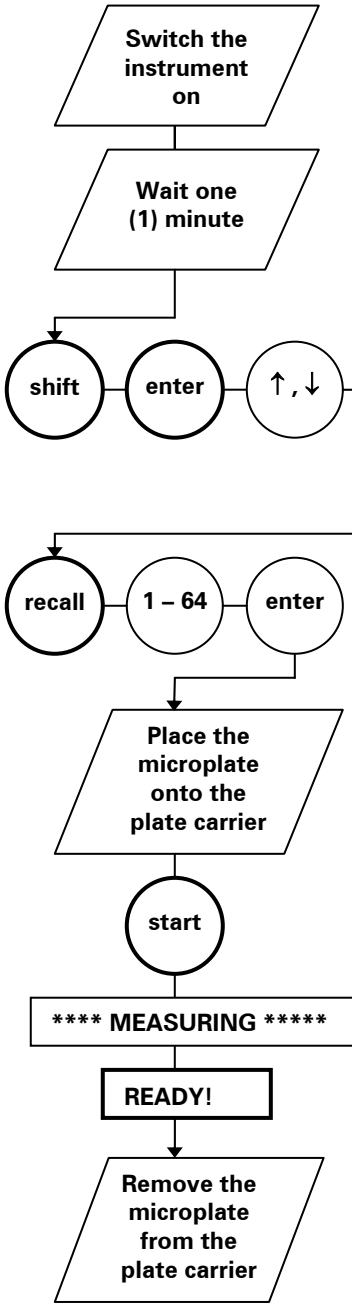


Note: It is recommended to keep a record of stored programs. You can use Table 6.2 for this purpose.

Table 6.2 List of user-defined assay programs

Program no.	Program module	Name of assay and comments

6.3 Measuring



Use the power switch at the rear of the instrument (Fig. 5.9, item 1).

To prolong the useful life of the lamp, switch off the instrument when it is not in use. A warm-up period of one (1) minute has to be allowed before you measure.

Select first the program module.

In the autocalibration procedure the instrument selects the proper light intensity for each installed filter.

Take the stored program into use.

Check that the filter and the plate are correct and that the plate is placed properly on the plate carrier (Fig. 5.2, item 9) with the A1 well in the upper left-hand corner (Fig. 6.1).

It is recommended that the assay include internal quality controls.

The instrument performs the measurement.

After the measurement, the results are printed on the internal printer or sent via the interface and recorded on the external printer or the computer, according to the selection (see Section 6.8.1). Check from the printout that the used general and measurement parameters were as intended.

Caution: Handle the microplate with care to avoid any contamination of the instrument and therefore subsequent specimens. The contamination of the specimen leads to incorrect results.

If the contents of the microplate do spill, however, follow the decontamination procedure given in Section 7.8. Follow also the system supplier's instructions in regard to the external PC software, reagent kit and specimen handling in the event of contamination.

Note: The printer destination is set to external printer as default. If no printer is connected to the instrument, the message NO CENTRONICS PRINTER is displayed. Follow the instructions presented in Section 6.8.1 to set the printer destination according to the instrument configuration.

Warning: If the instrument is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired. See Section 9.1 General specifications.

Caution: Do not use the internal printer without paper. Make sure the paper will not roll between the paper roll and the instrument. Help the paper to pass over the paper roll with your finger, if necessary.

Caution: Do not smoke, eat or drink while using the Multiskan EX. Wash your hands thoroughly after handling test plates. Observe normal laboratory procedures for handling potentially dangerous plates. Use proper protective clothing. Use disposable gloves. Ensure that the working area is well ventilated.

Caution: Never spill fluids in or on the equipment. Prevent any liquid from entering the instrument.

Caution: Immediately wipe away spilled liquids from outer surfaces to prevent damage and wipe with deionized distilled aqua.

Caution: Keep the instrument free of dust and other foreign matter. Clean and keep dry the plate carrier and transfer rails to prevent jamming.

Note: You can print the programs stored in the instrument memory by pressing the **param** key and selecting 3 PROGRAM PRINTING.

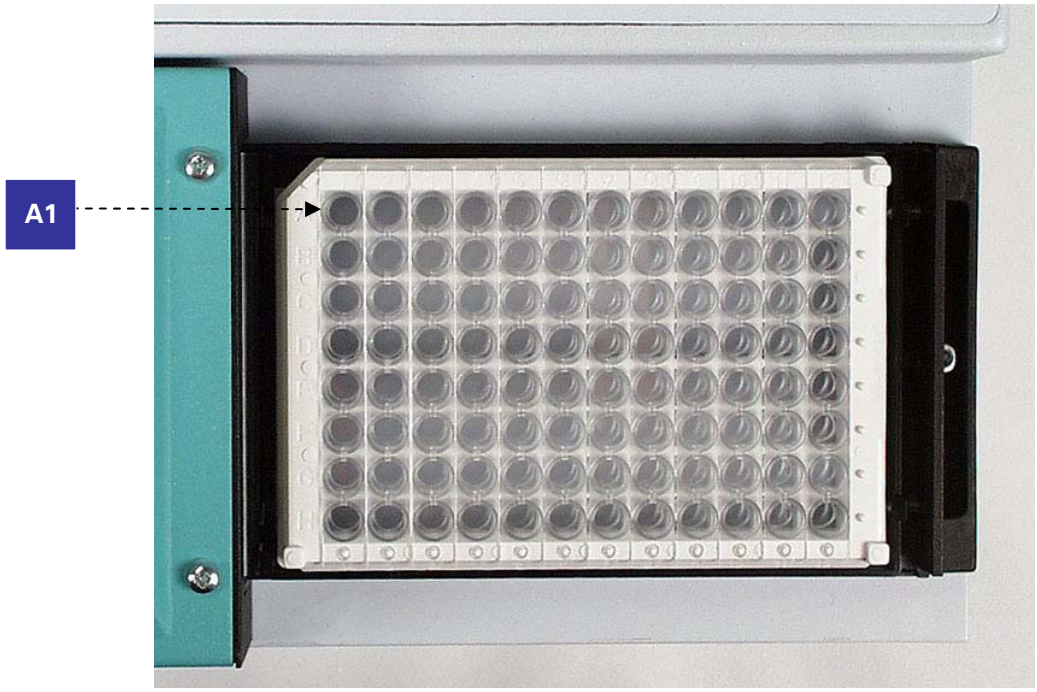
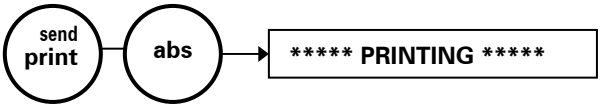


Fig. 6.1 Positioning the microplate correctly

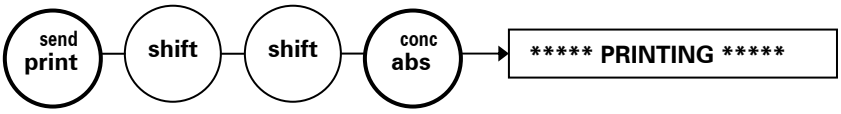
6.4 Printing data

The calculated results are automatically printed after the measurement. The printout is sent to the internal printer, the external printer or the computer according to the general settings of the instruments (Section 6.8.1).

If you want to print the raw measurement data:



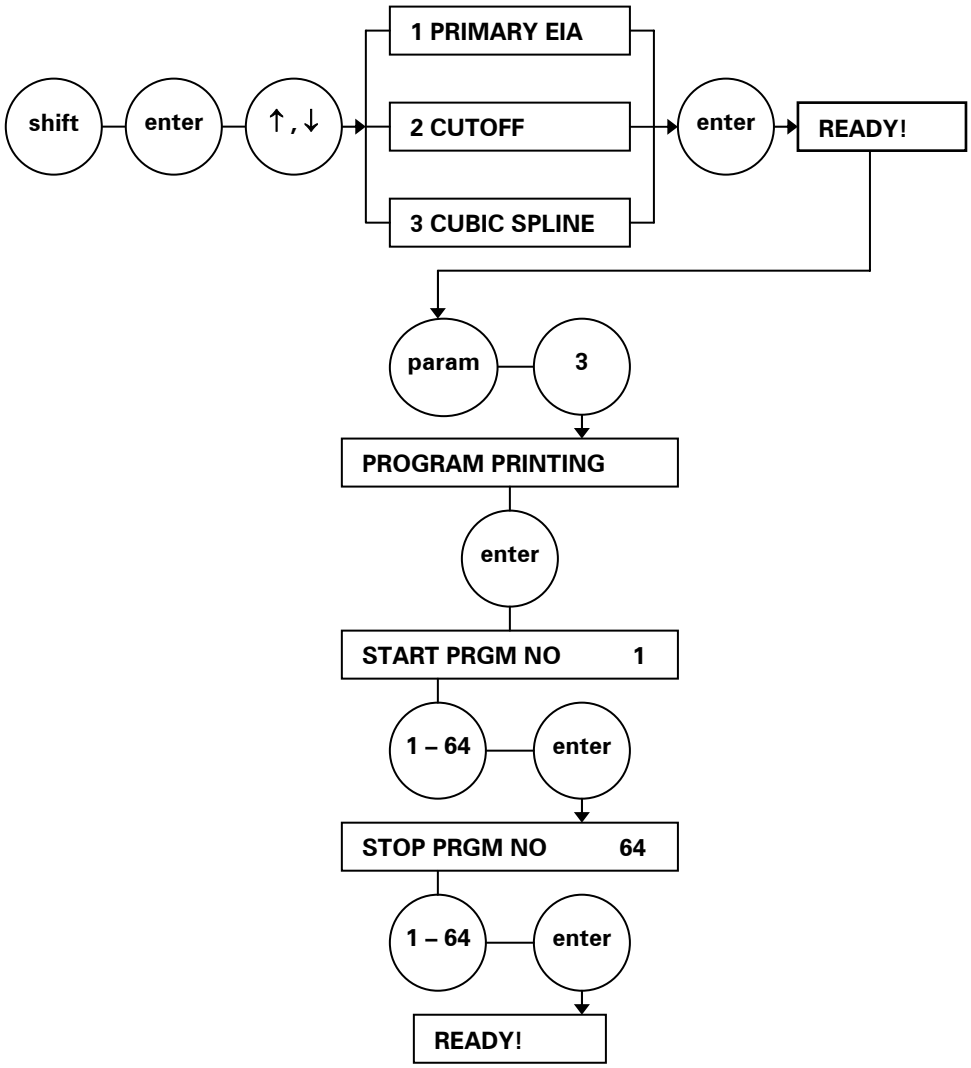
If you want to reprint the calculated results:



Note: You can only print the results directly after the measurement. After you perform any other actions, such as saving the program, the measurement and calculation data are no longer in the instrument memory.

6.5 Printing stored programs

Select the program module from which you want print the program parameters. You can print a range of programs, but the parameters are printed only for the programs in the selected module.



6.6 Shutdown procedure

Warning: Remove any microplates still on the plate carrier. Dispose of all microplates and strips as biohazardous waste.

Switch the Multiskan EX off by pressing the mains switch (Fig. 5.9, item 1) into the OFF position.

Wipe the instrument surfaces with a soft cloth or tissue paper moistened with deionized distilled aqua, a mild detergent (SDS, sodium dodecyl sulfate) or soap solution.

If you have spilt infectious agents on the instrument, disinfect with 70% alcohol or some other disinfectant (see the Multiskan EX User Manual, Section 7.8).

Last of all, put the dust cover on.

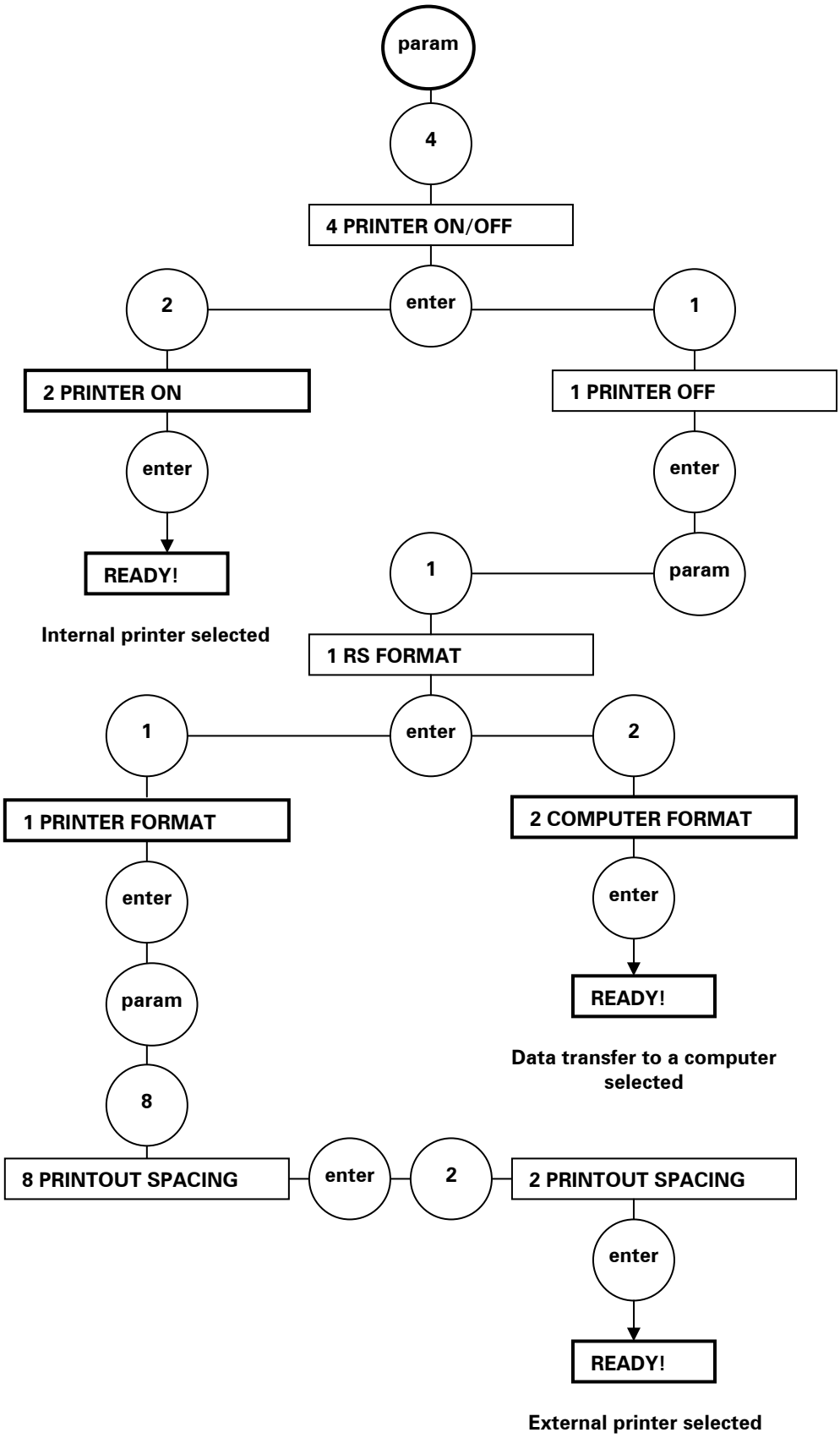
6.7 Emergency situations

In case there is any abnormal situation during the operation, such as fluids spilling inside the instrument, follow these steps:

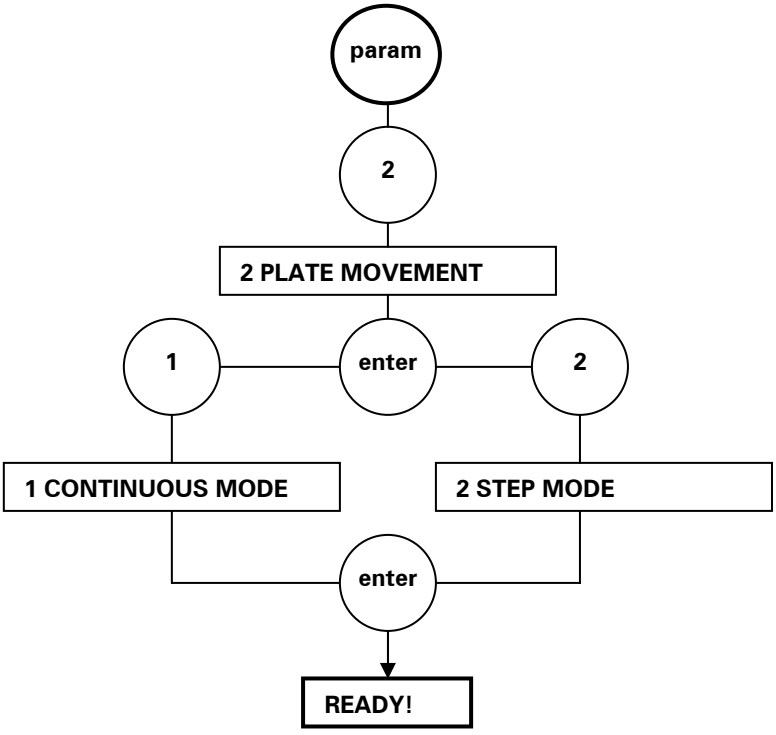
1. Switch OFF the instrument.
2. Unplug the instrument from the power supply.
3. Perform appropriate corrective actions. However, do not touch the interior of the instrument.
4. Contact authorized service or your local Thermo Fisher Scientific representative.

6.8 Changing general parameters

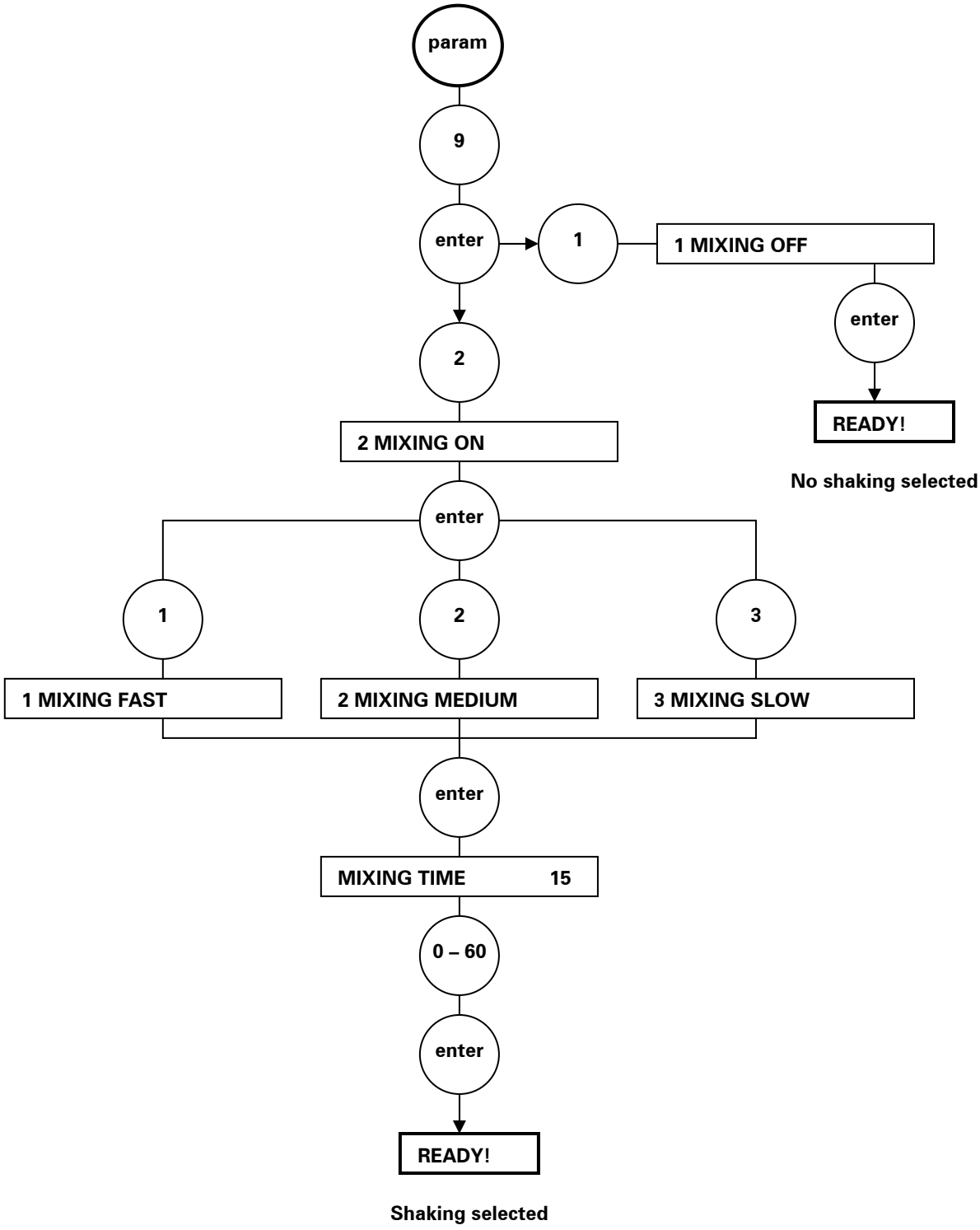
6.8.1 Selecting the printing destination



6.8.2 Selecting the plate movement

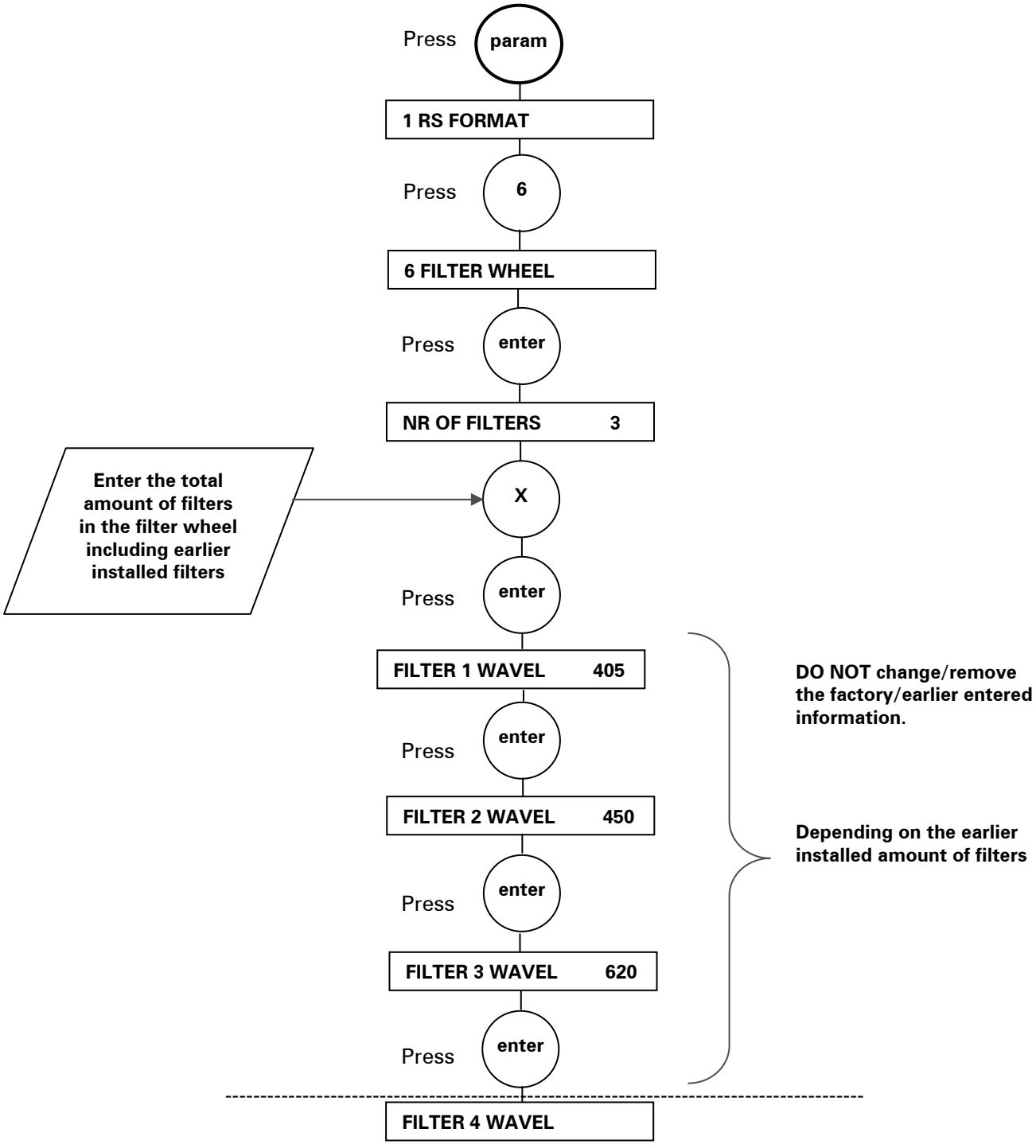


6.8.3 Selecting shaking

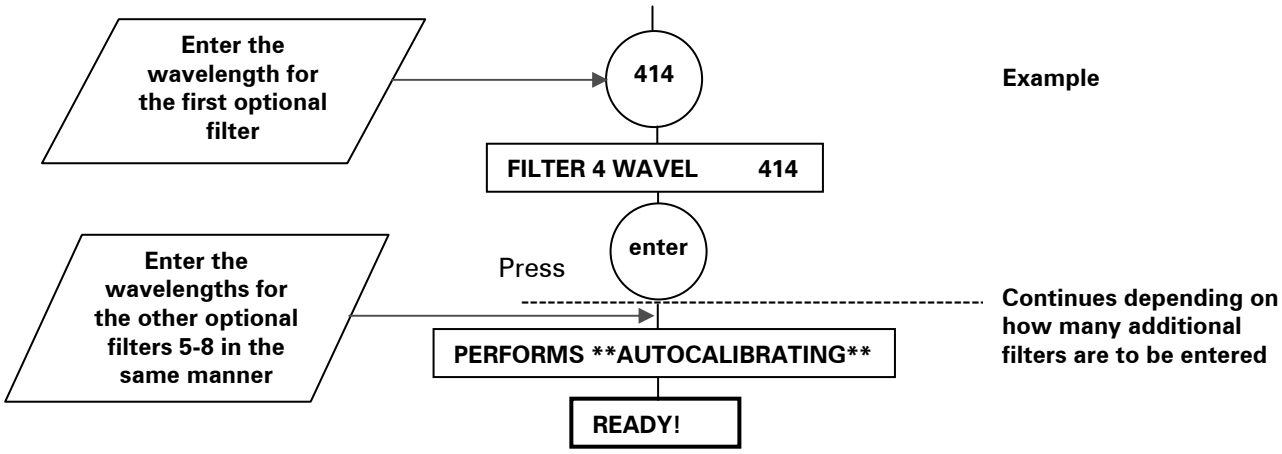


6.8.4 Entering filter wheel parameters

An example of how to enter the filter wheel parameters in the memory of the embedded software:



Continued


Enter the wavelength for the first optional filter
414
Example
FILTER 4 WAVEL 414
enter
Press
Enter the wavelengths for the other optional filters 5-8 in the same manner
Continues depending on how many additional filters are to be entered
PERFORMS **AUTOCALIBRATING**
READY!

6.9 Programming parameters of the Multiskan EX

Measurement modes (meas mode key)	Measurement parameters (meas param key)	Calculation modes and parameters (calc mode and calc param keys)			General parameters (param key)
		Primary EIA	Cut Off	Cubic Spline	
1 ABSORBANCE MODE **2 DUAL WAVEL. MODE** **3 TWO POINT MODE** **4 KINETIC MODE** **5 MULTI WAVEL. MODE** **6 COMPUTER CONTROL**	**FILTER** **1 NO REAGENT BLANK /** **2 SINGLE WELL BLANK /** ↳ BLANK WELL A1 **3 COLUMN MEAN BLANK /** ↳ BLANK COLUMN 1 **4 COLUMN BLANK /** ↳ BLANK COLUMN 1 **5 ROW MEAN BLANK /** ↳ BLANK ROW A **6 ROW BLANK /** ↳ BLANK ROW A **1 BL ON EVERY PL /** **2 RETAINED BLANK** ↳ 1 USE OLD BLANK / 2 NEW BLANK NOW **1 END RESULTS /** **2 ALL RESULTS** **INTERVAL TIME** **LAG TIME** **TOTAL TIME**	**1 NO CALCULATION** **2 FACTOR CALCULATION** ↳ FACTOR **3 LINEAR STANDARD** ↳ NO OF STDS ↳ NO OF REPL ↳ STANDARD 1 ↳ STANDARD 1 REPL 1 A1 ↳ 1 STD ON EVERY PLATE / 2 RETAINED STD ↳ 1 USE OLD LINE / 2 NEW LINE NOW **4 STANDARD LINE** ↳ LINE SLOPE ↳ INTERCEPT **5 LIMIT CALCULATION** ↳ LIMIT **6 DOUBLE LIMIT** ↳ LOW LIMIT ↳ HIGH LIMIT **7 RANGE CALCULATION** ↳ RANGE **8 COLUMN SUBTRACTION** ↳ 1–2 3–4 5–6 … / 2–1 4–3 6–5 … **9 POINT TO POINT** ↳ NO OF STDS ↳ NO OF REPL ↳ STANDARD 1 ↳ STANDARD 1 REPL 1 A1 ↳ 1 STD ON EVERY PLATE / 2 RETAINED STD ↳ 1 USE OLD LINE / 2 NEW LINE NOW	**1 NO CALCULATION** **2 DOUBLE LIMIT** ↳ LOW LIMIT ↳ HIGH LIMIT **3 RANGE CALCULATION** ↳ RANGE **4 CUT OFF** ↳ CUT OFF EQUATION ↳ NO OF POS CONTROL ↳ POS CTRL WELL A1 ↳ NO OF NEG CONTROL ↳ NEG CTRL WELL A1 ↳ NO OF LOW CONTROL ↳ LOW CTRL WELL A1 ↳ GREY AREA ↳ INTERPRETATION ↳ 1 + > – / 2 – > +	**1 NO CALCULATION** **2 CUBIC SPLINE** ↳ NO OF STDS ↳ NO OF REPL ↳ STANDARD 1 0.000 ↳ STANDARD 1 REPL 1 A1 ↳ STANDARD 2 0.000 ↳ STANDARD 2 REPL 1 A1 ↳ STD ON EVERY PLATE / RETAINED STANDARD ↳ 1 USE OLD CURVE / 2 NEW CURVE NOW ↳ 1 UNIT NO UNIT / 2 UNIT U/l / 3 UNIT IU/l / 4 UNIT mIU/l / 5 UNIT g/l / 6 UNIT mg/l / 7 UNIT mg/dl / 8 UNIT ug/l / 9 UNIT ug/ml / 10 UNIT ng/ml / 11 UNIT mmol/l / 12 UNIT umol/l / 13 UNIT nmol/l / ↳ 1 LIN/LIN / 2 LIN/LOG / 3 LOG/LIN / 4 LOG/LOG ↳ 1 ACCEPT RESULTS / 2 NEW FIT	**1 RS FORMAT** ↳ 1 PRINTER FORMAT / 2 COMPUTER FORMAT **2 PLATE MOVEMENT** ↳ 1 CONTINUOUS MODE / 2 STEP MODE **3 PROGRAM PRINTING** **4 PRINTER ON/OFF** ↳ 1 PRINTER OFF / 2 PRINTER ON **5 PLATE ANALYSIS** ↳ 1 ANALYSIS OFF / 2 ANALYSIS ON **6 FILTER WHEEL** ↳ NO OF FILTERS 1 ↳ FILTER 1 WAVEL 405 **7 CLOCK SET** **8 PRINTOUT SPACING** ↳ 1 NO SPACING / 2 PRINTOUT SPACING **9 MIXING** ↳ 1 MIXING OFF ↳ 2 MIXING ON ↳ 1 MIXING FAST / 2 MIXING MEDIUM / 3 MIXING SLOW ↳ MIXING TIME **10 MODULE LISTING**

6.9.1 Measurement modes and parameters

Table 6.3 Measurement modes

Measurement mode	Function
1 ABSORBANCE MODE	The absorbances are measured at one wavelength (also called an end point).
2 DUAL WAVEL. MODE	The absorbances are measured using two wavelengths: The results of the second measurement are subtracted from the results of the first measurement.
3 TWO POINT MODE	The absorbances of the plate are measured at two separate points in time. The results of the first measurement are subtracted from the results of the second measurement.
4 KINETIC MODE	The rates of absorbance change are measured.
5 MULTI WAVEL. MODE	The absorbances are measured using individual filter selection for each column of a microplate. Only available with the Primary EIA program.
6 COMPUTER CONTROL	The instrument is controlled by an external computer. Only available with the Primary EIA program.

Table 6.4 Measurement parameters

Measurement parameter	Function
FILTER	Enter the wavelength(s) of the filter(s) or the filter number(s) (see 6 FILTER WHEEL in Table 6.8 on p. 59).
BLANKING POSSIBILITIES	The following blanking possibilities are available in all available measurement modes. 1 NO REAGENT BLANK 2 SINGLE WELL REAGENT BLANK • Enter the blank well 3 COLUMN MEAN BLANK • Enter the blank column (1 – 12) • The average of the blank values (8) of the column is used 4 COLUMN BLANK • Enter the blank column (1 – 12) • Each row will have an individual blank value that is used 5 ROW MEAN BLANK • Enter the blank row (A – H) • The average of the blank values (12) of the row is used 6 ROW BLANK • Enter the blank row (A – H) • Each column will have an individual blank value that is used

Continued

Table 6.4 Measurement parameters

Measurement parameter	Function
1 BL ON EVERY PL / **2 RETAINED BLANK**	You can also select either blanking on every plate (1 BL ON EVERY PL) or retained blank (2 RETAINED BLANK, blank value of a former plate is used). If you select RETAINED BLANK, 1 USE OLD BLANK/ 2 NEW BLANK NOW will be requested before reading the next plate.
1 END RESULTS / **2 ALL RESULTS**	In end point, kinetic or dual wavelength measurements, you can select final results (e.g., absorbance differences) and intermediate results (e.g., absorbances with filter 1 and filter 2).
INTERVAL TIME	You can select the INTERVAL TIME parameter in two point and kinetic measurements. It is the time between successive measurements of the plate. The minimum interval time is 5 s, the maximum 17 h 59 min 59 s with Primary EIA and 100 s with Cutoff and Cubic spline program modules. Enter the interval time as HH.MM.SS (HH = hours, MM = minutes, SS = seconds).
Caution: When the kinetic measurement and ALL RESULTS are selected and the results are transmitted via the RS-232C interface, the actual minimum interval time is dependent on the baud rate used: the lower the baud rate, the slower the intermediate results are transmitted. This means that the interval time has to be long enough for the instrument to be able to transmit the intermediate results during the selected interval time. Example: with baud rate 4800 the minimum interval time is 6 – 7 depending on the printer used.	
LAG TIME	You can select the LAG TIME parameter in kinetic measurements. It is the time before the measurement is started. The minimum lag time is 0 s, the maximum 17 h 59 min 59 s with Primary EIA and 100 s with Cutoff and Cubic spline program modules. Enter the lag time as HH.MM.SS (HH = hours, MM = minutes, SS = seconds).
TOTAL TIME	You can select the TOTAL TIME parameter in kinetic measurements. It is the time during which the reaction is followed. The minimum total time is 5 s, the maximum 17 h 59 min 59 s with Primary EIA and 100 s with Cutoff and Cubic spline program modules. Enter the total time as HH.MM.SS (HH = hours, MM = minutes, SS = seconds).

6.9.2 Calculation parameters

6.9.2.1 Primary EIA program

Table 6.5 Calculation parameters in Primary EIA program

Primary EIA program calculation parameter	Operation
1 NO CALCULATION	The results are sent as absorbances via the interface.
2 FACTOR CALCULATION	Measured absorbances are multiplied with a factor given by the user to obtain the concentrations. The concentration unit is defined by the unit for the factor. The concentration is calculated according to the following equation: Concentration = FACTOR x absorbance The measurement parameters, calculation parameters and the calculated concentrations are sent via the interface. Parameter: FACTOR
3 LINEAR STANDARD	Enter the concentrations of the standards and the Multiskan EX calculates a standard line with the aid of these standards using the method of least squares. The measured absorbances are converted to concentration units using this line. The measurement parameters, calculation parameters and the concentrations obtained are sent via the interface. Parameters: Number of standards (NR OF STDS) Number of replicates (NR OF REPL) Standard concentrations (STANDARD 1), etc. Standard locations (STANDARD 1 REPL 1 A1), etc. Up to eight (8) standard solutions can be incorporated into the plate in up to three (3) replicates. 1 STD ON EVERY PLATE/ Standard on every plate (1 STD ON EVERY PLATE) or 2 RETAINED STD retained standard (2 RETAINED STD, the standard curve of the former plate is used) can be selected. If retained standard is selected, 1 USE OLD LINE/2 NEW LINE NOW will be requested before reading the next plate.
4 STANDARD LINE	You can define the standard line by entering the slope and the intercept by using the known standard line. The Multiskan EX calculates the concentrations using the following equation: absorbance = $A \times$ concentration + B where A = slope as in the linear standard mode B = intercept concentration = **Error!** The measurement parameters, calculation parameters and the concentrations obtained are sent via the interface. Parameters: LINE SLOPE INTERCEPT
5 LIMIT CALCULATION	The measurement absorbance values are compared to a limit value defined by the user. If the result is lower than the set limit, a negative sign (–) is sent, otherwise a positive sign (+). The measurement parameters, calculation parameters and the results in a +/– matrix are sent via the interface. Parameters: Limit value (LIMIT) (0.000 – 2.000)

Continued

Table 6.5 Calculation parameters in Primary EIA program

Primary EIA program calculation parameter	Operation
6 DOUBLE LIMIT	The measured absorbance values are compared to two (2) limit values defined by the user. If the result is lower than the lower limit, a negative sign (–) is sent. If the result is between the two limit values, 0 is sent. If the result is higher than the upper limit, a positive sign (+) is sent. The measurement parameters, calculation parameters and the results in a –/0/+ matrix are sent via the interface. Parameters: Low limit value (LOW LIMIT) (0.000 – 2.000) High limit value (HIGH LIMIT) (0.001 – 2.000)
7 RANGE CALCULATION	The range value defined by the user is divided into ten (10) equal segments. The segments are numbered from 0 to 9. The measured absorbance value is represented by one of these numbers depending on which segment it lies in. The measurement parameters, calculation parameters and the matrix where the results are shown by segment numbers (0...9) are sent via the interface. Parameters: Range value (RANGE) (0.000 – 2.000) Example: if an absorbance range of 1.5 is set, the segments are as follows: Segment — Measured absorbance value in range — Printout 1 — $A \leq 0.150$ — 0 2 — $0.150 < A \leq 0.300$ — 1 3 — $0.300 < A \leq 0.450$ — 2 4 — $0.450 < A \leq 0.600$ — 3 5 — $0.600 < A \leq 0.750$ — 4 6 — $0.750 < A \leq 0.900$ — 5 7 — $0.900 < A \leq 1.050$ — 6 8 — $1.050 < A \leq 1.200$ — 7 9 — $1.200 < A \leq 1.350$ — 8 10 — $1.350 < A \leq 1.500$ — 9
8 COLUMN SUBTRACTION	The results of column 1 are subtracted from the results of column 2, the results of column 3 are subtracted from the results of column 4, etc., or vice versa. The measurement parameters, calculation parameters and the absorbance differences of every other column are sent via the interface. Parameter: 1−2 3−4... or 2−1 4−3...

Continued

Table 6.5 Calculation parameters in Primary EIA program

Primary EIA program calculation parameter	Operation
9 POINT TO POINT	Enter the concentrations of the standards and the Multiskan EX calculates a piece-wise linear standard curve with the aid of these standards. The measured absorbances are converted to concentration units using this curve. The measurement parameters, calculation parameters and the concentrations obtained are sent via the interface. If the piece-wise linear standard curve is not monotonous, the text NON-MONOTONOUS curve will be printed and the results are incorrect. Parameters: Number of standards (NR OF STDS) Number of replicates (NR OF REPL) Standard concentrations (STANDARD 1), etc. Standard locations (STANDARD 1 REPL 1 A1), etc. Up to eight (8) standard solutions can be incorporated into the plate in up to three (3) replicates. 1 STD ON EVERY PLATE/ Standard on every plate (1 STD ON EVERY PLATE) or 2 RETAINED STD Retained standard (2 RETAINED STD, the standard curve of the former plate is used) can be selected. If retained standard is selected, 1 USE OLD LINE/2 NEW LINE NOW will be requested before reading the next plate.

6.9.2.2 Cutoff program

Table 6.6 Calculation parameters in Cutoff program

Cutoff program calculation parameter	Operation
1 NO CALCULATION	The results are sent as absorbances via the interface.
2 DOUBLE LIMIT	The measured absorbance values are compared to two limit values defined by the user. If the result is lower than the lower limit, a negative sign (–) is sent. If the result is between the two limit values, 0 is sent. If the result is higher than the upper limit, a positive sign (+) is sent. The measurement parameters, calculation parameters and the results in a –/0/+ matrix are sent via the interface. Parameters: Low limit value (LOW LIMIT) (0.000 – 2.000) High limit value (HIGH LIMIT) (0.001 – 2.000)

Continued

Table 6.6 Calculation parameters in Cutoff program

<table>
<tr><th>Cutoff program calculation parameter</th><th>Operation</th></tr>
<tr><td>3 RANGE CALCULATION</td><td>The range value defined by the user is divided into ten (10) equal segments. The segments are numbered from 0 to 9. The measured absorbance value is represented by one of these numbers depending on which segment it lies in. The measurement parameters, calculation parameters and the matrix where the results are shown by segment numbers (0...9) are sent via the interface.
Parameters: Range value (RANGE) (0.000 – 2.000)
Example: if an absorbance range of 1.5 is set, the segments are as follows:
<table>
<tr><th>Segment</th><th>Measured absorbance value in range</th><th>Printout</th></tr>
<tr><td>1</td><td>A ≤ 0.150</td><td>0</td></tr>
<tr><td>2</td><td>0.150 < A ≤ 0.300</td><td>1</td></tr>
<tr><td>3</td><td>0.300 < A ≤ 0.450</td><td>2</td></tr>
<tr><td>4</td><td>0.450 < A ≤ 0.600</td><td>3</td></tr>
<tr><td>5</td><td>0.600 < A ≤ 0.750</td><td>4</td></tr>
<tr><td>6</td><td>0.750 < A ≤ 0.900</td><td>5</td></tr>
<tr><td>7</td><td>0.900 < A ≤ 1.050</td><td>6</td></tr>
<tr><td>8</td><td>1.050 < A ≤ 1.200</td><td>7</td></tr>
<tr><td>9</td><td>1.200 < A ≤ 1.350</td><td>8</td></tr>
<tr><td>10</td><td>1.350 < A ≤ 1.500</td><td>9</td></tr>
</table></td></tr>
<tr><td>4 CUTOFF</td><td>The measured absorbance value is compared to a cutoff value calculated with the aid of a cutoff equation using measured absorbances of positive or negative controls.
Parameters:
<table>
<tr><td>CUTOFF EQUATION</td><td>Enter the equation with the aid of (,), +, –, x, /, P, L and N keys.
Example: (P+N) x 0.5</td></tr>
<tr><td>NO OF POS CONTROL</td><td>Enter the number of positive controls.</td></tr>
<tr><td>POS CONTROL A1</td><td>Enter the positions of positive, negative or low positive controls.</td></tr>
<tr><td>NO OF NEG CONTROL
NEG CONTROL A1</td><td>See pos control above.</td></tr>
<tr><td>NO OF LOW POS CONTROL
LOW POS CONTROL A1</td><td>See pos control above.</td></tr>
<tr><td>GREY AREA</td><td>Enter the absorbance range where the results obtained are doubtful; results inside the gray area are presented with 0.</td></tr>
<tr><td>INTERPRETATION 1 + > –
2 – > +</td><td>Interpretation of the results is chosen:
1 + > –: the results above the cutoff value are presented with +, the results below the cutoff are presented with –.
2 – > +: the results above the cutoff value are presented with –, the results below it are presented with +.</td></tr>
</table></td></tr>
</table>

6.9.2.3 Cubic spline program

Table 6.7 Calculation parameters in Cubic spline program

Cubic spline program calculation parameter	Operation
1 NO CALCULATION	The results are sent as absorbances via the interface.
2 CUBIC SPLINE	Cubic spline is a sigmodial curve used, for example, with hormones and tumor markers. Parameters: NO OF STDS 2 — 2 to 8 standards are allowed NO OF REPL 1 — 1 to 3 replicates are allowed. STANDARD 1 0.000 — Enter the concentration of standard 1 STANDARD 1 REPL 1 A1 — Enter the location(s) of standard 1 STANDARD 2 0.000 — Enter the concentration of standard 2 STANDARD 2 REPL 1 A1 — Enter the location(s) of standard 2. STANDARD ON EVERY PLATE or RETAINED STANDARD 1 UNIT — No unit, U/l, IU/l, mIU/l, g/l, mg/l, mg/dl, µg/l, µg/ml, ng/ml, mmol/l, µmol/l, nmol/l 1 scale — LIN/LIN 2 scale — LIN/LOG 3 scale — LOG/LIN 4 scale — LOG/LOG After measurement and data transfer, the program requests if the results are accepted or if a new fit is required: 1 ACCEPT RESULTS 2 NEW FIT If you accept the results, the instrument goes to the READY state. If a new fit is required, you have to select new scale parameters and press the PRINT key. The new results will be interfaced. In case retained standard is used: 1 USE OLD CURVE 2 NEW CURVE NOW is requested to be selected.

6.9.3 General parameters

You can change the general instrument parameters using the **param** key. See also Section 6.8.

Table 6.8 General parameters

Parameter	Function
1 RS FORMAT	1. PRINTER FORMAT (header information and absorbances are sent via the interface) 2. COMPUTER FORMAT (only absorbances are sent via the interface in plate format)
2 PLATE MOVEMENT	You can select the speed at which the plate is moved: 1. CONTINUOUS (5 s) 2. STEP MODE (25 s)
3 PROGRAM PRINTING	Select this parameter to print out (with the printer) the programs stored in the memory of the instrument.
4 PRINTER ON/OFF SELECTION	On/Off selection of the printer. When you select Off, the results are automatically sent via the interface. When the instrument is switched on, the latest selection will be valid.

Continued

Table 6.8 General parameters

Parameter	Function
5 PLATE ANALYSIS	After the results have been presented in microplate format, the instrument sends the mean value, minimum value, maximum value, delta value, standard deviation value, delta percentage and the coefficient of variation percentage for every column and row as well as for the whole plate via the interface. You can select whether to perform the analysis or not: 1. ANALYSIS OFF 2. ANALYSIS ON (not available in the Cubic spline program)
6 FILTER WHEEL	The number of filters and filter wavelengths can be entered. See Section 6.8.4. NR OF FILTERS 1 — The number of filters (1 – 8) can be entered or changed with the arrow and number keys. FILTER 1 WAVEL 405 — Filter wavelengths in nm can be entered or changed with the arrow and number keys. The entered values are used until changed.
7 CLOCK SET	Date and time (year, month, day, day of the week, hour and minute) can be changed with the arrow and number keys.
8 PRINTOUT SPACING	On the printout of the external printer, you can select whether to leave an empty row between the results of the rows (printout spacing). On/Off selection of the printout spacing: 1. NO SPACING 2. PRINTOUT SPACING
9 MIXING	Mixing (shaking) of the microplate before measurement is started: 1. MIXING OFF 2. MIXING ON • MIXING FAST • MIXING MEDIUM • MIXING SLOW – MIXING TIME: enter the time in seconds (0 – 60 s). The default value is 15 s.
10 MODULE LISTING	A list of the program modules is printed out.

Table 6.9 Default values of the general parameters

Parameter	Default value
1 RS FORMAT	1 PRINTER FORMAT
2 PLATE MOVEMENT	1 CONTINUOUS (5 s)
4 PRINTER ON/OFF	ON
5 PLATE ANALYSIS	1 ANALYSIS OFF
6 FILTER WHEEL	NR OF FILTERS 3 FILTER 1 WAVEL 405 Filter wavelengths in nm FILTER 2 WAVEL 450 FILTER 3 WAVEL 620
7 CLOCK SET	Date and time are set at the factory.
8 PRINTOUT SPACING	1 NO SPACING
9 MIXING	1 MIXING OFF – MIXING TIME 15 (seconds)

6.10 Examples on how to use the Multiskan EX

6.10.1 Example 1: Primary EIA program module

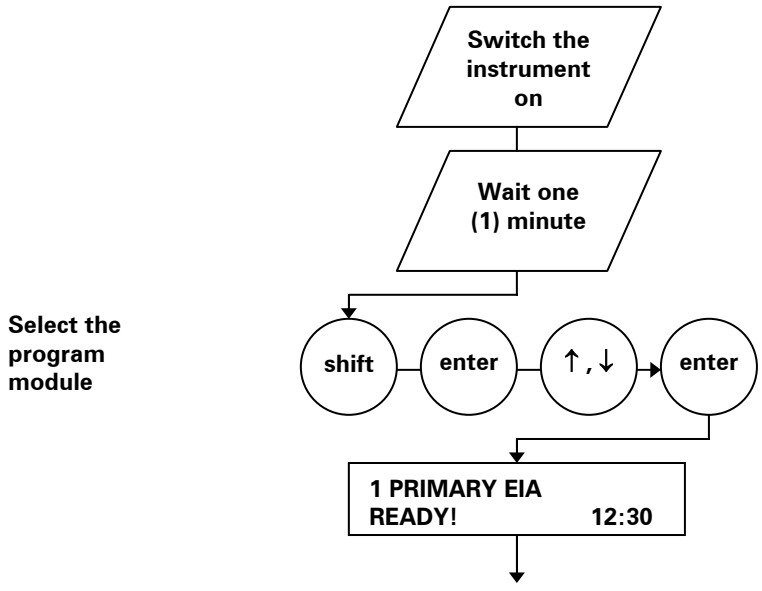
- Module 1, primary EIA

Note: The program module number depends on which modules are installed into your Multiskan EX instrument. It may therefore differ from the program module number given in this example.

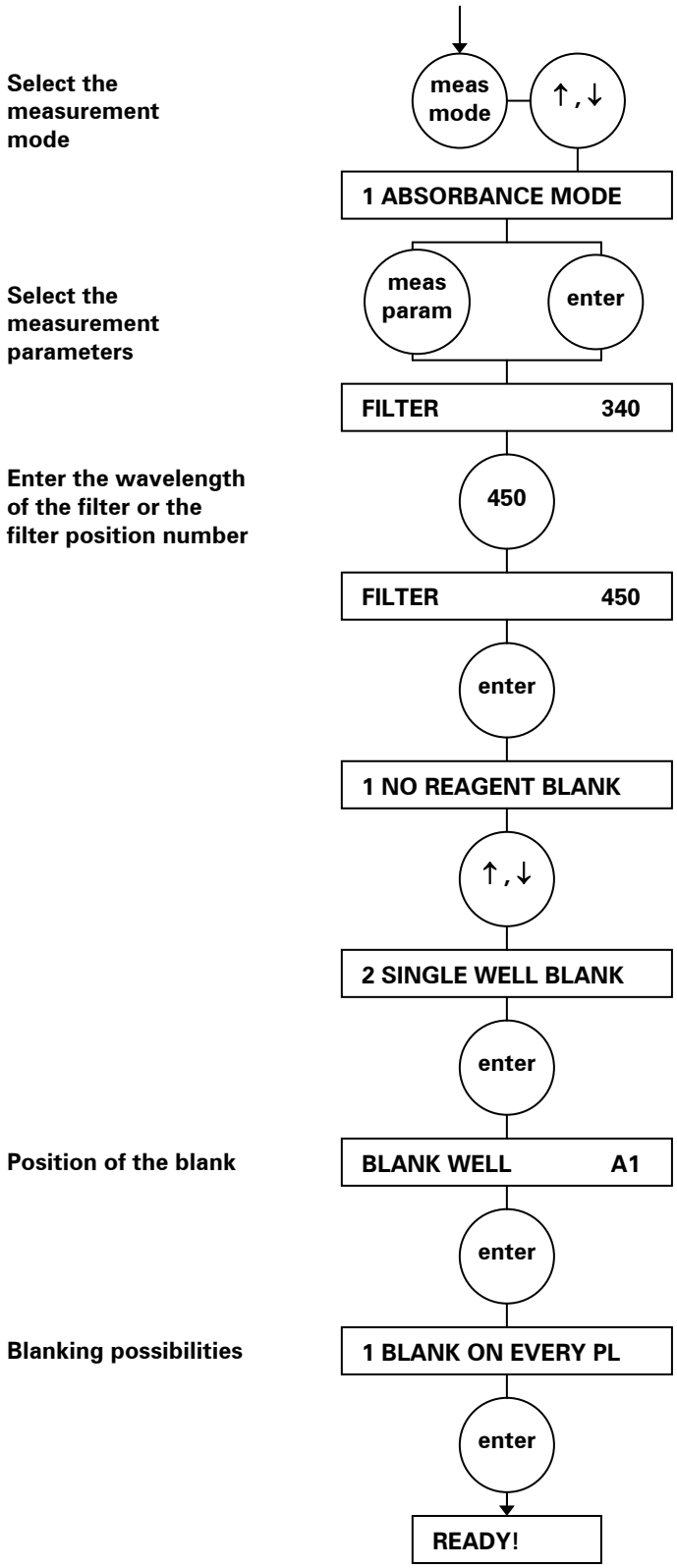
- Absorbance measurement with point-to-point calculation
- Three (3) standards (with concentrations 0, 15 and 100 and in positions B1, C1 and D1)
- Two (2) replicates (positions: B2, C2 and D2) on every plate
- The blank is positioned in well A1 on every plate
- The results are printed out on the internal or external printer or the computer according to the selection (Section 6.8.1).

	1	2	3	4	5	6	7	8	9	10	11	12
A	Blank		Un 5	Un 5								
B	Std 1	Std 1	etc.	etc.								
C	Std 2	Std 2										
D	Std 3	Std 3										
E	Un 1	Un 1										
F	Un 2	Un 2										
G	Un 3	Un 3										
H	Un 4	Un 4										

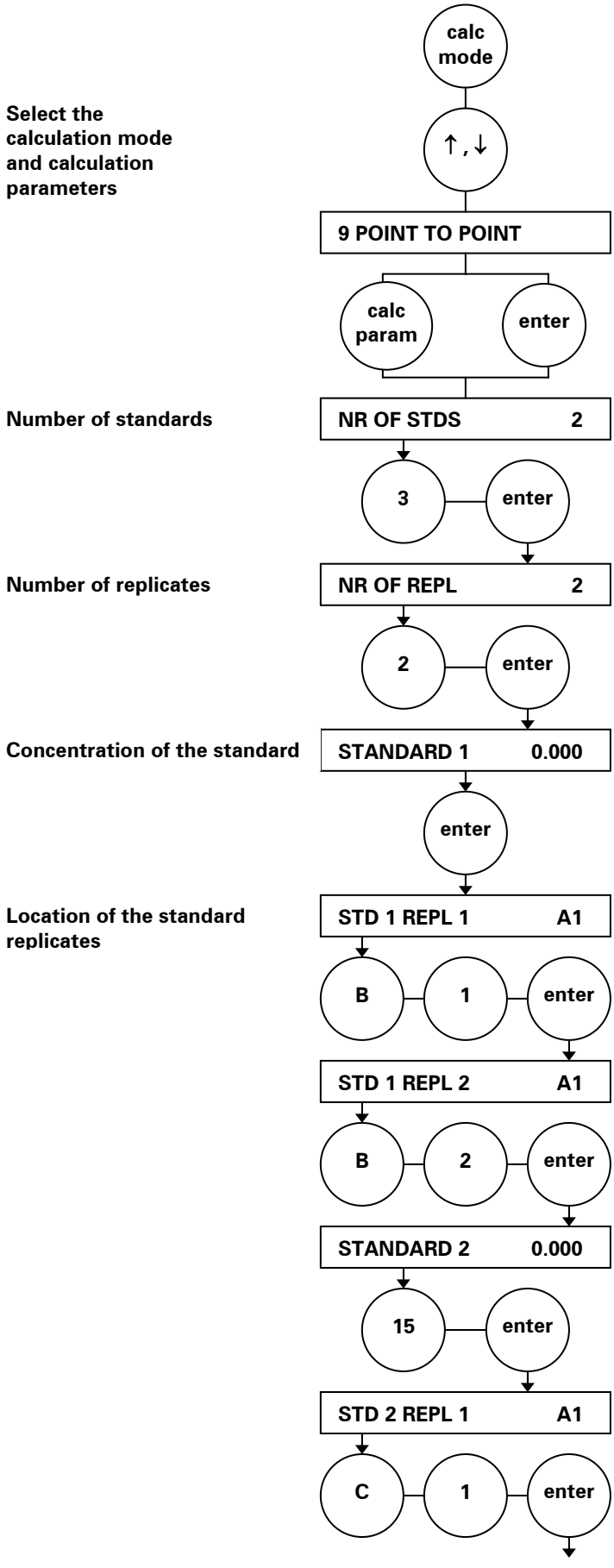
Fig. 6.2 Plate layout in the example for Primary EIA program module



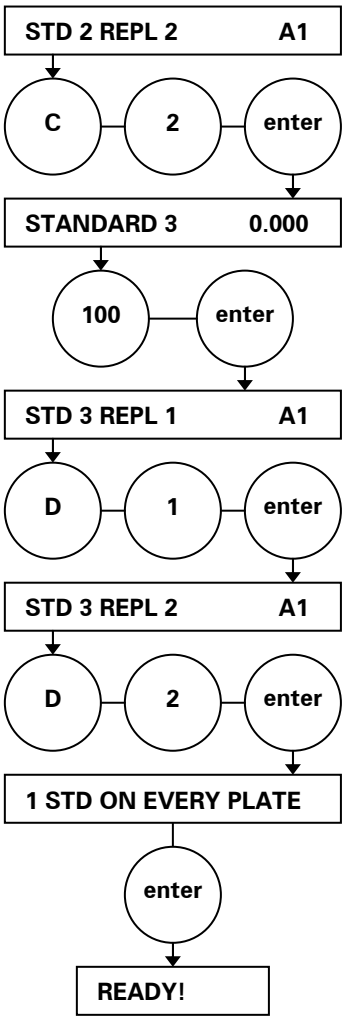
Continued


Select the measurement mode
meas mode
↑,↓
1 ABSORBANCE MODE
Select the measurement parameters
meas param
enter
FILTER 340
Enter the wavelength of the filter or the filter position number
450
FILTER 450
enter
1 NO REAGENT BLANK
↑,↓
2 SINGLE WELL BLANK
enter
Position of the blank
BLANK WELL A1
enter
Blanking possibilities
1 BLANK ON EVERY PL
enter
READY!

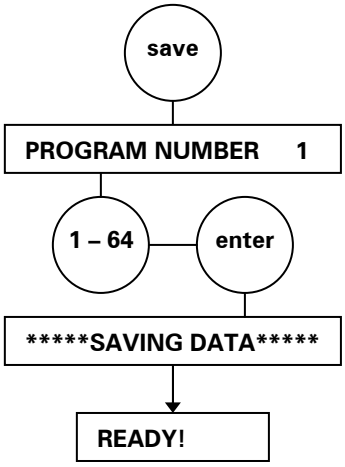
Continued


Select the calculation mode and calculation parameters
calc mode
↑, ↓
9 POINT TO POINT
calc param
enter
Number of standards
NR OF STDS 2
3
enter
Number of replicates
NR OF REPL 2
2
enter
Concentration of the standard
STANDARD 1 0.000
enter
Location of the standard replicates
STD 1 REPL 1 A1
B
1
enter
STD 1 REPL 2 A1
B
2
enter
STANDARD 2 0.000
15
enter
STD 2 REPL 1 A1
C
1
enter

Continued



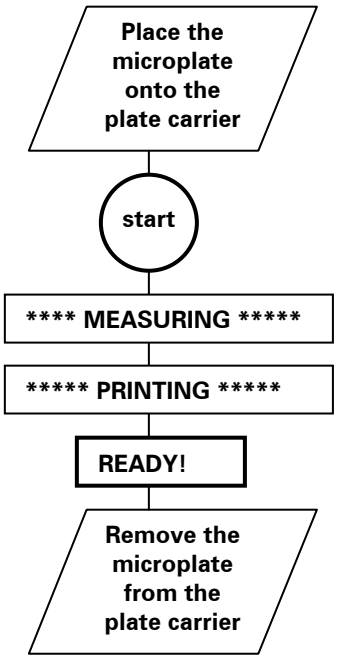
The standard curve is calculated for every plate



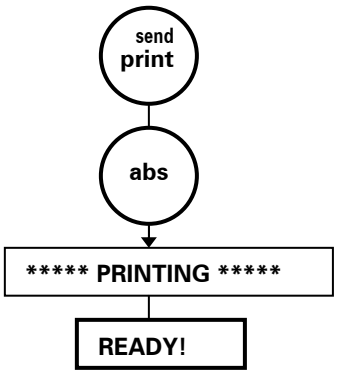
Save the program

Continued

Start the measurement.



Print the raw measurement data.



6.10.2 Example 2: Cutoff calculation using equation

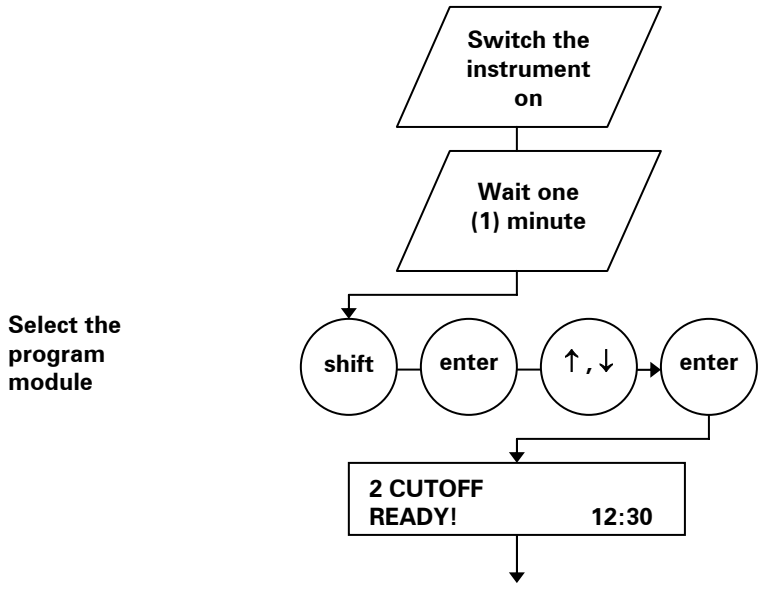
- Module 2

Note: The program module number depends on which modules are installed into your Multiskan EX instrument. It may therefore differ from the program module number given in this example.

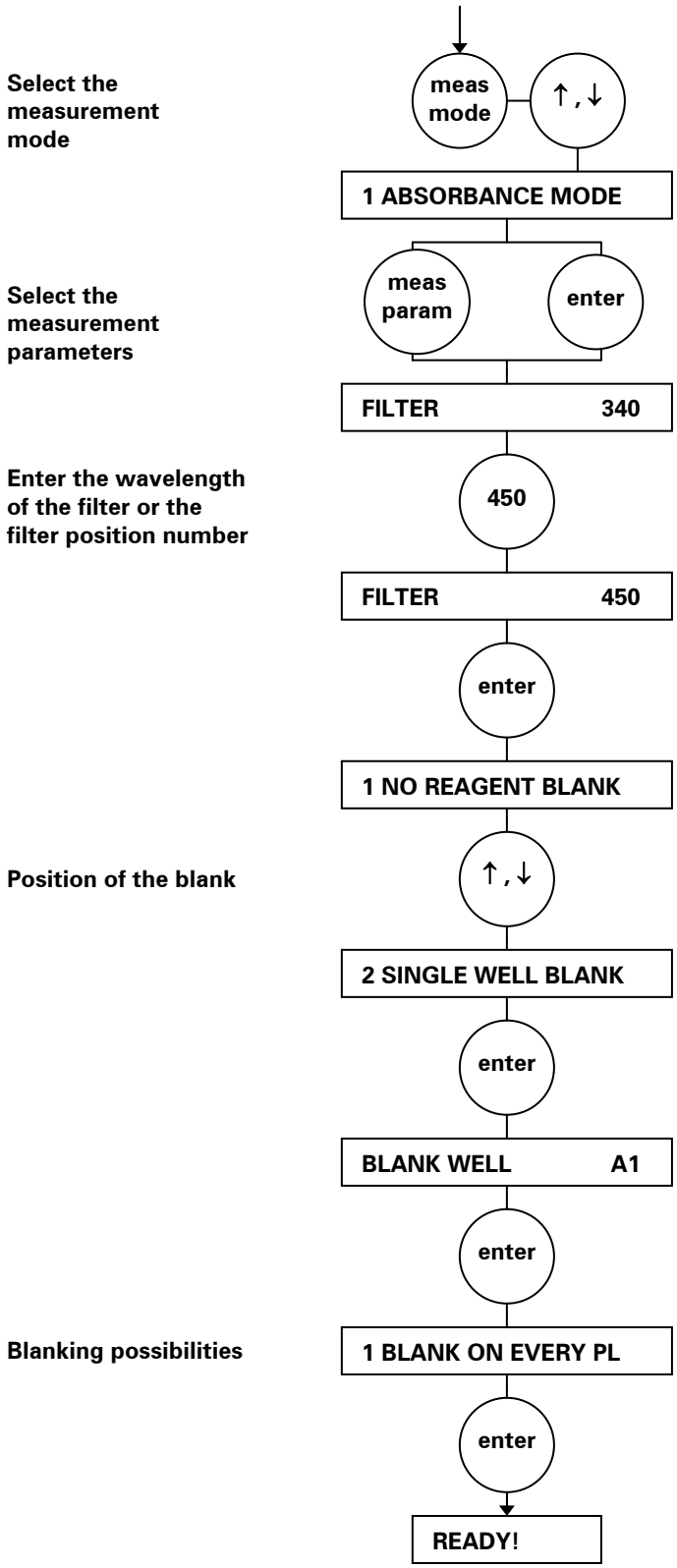
- Absorbance measurement at 450 nm
- Blank in well A1
- Cutoff calculation with cutoff equation (P+N) x 0.5
- Grey area 0.02
- Interpretation + > –
- Check the printing: the results are sent to the external printer.

	1	2	3	4	5	6	7	8	9	10	11	12
A	Blank	Un 4										
B	Pos 1	Un 5										
C	Pos 2	etc.										
D	Neg 1											
E	Neg 2											
F	Un 1											
G	Un 2											
H	Un 3											

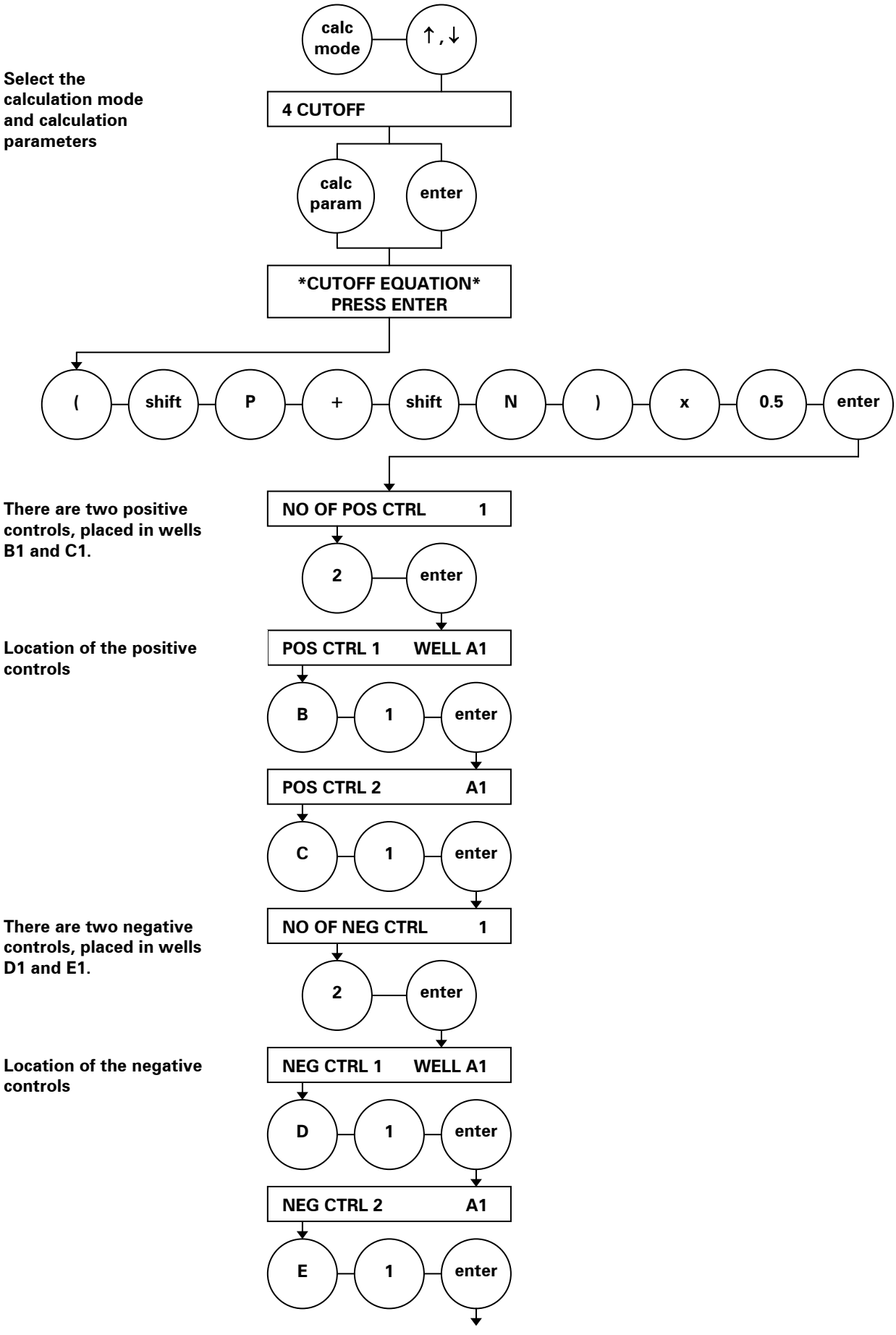
Fig. 6.3 Plate layout in the example for Cutoff program module



Continued

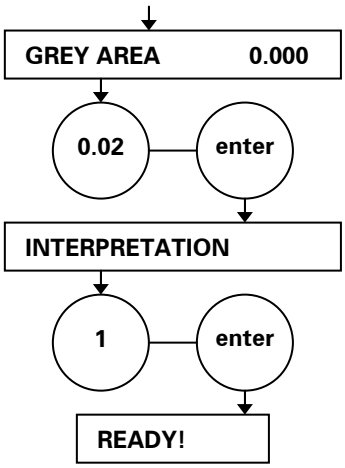

Select the measurement mode
meas mode
↑, ↓
1 ABSORBANCE MODE
Select the measurement parameters
meas param
enter
FILTER 340
Enter the wavelength of the filter or the filter position number
450
FILTER 450
enter
1 NO REAGENT BLANK
Position of the blank
↑, ↓
2 SINGLE WELL BLANK
enter
BLANK WELL A1
enter
Blanking possibilities
1 BLANK ON EVERY PL
enter
READY!

Continued

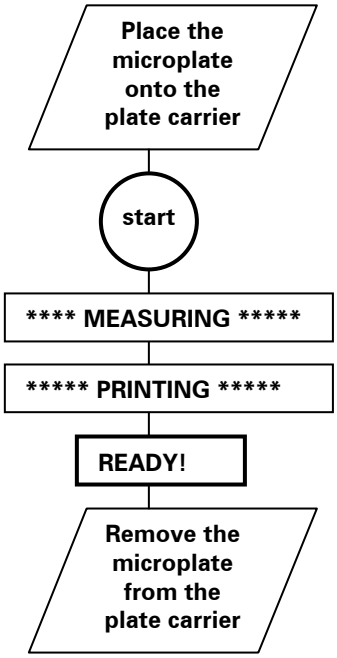

Select the calculation mode and calculation parameters
calc mode
↑, ↓
4 CUTOFF
calc param
enter
CUTOFF EQUATION
PRESS ENTER
(
shift
P
+
shift
N
)
x
0.5
enter
There are two positive controls, placed in wells B1 and C1.
NO OF POS CTRL 1
2
enter
Location of the positive controls
POS CTRL 1 WELL A1
B
1
enter
POS CTRL 2 A1
C
1
enter
There are two negative controls, placed in wells D1 and E1.
NO OF NEG CTRL 1
2
enter
Location of the negative controls
NEG CTRL 1 WELL A1
D
1
enter
NEG CTRL 2 A1
E
1
enter

Continued

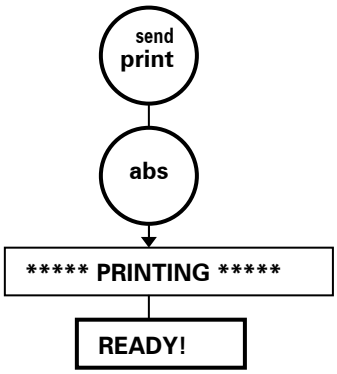
Select either 1 + > – or 2 – > +.
With 1 + > –, the results above the cutoff are considered to be positive.



Start the measurement.



Print the raw measurement data.



The following results are printed in plate layout format:

- Raw data, absorbances at 450 nm
- Calculated results, + (positive) or – (negative)

6.10.3 Example 3: Cubic spline program module

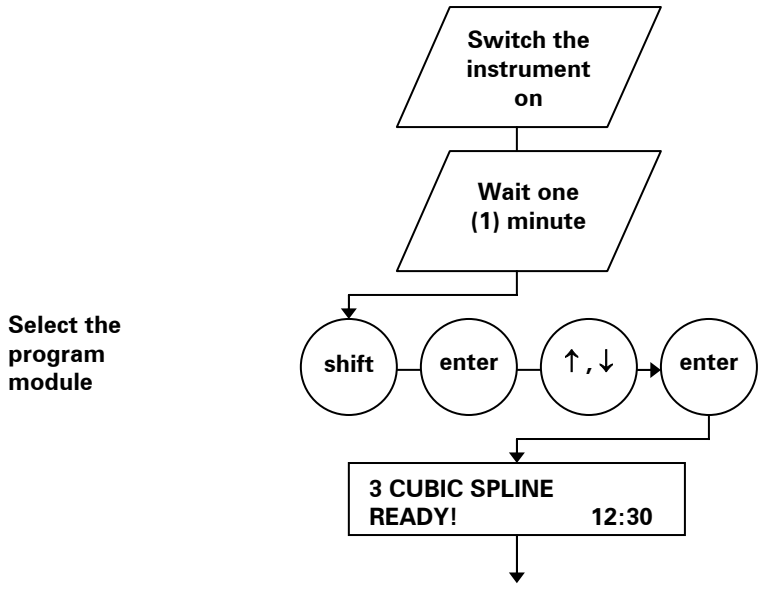
- Module 3

Note: The program module number depends on which modules are installed into your Multiskan EX instrument. It may therefore differ from the program module number given in this example.

- Absorbance measurement at 405 nm
- Blanking in well A1 (a blank well only in the first plate)
- Cubic spline curve fit with six (6) standards (concentrations 7, 30, 50, 85, 130 and 200) in positions B1, C1, D1, E1, F1 and G1.
- Same standard curve used for other plates
- Unit for standard concentrations IU/l
- Two plates are measured
- The scale used is tried with log/lin and lin/lin
- Use of an external printer for recording the results.

	1	2	3	4	5	6	7	8	9	10	11	12
A	Blank	Un 2										
B	Std 1	Un 3										
C	Std 2	etc.										
D	Std 3											
E	Std 4											
F	Std 5											
G	Std 6											
H	Un 1											

Fig. 6.4 Plate layout in the example for Cubic spline program module



Continued

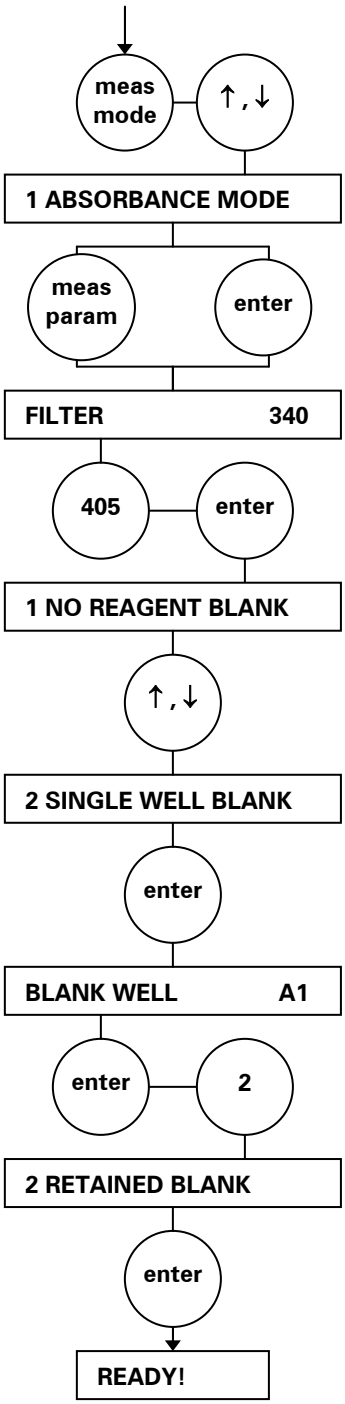
Select the measurement mode

Select the measurement parameters

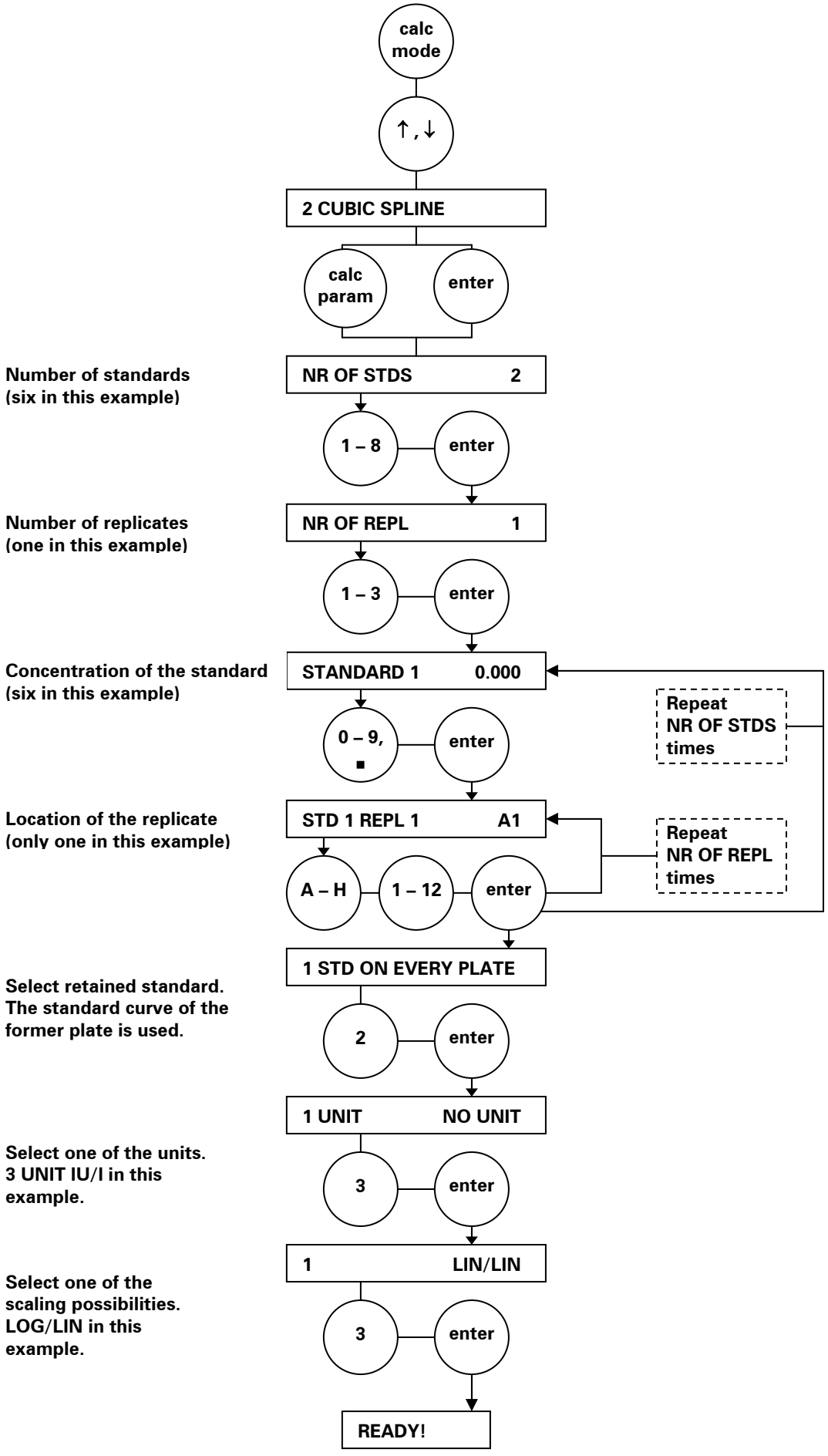
Enter the wavelength of the filter or the filter position number

Position of the blank

Blanking possibilities

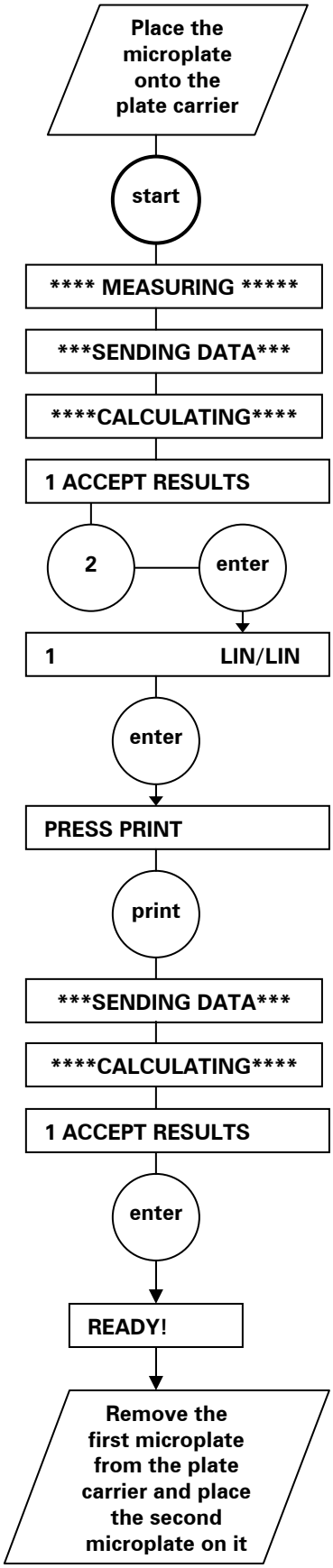


Continued


calc mode
↑, ↓
2 CUBIC SPLINE
calc param
enter
Number of standards (six in this example)
NR OF STDS 2
1 – 8
enter
Number of replicates (one in this example)
NR OF REPL 1
1 – 3
enter
Concentration of the standard (six in this example)
STANDARD 1 0.000
0 – 9, ■
enter
Repeat NR OF STDS times
Location of the replicate (only one in this example)
STD 1 REPL 1 A1
A – H
1 – 12
enter
Repeat NR OF REPL times
1 STD ON EVERY PLATE
Select retained standard. The standard curve of the former plate is used.
2
enter
1 UNIT NO UNIT
Select one of the units. 3 UNIT IU/l in this example.
3
enter
1 LIN/LIN
Select one of the scaling possibilities. LOG/LIN in this example.
3
enter
READY!

Continued

Start the measurement of the first plate.



Parameters, standard curve, concentrations are printed out.

Select whether the results are accepted or a new fit is required. New fit in this example.

Select one of the scaling possibilities. LIN/LIN in this example.

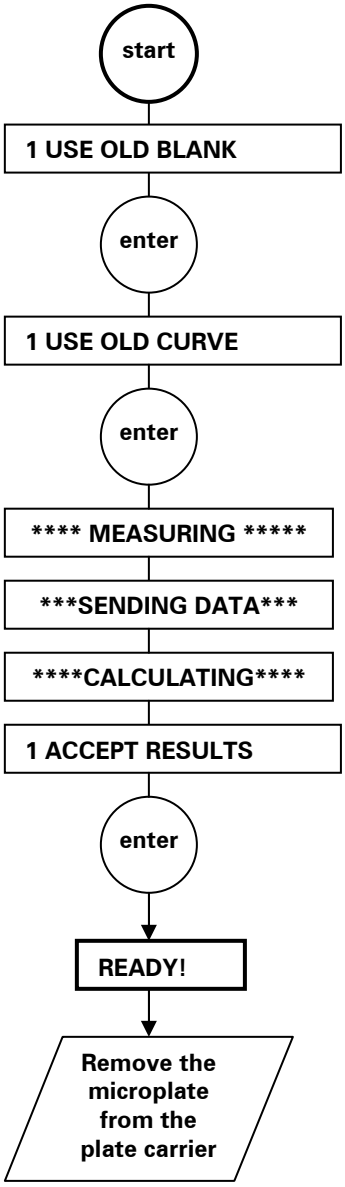
Continued

Start the measurement of the second plate.

Select whether the old blank can be used or a new blank on the plate is used instead.

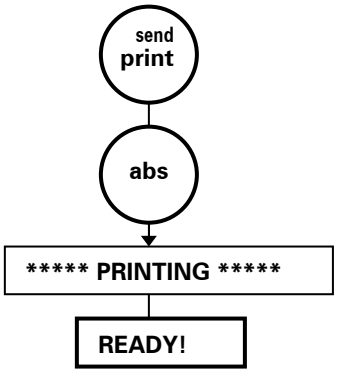
Select whether the old curve can be used or a new curve is calculated instead.

Select whether the results are accepted or a new fit is required.



The absorbance values of the standards are given and a standard curve is plotted. The calculated values of the individual samples are given in plate layout format.

Print the raw measurement data.



7 Maintenance

7.1 Regular and preventive maintenance

7.1.1 Service contracts

It is strongly recommended that this instrument be regularly maintained and serviced every twelve (12) months on a contract basis by trained service engineers of the manufacturer. This will ensure that the product is properly maintained and gives trouble-free service. For more details, contact Thermo Fisher Scientific's service department.

7.1.2 Maintenance check list

The check list below contains a recommended maintenance schedule .

Table 7.1 Maintenance check list

Item	As required	Daily	Weekly	Monthly	Yearly
Wipe the case of the instrument.		●			
Cover the instrument with the dust cover after use.		●			
Clean the instrument outside, the transfer rails and track (Fig. 5.2, item 8) and the plate carrier (Fig. 5.2, item 9) with a cloth dampened with mild detergent, followed by deionized distilled aqua.			●		
Clean and check the condition of the filters and the filter wheel position slots.					2 x
Clean the optical system. See Section 7.3.				●	
If the internal printer is installed, change the paper roll when paper is finished. See Section 7.9.	●				
Change the lamp when blown. See Section 7.5.	●				
Change the fuses when blown. See Section 7.6.	●				
Decontaminate the instrument if any biohazardous material has spilled or when shipping to service. See Section 7.8.	●				
Perform verification with the Multiskan verification plate, Cat. no. 24072800.				●	

Caution: Painted surfaces can be cleaned with most laboratory detergents. Dilute the cleaning agent as recommended by the manufacturer. Do not expose painted surfaces to concentrated acids or alcohols for prolonged periods of time or use any solutions containing hypochlorite, such as bleach, on any of the stainless steel surfaces as damage may occur.

7.1.3 General

Routine and service procedures must be performed by the user to prevent unnecessary wear or hazards and are described below at the frequency with which they should be applied.

Always ensure that the electrical supply in the laboratory conforms to that specified on the voltage label on the instrument.

To guarantee the continuous reliability and accuracy of the Multiskan EX, avoid disturbing any of the optical system components. A misalignment of the light path affects measurements.

- Keep the optical system clean to ensure proper functioning and accurate results.
- Prevent any liquid from entering the instrument.
- Keep the instrument free of dust and other foreign matter.
- Avoid touching the lens surfaces, filters or detectors with your bare fingers.
- Perform the operational test regularly (see Section 5.4).

For reliable daily operation, keep the instrument free of dust and spills from liquids. It is also advisable to cover the instrument with the dust cover supplied when not in use. In the event of any damage, contact your local Thermo Fisher Scientific representative for service.

Abrasive cleaning agents are not recommended, because they are likely to damage the paint finish.

It is recommended that you clean the case of the instrument periodically to maintain its good appearance (see Section 7.2).

Clean the keyboard surface with a mild laboratory detergent.

Plastic covers and surfaces can be cleaned with a mild laboratory detergent or alcohol.

Warning: If any surfaces have been contaminated with biohazardous material, a mild sterilizing solution should be used. See Section 7.8.

7.1.4 Immediate

Although the Multiskan EX is constructed from high-quality materials, you must immediately wipe away spilled saline solutions, solvents, acids or alkaline solutions from outer surfaces to prevent damage and wipe with deionized distilled aqua.

7.1.5 Filter maintenance

The filter is a consumable. It is recommended that you check its condition twice a year to ensure proper functioning of the instrument. It can be checked using the Plate verification (PVT) kit. For ordering information, see Section 10.3. See Section 7.4 on replacing filters.

7.2 Routine cleaning of the instrument

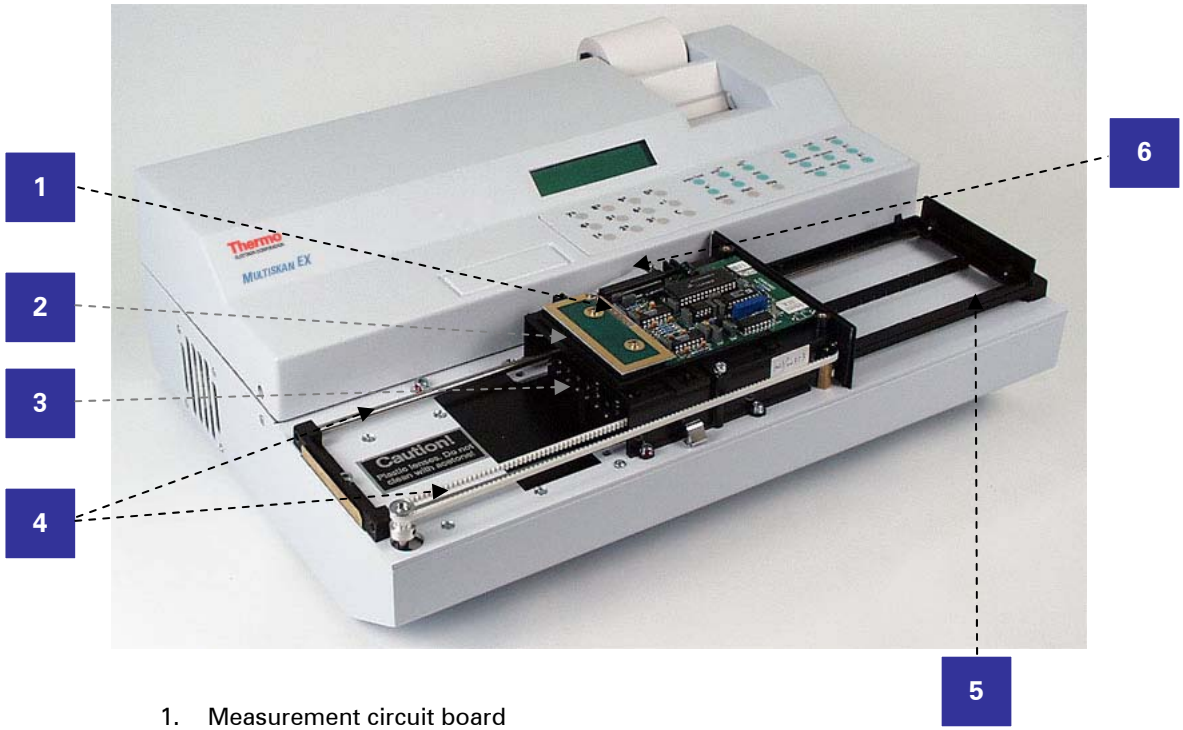
Clean the instrument regularly as stated below.

It is recommended that the case of the instrument be cleaned periodically to maintain its good appearance. It is particularly essential that the plate carrier be clean and dry to prevent jamming. A soft cloth dampened in warm, mild detergent solution will suffice.

Caution: Painted surfaces can be cleaned with most laboratory detergents. Dilute the cleaning agent as recommended by the manufacturer. DO NOT expose painted surfaces to concentrated acids or alcohols for prolonged periods of time as damage may occur.

1. Turn the power OFF and unplug the instrument.
2. Use disposable gloves.
3. Clean the instrument outside, the track (Fig. 7.1, item 4) and the plate carrier (Fig. 7.1, item 5) with a cloth dampened with water or mild detergent.
4. If any surfaces have been contaminated with biohazardous material, a mild sterilizing solution should be used.

Caution: DO NOT use any solutions containing hypochlorite, such as bleach, on any of the stainless steel surfaces, as this may cause permanent damage to the finish.



1. Measurement circuit board
2. Detector frame
3. Focusing lenses
4. Track rails
5. Plate carrier
6. Measurement circuit board cable

Fig. 7.1 Opening the measurement assembly cover

7.3 Cleaning the optical system

1. While the instrument is turned OFF, remove the two (2) retaining screws (Fig. 5.2, item 7) of the measurement assembly cover. Make sure that the plastic washers are kept with the screws. Slide the cover slightly to the left and lift the cover.
2. Clean the track (Fig. 7.1, item 4 inside the measurement assembly as mentioned above.

Caution: DO NOT touch the measurement circuit board (Fig. 7.1, item 1) by hand.

3. Clean the eight (8) focusing lenses at the end of the optical fiber bundle (Fig. 7.1, item 3) with a cloth dampened with water, mild detergent or 96% ethanol. If 96% ethanol is used, wipe afterwards with a napless cloth dampened with water.
4. The upper lenses are situated under the detector frame (Fig. 7.1, item 2). Remove the two detector frame fasteners with washers (Fig. 7.2, item 1). Lift the detector frame from the handle (Fig. 7.3, item 1). Clean the upper lenses (Fig. 7.3, item 2) in the same way as the focusing lenses.

Caution: DO NOT use acetone to clean the plastic lenses (focusing lenses or upper lenses). Avoid harsh treatment.

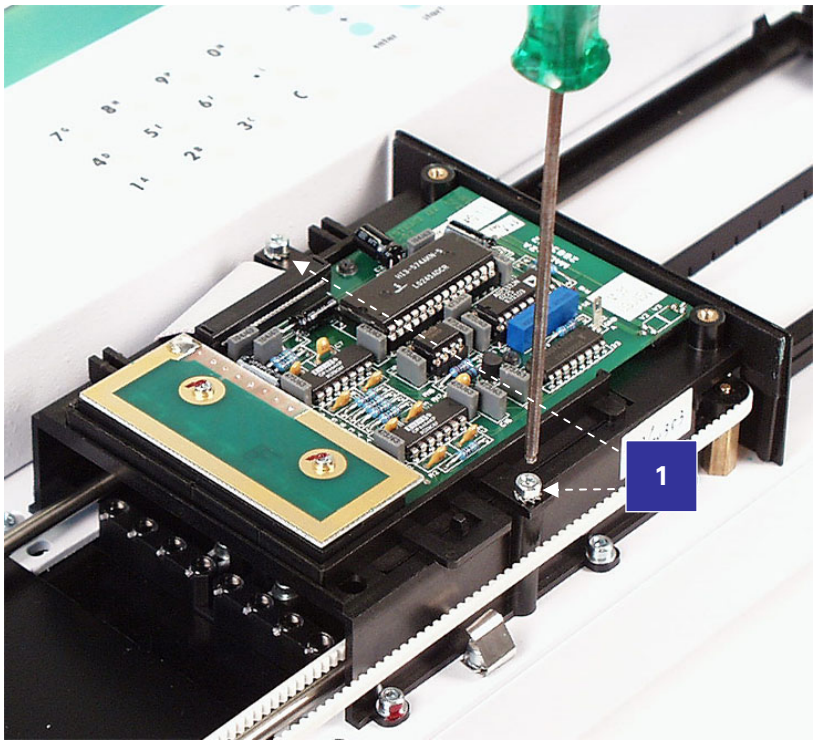
5. After cleaning the upper lenses, lower the detector frame back to its position.

Caution: Make sure that the Hall element sensor (Fig. 7.3, item 3) is positioned into its slot (Fig. 7.3, item 4).

6. Replace the detector frame fasteners with washers (Fig. 7.2, item 1). Make sure that the detector frame fasteners are placed so that the edge in the fastener faces up (Fig. 7.2).

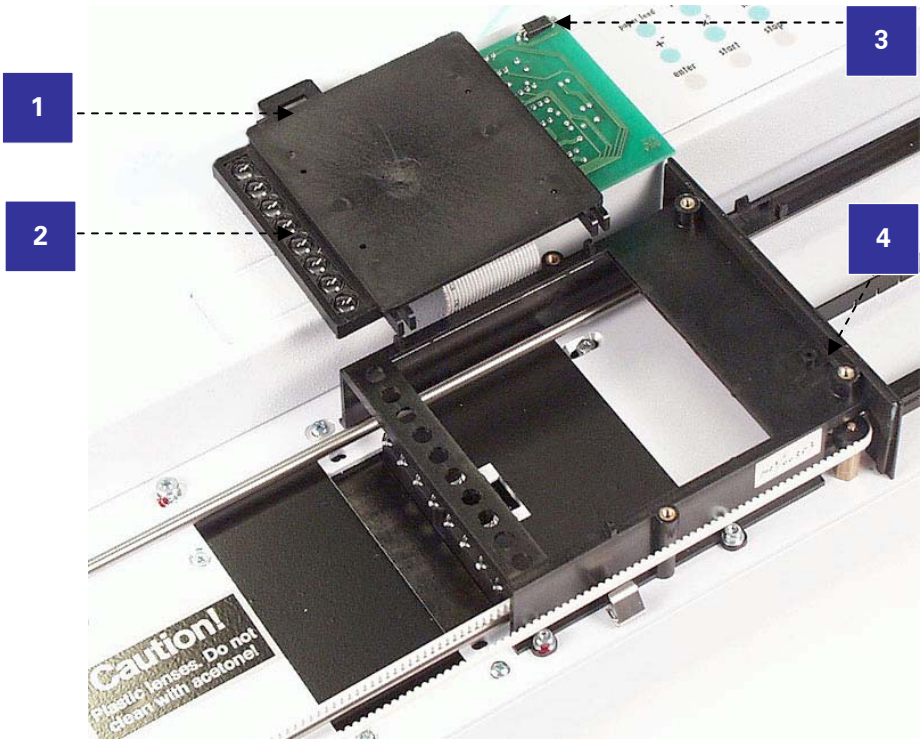
Caution: DO NOT bend the measurement circuit board cable (Fig. 7.1, item 6).

7. Lower the cover slightly to the left of its position. Make sure that all sides are firmly pressing against the instrument frame and slide the cover tightly to its place.
8. Replace the two cover retaining screws with their plastic washers. The screw (Fig. 5.2, item 7) will connect the measurement assembly cover to the instrument ground to suppress electrical disturbances.
9. Clean the interference filters with a napless cloth or with a lens paper. It is recommended not to use liquids when cleaning the filters.



1. Detector frame fasteners with washers

Fig. 7.2 Opening the detector frame



1. Handle
2. Upper lenses
3. Hall element sensor
4. Position of the Hall element sensor

Fig. 7.3 Lifting the detector frame

7.4 Changing individual filters in the filter wheel

Caution: Only use filters approved by the supplier.

1. Switch the power OFF.
2. Unscrew the two (2) cover retaining screws (Fig. 5.2, item 6) and lift the cover.

Caution: When handling the filter wheel, do not touch any other mechanical or electronic part.

3. Lift the filter wheel from the filter wheel slot. Do not touch the filter surfaces.

Fig. 7.4 Removing the filter spring

4. Remove the filter spring by unscrewing the four (4) spring position holding screws.

Caution: Do not touch the filter glass surfaces with your bare fingers.

Caution: The magnet in the middle of the filter wheel attracts both the screwdriver and the screws. Make sure the screwdriver or the screws do not scratch the filters.

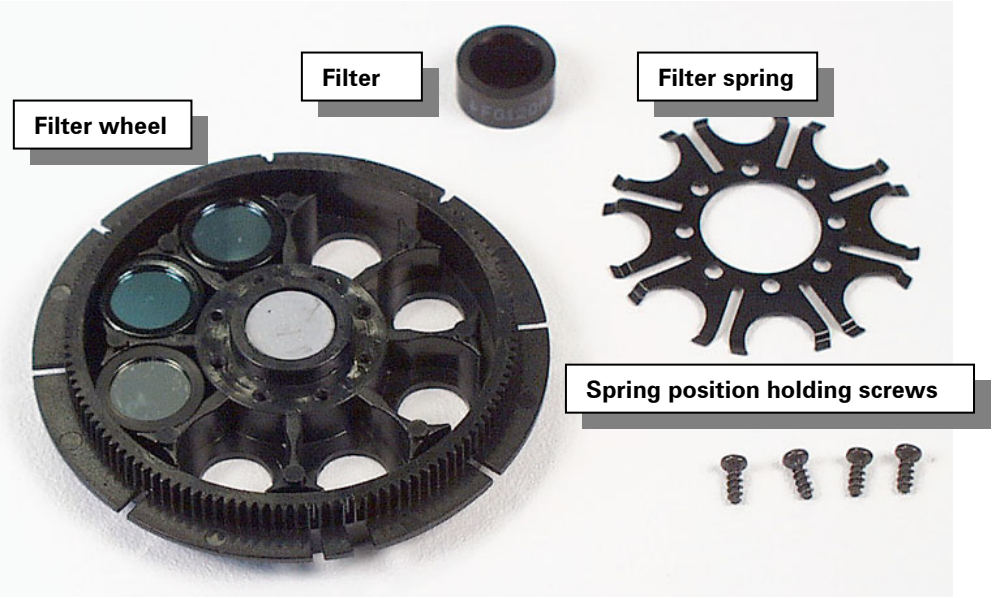


Fig. 7.5 Filter wheel parts

Fig. 7.6 Individual filter showing the arrow

5. Insert a new filter or an additional optional filter into the filter wheel when the filter wheel is in the position shown in Fig. 7.5 so that the arrow on the filter rim points downwards in the direction of the light (Fig. 7.6). The wavelength of the filter is marked on the side, i.e., the three digits before the last digit of the number sequence: xxxxx NNNx, where NNN is the wavelength. The filter positions are marked on the other side of the filter wheel. The filter wheel has at present three filters factory installed (Table 7.2).

Note: Do not change the positions of the factory or earlier installed filters. Insert the optional filters into filter wheel positions after the earlier installed filters.

Table 7.2 Example of the filters in the filter wheel positions 1-8

Filter wheel position	Wavelength (nm)
1	405 (example of factory installed filter)
2	450 (example of factory installed filter)
3	620 (example of factory installed filter)
4	
5	
6	
7	
8	

6. Write down in Table 7.2 the additional filters you have installed into the filter wheel. It is recommended to add the filters in ascending wavelength order.
7. Place the filter spring into its original position and fasten the screw.
8. Slide the filter wheel back into the filter wheel slot with the toothed edge facing towards the rear of the instrument. The magnet locking mechanism will automatically lock the wheel in the correct position. See Section 5.3.1.
9. Close the instrument cover and replace the two cover retaining screws.
10. Switch the instrument ON.
11. Add the filters into the embedded software's general instrument parameters (filter wheel: number of filters and wavelength) using the **param** key. See Section 6.8.4 and Table 6.8.

Note: The measurement results will be incorrect, if the filter parameters differ from the actual filters on the filter wheel.

12. Perform the operational check to ensure the correct functioning of the new filter (Section 5.6).
13. Now the filters are ready for use.

The filter is a consumable. It is recommended that you check its condition twice a year to ensure proper functioning of the instrument. It can be checked using the Plate verification (PVT) kit.

7.5 Changing the lamp

If the lamp burns out, replace it as follows.

Warning: Only use the lamp approved by the supplier: Cat. no. 2400620, Lamp, quartz tungsten halogen lamp (Osram 64607A, 8V/50W).

1. Turn the power OFF and unplug the instrument. Open the instrument cover by unscrewing the two (2) cover retaining screws on each side of the instrument and lift up the cover.

Warning: If the instrument has been in use and you need to replace a burned lamp, the lamp and its surroundings may be very hot. Wait for the lamp to cool down before replacing it.

Caution: When handling the lamp, do not touch any other mechanical or electronic part.

2. Lift up the lamp with the terminal socket. Pull the terminal socket from the lamp contacts (Fig. 7.7).

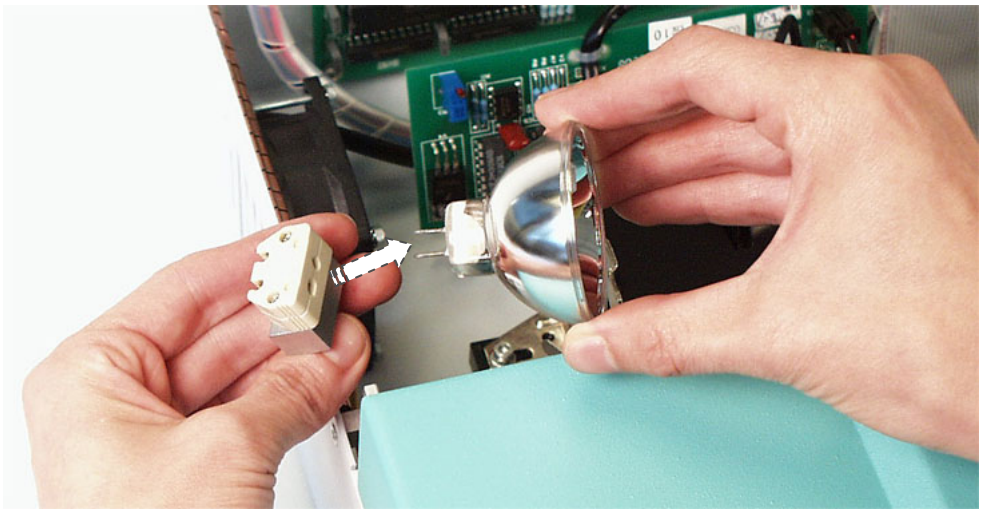


Fig. 7.7 Changing the lamp

Caution: DO NOT touch the reflective surface of the new lamp or the bulb itself.

3. Refit the terminal socket to the contacts of the new lamp approved by the manufacturer (OSRAM 64607A, 8V/50 W). Place the new lamp into its place.
4. Close the instrument cover and replace the two cover retaining screws. Plug in the instrument and switch the power ON.

7.6 Changing the fuses

The fuses are located at the rear of the instrument (Fig. 5.9, item 3).

1. Switch the power OFF.
2. Unplug the instrument and disconnect the power cable from the power input socket.
3. Unscrew the caps of the fuse holders (Fig. 7.8). Use a flat screwdriver and turn about 45° to the left. The fuse cap is released and you can remove it.

Fig. 7.8 Changing the fuses

4. Replace the blown fuses with the same type. Replace always both fuses, as they are usually both damaged.
5. Screw the caps back onto the fuse holders. Turn the cap until you can feel it going further in. Turn it about 45° to the right with the screwdriver.
6. Reconnect the power cable and switch the power ON.

7.7 Disposal of materials

When disposing of used material, follow the Good Laboratory Practices (GLP). Refer to local regulations for the disposal of infectious material.

Warning: The samples can be potentially infectious. Dispose of all used microplates, microstrips, disposable gloves, syringes, disposable tips, etc., as biohazardous waste.

7.8 Decontamination procedure

Decontamination should be performed in accordance with normal laboratory procedures. Any decontamination instructions provided with the reagents used should be followed.

A decontamination procedure is only recommendable when infectious substances have been in direct contact with any part(s) of the instrument.

If there is any risk of contamination with biohazardous material, the procedure recommended below or some other corresponding decontamination procedure must be performed.

It is strongly recommended that the complete decontamination procedure is performed before relocating the instrument from one laboratory to another. Refer to Section 7.8.

Decontamination is not required for the proper functioning of the instrument.

Example of decontaminants

- Ethanol 70%
- Virkon solution 1 – 3%
- Glutaraldehyde solution 4%
- Chloramine T
- Microcide SQ™ 1:64

Caution: If local or laboratory regulations prescribe regular decontamination, it is not advisable to use formaldehyde, since even small traces of formaldehyde affect the enzyme being used in EIA tests in a negative way resulting in bad test results.

Warning: Always use disposable gloves and protective clothing and operate in a well-ventilated area.

7.8.1 How to decontaminate the instrument

Decontaminate the instrument in case of a biohazard of infectious agents as follows.

1. Turn the power OFF and unplug the instrument.
2. Use disposable gloves.
3. Clean the instrument outside, the track (Fig. 7.1, item 4) and the plate carrier (Fig. 7.1, item 5) with a disposable cloth dampened either with 70% ethanol or 1% glutaraldehyde.
4. Remove the two (2) screws (Fig. 5.2, item 7) of the measurement assembly cover and remove the cover. Clean the track (Fig. 7.1, item 4) inside the measurement assembly and the eight (8) focusing lenses at the end of the optical fiber bundle (Fig. 7.1, item 3) as mentioned above.

Caution: DO NOT touch the measurement circuit board (Fig. 7.1, item 1) by hand.

5. The upper lenses are situated under the detector frame (Fig. 7.1, item 3). Remove the two (2) detector frame fasteners with washers (Fig. 7.2, item 1).

Lift the detector frame from the handle (Fig. 7.3, item 1). Clean the upper lenses (Fig. 7.3, item 2) in the same way as the focusing lenses.

Caution: DO NOT use acetone to clean the plastic lenses (focusing lenses or upper lenses). Avoid harsh treatment.

6. Let the surfaces of the instrument dry.
7. Wipe out the thin film caused by the decontamination agent from the surfaces of the eight (8) focusing lenses and the upper lenses with a napless lens tissue dampened with water. Dry the lenses with a dry lens tissue.
8. After drying the upper lenses, lower the detector frame back to its position.

Caution: Make sure that the Hall element sensor (Fig. 7.3, item 3) is positioned into its slot (Fig. 7.3, item 4).

9. Replace the detector frame fasteners with washers (Fig. 7.2, item 1). Make sure that the detector frame fasteners are placed so that the edge in the fastener faces upwards (Fig. 7.2).

Caution: DO NOT bend the measurement circuit board cable (Fig. 7.1).

10. Slide the measurement assembly cover into its position. Replace the two cover retaining screws. The screw (Fig. 5.2, item 7) will connect the measurement assembly cover to the instrument ground to suppress electrical disturbances.
11. After performing this decontamination procedure, include a signed and dated Certificate of Decontamination (Appendix B) both inside the transport package and attached to the outside of the package.

7.9 Replacing the printer paper roll (internal printer only)

If the paper of the internal printer is finished, replace the printer paper roll as follows:

1. Remove the old paper roll by lifting it. The black paper roll shaft (Fig. 5.1) will come off with the roll.
2. Make sure the edge of the paper in the new roll is straight (no tears or creases). Feed the paper evenly through the back slot as far as it goes without using any force.
3. Press the **paper feed** key.
4. Insert the paper roll shaft inside the roll and put it back in its place.

7.10 How to pack for service

When you ship the instrument for service remember to:

- Inform about the use of hazardous materials.
- Decontaminate the instrument beforehand.
- Pack the instrument according to the enclosed packing instructions using the original packaging.
- Use the original packaging to ensure that no damage will occur to the instrument during shipping. Any damage will incur additional labor charges.
- Enclose a dated and signed Certificate of Decontamination (Appendix B) both inside and attached to the outside of the package, in which you return your instrument (or other items).
- Enclose the return authorization number (RGA) given by your Thermo Fisher Scientific representative.
- Indicate the fault after you have been in touch with your local Thermo Fisher Scientific representative or Thermo Fisher Scientific's service department.

See Chapter 9 for details on storage and transportation temperatures. See also Section 8.2 Service request protocol.

7.11 Disposal of the instrument

Warning: Decontaminate the instrument prior to disposal. See Section 7.8 and Appendix B on decontamination.

Dispose of the instrument according to the legislation stipulated by the local authorities concerning take-back of electronic equipment and waste. The proposals for the procedures vary by country.

Thermo Fisher Scientific has contracted with one or more recycling/disposal companies in each EU Member State European Country, and this product should be disposed of or recycled through them. Further information on Thermo Fisher Scientific's compliance with these Directives, the recyclers in your country, and information on Thermo Fisher Scientific products which may assist the detection of substances subject to the RoHS Directive are available at www.thermo.com/WEEERoHS.

The instrument includes a lithium battery. Follow the local regulations for the disposal of batteries.

Regarding the original packaging and packing materials, use the recycling operators known to you.

For further information, contact your local Thermo Fisher Scientific representative.

8 Troubleshooting

Warning: DO NOT use the instrument if it appears that it does not function properly.

8.1 Troubleshooting guide

The problems covered below are considered as faults that require repair or corrective repair. If the installation procedure is carefully followed, no faults should arise. However, if problems occur or reoccur, contact authorized technical service immediately.

Table 8.1 Troubleshooting guide and error messages

Error	Cause	Action
No power when switched on		Check that the instrument is plugged in. Check that the fuses are not blown.
Unsuccessful transfer of data via the interface system		Check that both the instrument and the computer have the same baud rate, character length and handshake settings. See Section 5.4. Check that the transmit / receive pin configuration is correctly set. See Section 5.4. Check the connection cable.
The printer is not printing	The printer has no paper. A wrong cable is in use The printer cable is connected to the RS-232 port The printer settings are incorrect	Add paper. Check the used cable. Connect the printer cable to the printer port (Fig. 5.9, item 4). Check the printer settings (Section 6.8.1). Check the DIL switches (Section 5.4).
The printer prints overlapping rows	The printer paper in the printer is jammed.	Ensure fluent flow of the printer paper.
Internal printer stops printing	The printer paper in the internal printer is jammed.	Ensure fluent flow of the printer paper. Contact authorized technical service.

Error	Cause	Action
PLATE ERROR		Check that the plate is properly positioned in the plate carrier (Fig. 6.1). Check that no foreign matter is obstructing the plate carrier. Check that the rails are clean and not bent. Check that the toothed belt is not broken.
FILTER ERROR	The filter wheel is missing or faulty.	Place the filter wheel into the filter wheel slot. Check that the filter wheel has been properly installed or is not broken. Check the condition of the filter wheel position slots (Fig. 5.4).
TOO MUCH LIGHT	Too much light enters the detectors. The filter wheel may be missing or an individual filter is faulty.	Check the filter. Contact authorized technical service.
NO LIGHT	The lamp has burnt out. The optical light path is obstructed.	Change the lamp. Check also the previous measurement results in case the lamp has burned in the middle of the measurement. Check the instrument and filters. Change the filter if damaged.
CHOPPER SPEED ERROR	Chopper motor control faulty	Contact authorized technical service.
NO CENTRONICS PRINTER	The parallel, Centronics type printer is not connected. The printer has no paper.	Connect the Centronics printer. Check the printer settings. Check the option switch no. 2. (Section 5.4.5) Add paper to the Centronics printer.
PRINTER ERROR	The Centronics printer is not switched on.	Switch the Centronics printer on.
SAVING ERROR	Saving the program is not successful.	Contact authorized technical service.
CHECKSUM ERROR	Loading the program is not successful.	Contact authorized technical service.
OUT OF RANGE	The value entered is out of available value range.	Enter a value that is within the instrument's range.
NOT AVAILABLE	The selection is not available.	Enter another selection.
EQUATION ERROR 1-5	There are errors in the cutoff equation.	Make corrections to the cutoff equation.
EQUATION ERROR 1	The first character in the equation is).	Should be (
EQUATION ERROR 2	The number of parentheses is uneven.	Should be even

Error	Cause	Action
EQUATION ERROR 3	The first symbol in the cutoff equation is not (nor an operand.	Should be (or operand
EQUATION ERROR 4	The operator is not followed by C or an operand.	Make corrections.
EQUATION ERROR 5	There are two operands after each other in the equation.	Make corrections.

If you were able to correct the error without having to turn off the instrument, you may continue instrument operation by pressing **start**.

8.2 Service request protocol

If the Multiskan EX requires service, contact your local Thermo Fisher Scientific representative or Thermo Fisher Scientific's service department. DO NOT under any circumstances send the instrument for service without any prior contact. It is imperative to indicate the fault and nature of the required service. This will ensure a faster return of the instrument to the customer.

Your Thermo Fisher Scientific representative or distributor will take care of sending a complaint form (Complaint-order) to Thermo Fisher Scientific's service department. The Complaint-order contains a more detailed description of the fault, symptom or condition. Give all the necessary information to the distributor, who will fill in and forward the Complaint-order to Thermo Fisher Scientific's service department.

Check Section 7.10. You will find instructions on how to proceed before shipping the instrument for service.

Check that any necessary decontamination procedure has been carried out before packing. See Section 7.8 Decontamination procedure. Ensure that the Certificate of Decontamination (see Appendix B) as well as the return authorization number (RGA) are sent with the instrument.

Thermo Fisher Scientific's service department will keep you up to date with the progress of service and provide you with any further details you might need, e.g., on maintenance, serviceability, troubleshooting and replacement.

8.3 Warnings and cautions

This instrument is designed to provide full user protection. When correctly installed, operated and maintained, it will present no hazard to the user.

The following recommendations are given for added user safety.

8.3.1 Electrical

Ensure that the mains supply cable supplied with the unit is always used. **If a correct type of mains cable is not provided, use only cables certified by the local authorities.**

The mains plug should only be inserted into a socket outlet provided with a protective ground contact. Never use an extension cable without a protective ground wire.

Warning: DO NOT replace fuses without first disconnecting the mains supply cable.

Ensure that only fuses with the required rated current and of the specified type are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders is prohibited.

Warning: When the instrument is connected to the mains supply, the opening of covers or the removal of components is likely to expose live parts. Disconnect the instrument from all voltage sources by disconnecting the mains supply cable before opening it for any adjustment, replacement, maintenance or repair.

Any adjustment, maintenance or repair of the opened instrument under voltage should be avoided, if possible, but, if unavoidable, should be carried out only by a skilled technician aware of the hazard.

The same precautions applicable when using any electrical equipment should naturally be observed with this instrument.

Warning: DO NOT touch switches or electrical outlets with wet hands.

Switch the instrument OFF before disconnecting it from the mains supply.

8.3.2 Defects and abnormal stresses

Warning: If the instrument is not functioning properly, it may create electromagnetic perturbation, which could impair the operation of other devices or equipment in the usual environment.

Whenever it is likely that the protection has been impaired, the instrument should be made inoperative and be secured against any unintended operation. Contact authorized technical service immediately.

The protection is likely to be impaired if, for example, the instrument:

1. Shows any visible damage
2. Fails to perform the intended functions
3. Has been subjected to prolonged storage under unfavorable conditions
4. Has been subjected to severe transport stresses.

9 Technical Specifications

9.1 General specifications

General specifications	
Overall dimensions	140 mm (H) x 420 mm (W) x 320 mm (D) [5.5" (H) x 16.5" (W) x 12.6" (D)]
Weight (Basic unit)	11 kg [24 lbs.]
Mains power supply	100 – 240 Vac, 50/60 Hz
Power consumption	170 VA max.
Heat dissipation	580 BTU
Fuse requirements	2 x 3.5 A, slow-blow type UL 198G Time Delay, 5 x 20 mm
Operating conditions	+10°C – +40°C, maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C Indoor use only
Transportation conditions	–40°C – +70°C, packed in transport packaging
Storage conditions	–25°C – +50°C, packed in transport packaging
Microplates	96-well plate
Optical system	Quartz tungsten halogen lamp (Osram 64607, 8V/50W), chopper wheel, aperture and condenser lens, semitransparent mirror, interference filter (in filter wheel), fiber bundle, focusing lenses, upper lenses and detectors
Wavelength range	400 – 750 nm
Filters	8-position filter wheel Standard filters 405 nm, 450 and 620 nm
Half-bandwidth of filters	3 – 9 nm
Wavelength accuracy	± 2 nm
Detector	Eight (8) silicon photodetectors
Measurement range	0 – 3.5 Abs
Resolution	0.001 Abs
Linearity	0 – 2 Abs, ± 2.0% at 405 nm
Accuracy	± 2.0% or ± 0.007 Abs whichever is greater, typical value ±1% (0 – 2.0 Abs) at 405 nm
Precision	CV < 0.5% (0.3 – 1.5 Abs) at 405 nm CV < 1.0% (1.5 – 2 Abs) at 405 nm
Start-up time	One (1) minute
Measurement time	5 s/96-well plate (continuous mode) 20 s/96-well plate (stepping mode)
Long-term stability	Due to the autoblanking procedure the instrument is stable.
Shaker	Linear shaking, 3 speeds
Display	82 mm (L) x 19 mm (W), 2 x 20 character alphanumeric LC display, 5 x 7 dots per character
Keyboard	30 keys with click action switches
Onboard software	Primary EIA, Cutoff and Cubic spline calculation programs
Reader memory	RAM: 32 kB ROM: 64 kB for each program module (max. 5 x 64 kB) EEPROM: 32 kB
Programs	64 user-determined programs
Interface	RS-232C serial interface

General specifications	
	Centronics-type parallel printer interface
Integrated printer (optional)	Three (3) columns simultaneously, up to 0.000 (3 decimals) Resolution: 138 dots per line Speed: results of one 96-well plate printed in about 60 s

9.2 Safety specifications

Safety performance:
EN 61010-1:1993 + A2:1995/IEC 61010-1:1990 + A1:1992 + A2:1995, including CENELEC Common Modifications, US and CA National differences
EN 61010-1:2001 (Ed. 2)

9.3 In conformity with the requirements

Multiskan EX bears the following markings:
Type 355
100 – 120 Vac, 200 – 240 Vac 50/60 Hz, 170 VA
CE

Multiskan EX conforms to the following requirements:
2006/95/EC (Low Voltage Directive)
2004/108/EC (Electromagnetic Compatibility Directive, EMC)
FCC Part 15, Subpart B/Class B
2002/96/EC (Waste of Electrical and Electronic Equipment)

EMC performance:	
EN 50081-1:1992	Generic emission standard. Residential, commercial and light industry.
EN 50082-1:1997	Generic immunity standard. Residential, commercial and light industry.
EN 61326-1:1997 + A1:1998	Product family standard.

10 Ordering Information

Contact your local Thermo Fisher Scientific representative for ordering and service information.

Code	Instrument
51118170	Multiskan EX, 200 – 240 V
51118177	Multiskan EX, 100 – 120 V
51118060	Onboard printer for Multiskan EX
51118070	Cutoff option for Multiskan EX
51118080	Cubic spline option for Multiskan EX

10.1 List of accessories

Code	Item
2304040	RS-232C interface cable for printer
2305300	RS-232C PC serial cable F-M
2303850	RS-232C interface cable for MAC
24071230	Filter wheel without filters
142xxx0	Other filters in the 400 – 750 nm range can be ordered (xxx corresponds to the wavelength)
1041980	Filter box
5185430CD	Ascent Software v. 2.6 for Multiskan
1507300	User manual
N02724	Brief User's Guide
1610002	Dust cover

10.2 Spares for maintenance

Code	Item
2400620	Lamp, quartz tungsten halogen lamp (Osram 64607A, 8V/50W)
1600510	Thermal paper MTP201/58mm
1210950	Fuse 3.5 A (10 pcs/box)

10.3 Verification plates

Code	Item
24072800	Multiskan Verification Plate
24073500	Multiskan Verification Plate, includes Ascent Software

11 Warranty Certificate

Thermo Fisher Scientific Microplate Instrumentation Business Multiskan EX is fully guaranteed against defective parts and materials, including defects caused by poor workmanship, for a period of three (3) years from the date of delivery.

Thermo Fisher Scientific will repair or replace defective parts or materials during the term of warranty at no extra charge for materials and labor provided that the products were used and maintained in accordance with Thermo Fisher Scientific's instructions. The warranty is invalid if products have been misused or abused.

For the warranty to be effective, the product must have been purchased either directly from Thermo Fisher Scientific or from an authorized Thermo Fisher Scientific distributor. The guarantee is not transferable to a third party without prior written approval from Thermo Fisher Scientific.

This guarantee is subject to the following exclusions:

- Any defects caused by normal wear and tear.
- Defects caused by fire, lightning, flood, earthquake, explosion, sabotage, war, riot, or any other occurrence of the character listed above.
- Refurbished products that are subject to different warranty conditions.

THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESSED OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. The seller is not liable for any loss or damage arising out of or in connection with the use of the product or other indirect damages.

Full warranty terms and conditions can be obtained from your local Thermo Fisher Scientific dealer.

This document acts as a warranty certificate.

11.1 Warranty limitations

Consumables are not included in the warranty.

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13 Glossary and Abbreviations

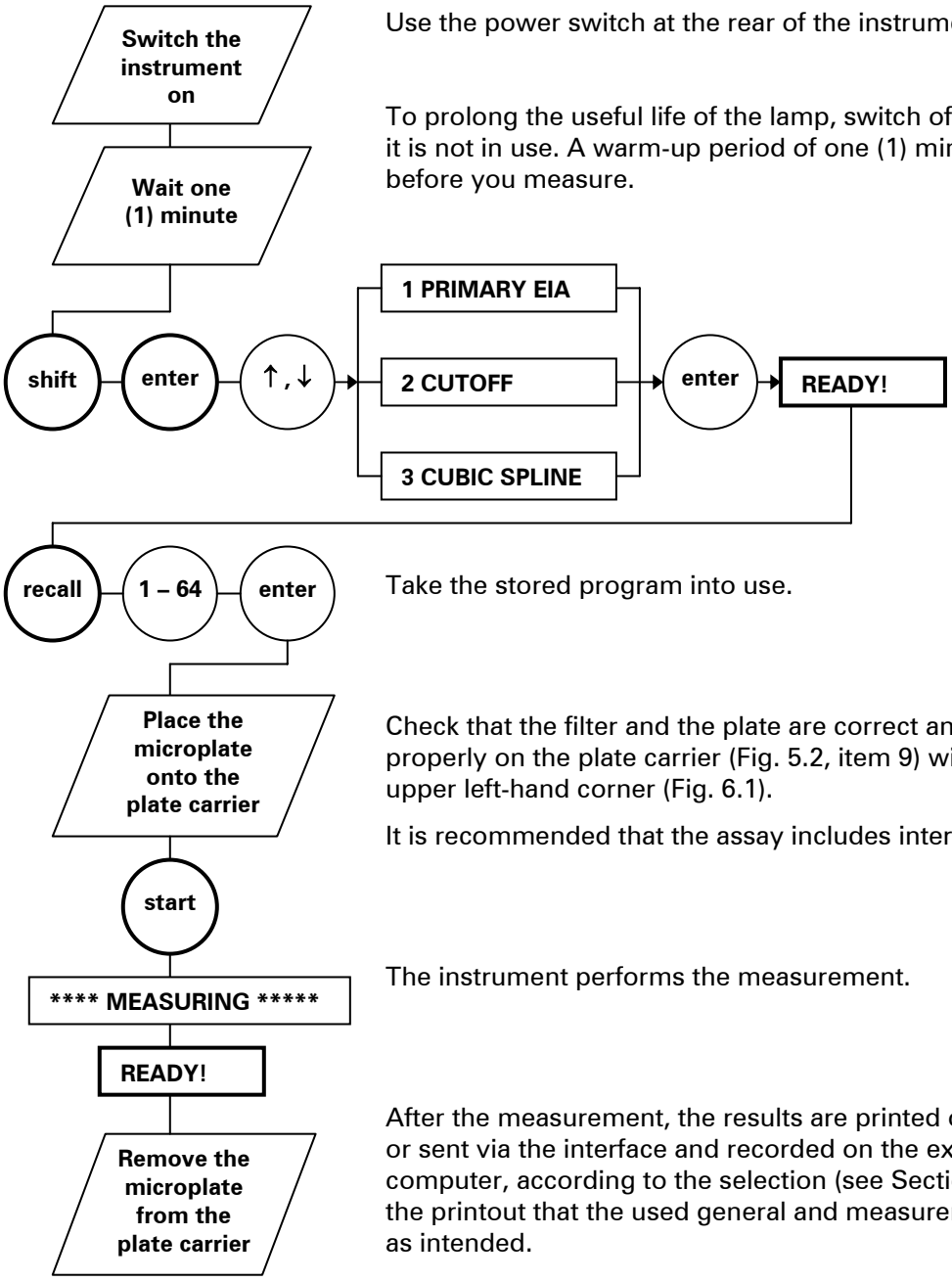
Absorbance	Negative logarithm of one minus absorptance as measured on a uniform sample.
Blank(s)	Blanks in assays: *Reagent blank* = reagent blank without any sample. The reagent blank well contains all test reagents except the sample itself. The absorbance of the reagent blank is usually subtracted from all other absorbances. *Specific blank* = each calibrator, control or sample has its own blank. A specific blank well contains the sample and the buffer but not the reagent giving the specific reaction. Background caused by individual samples can be subtracted. Abbr. BI, BL or BLANK
Control(s)	A material, solution, lyophilized preparation, or pool of collected serum designed to be used in the process of quality control. The concentrations of the analytes of interest in the control material are known within limits ascertained during its preparation, and confirmed in use.
Cubic spline	A curve fit type. Spline curves of degree 3 provide a useful means of approximating data to moderate accuracy. Cubic spline uses repeated calls to the cubic polynomial fit using three sequential calibrators. A spline is a curve calculated by a mathematical function that connects separate points with a high degree of smoothness.
Cutoff	The limit or threshold value. In qualitative assays cutoff can provide you with interpretations of data in a qualitative way, e.g., positive, negative, high, or low.
DIP switch	One or more small rocker- or sliding-type switches contained in the plastic or ceramic housing of a dual in-line package (DIP) connected to a circuit board. Each switch on a DIP switch can be set to one of two positions, closed or open, to control options on the circuit board.
Double limit	Pertaining to cutoff equations. The measured absorbance values are compared with two limit values defined by the user.
EIA	Enzyme immunoassay. An immunoassay using a color-changing enzyme-substrate system for indicating results. A diagnostic test method to measure or detect a substance using antibody-antigen reactions.
EN	European Norm.
EU	European Union.
Filter	An optically wavelength selective component.
IEC	International Electrotechnical Commission.
Kinetic measurement	Measurement over a time period at certain intervals.
Microplate	A rigid or framed polystyrene plate with microwells in different well formats (e.g., 6, 12, 24, 48, 96, 384, 864, etc., wells) for ease of use in performing multiple tests through techniques such as EIA or ELISA.
Photometer	A device for measuring the intensity of infrared, ultraviolet, or visible light.
Photometry	Volumetric analysis in which the endpoint of a reaction is determined from color changes detected by photoelectric means.

Point to point	Curve fit type. These fitting types will pass through each of the points. Adjacent response-concentration coordinates are linked with straight lines (linear interpolation).
Reagent	A substance or solution used to produce a characteristic chemical reaction in a sample that allows an analyte to be detected and measured.
RS-232C	EIA approved standard used in serial data transmission, covering voltage and control signals. The data is transferred serially (one digital bit at a time) via one path, but some control signals can be transferred simultaneously via parallel paths.

13.1 Keywords for web pages

absorbance
column subtraction
cubic spline
cutoff
double limit
drug discovery
dual wavelength
EIA
ELISA
end point
enzyme immunoassay
factor
immunoassay
kinetic reading
liquid handling
limit
linear standard
microplate
Microtiter plate
microwell plate
multiwavelength
photometer
photometry
plate
point to point
primary EIA
range
sandwich assay
standard line
Thermo Scientific
Thermo Fisher Scientific
two point

Thermo Scientific Multiskan EX Quick Reference Guide



Use the power switch at the rear of the instrument (Fig. 5.9, item 1).

To prolong the useful life of the lamp, switch off the instrument when it is not in use. A warm-up period of one (1) minute has to be allowed before you measure.

Select first the program module.

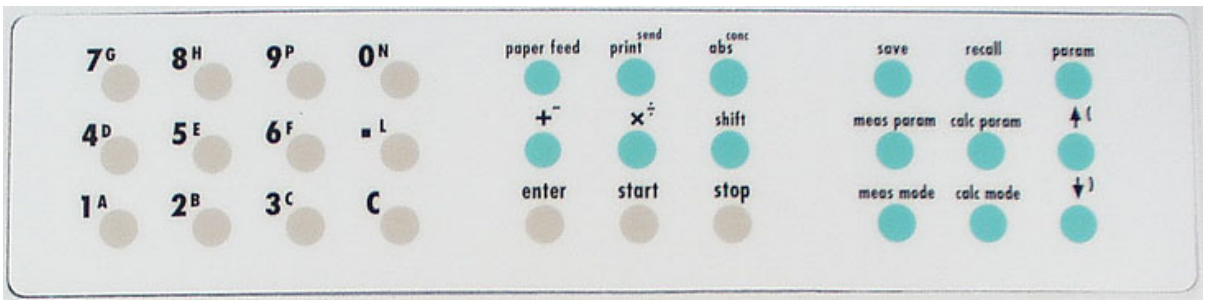
Take the stored program into use.

Check that the filter and the plate are correct and the plate is placed properly on the plate carrier (Fig. 5.2, item 9) with the A1 well in the upper left-hand corner (Fig. 6.1).

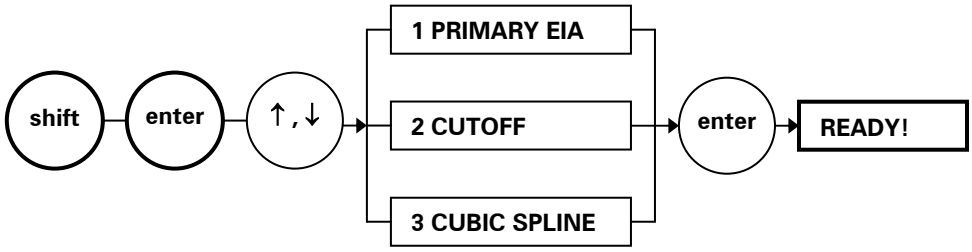
It is recommended that the assay includes internal quality controls.

The instrument performs the measurement.

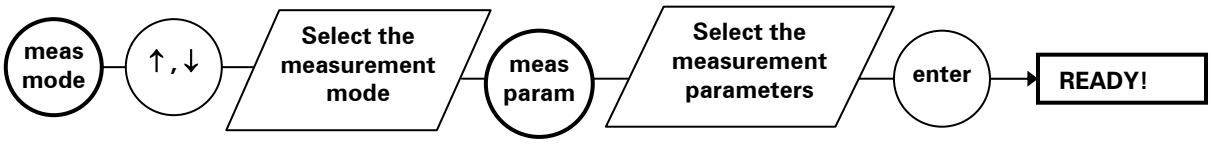
After the measurement, the results are printed on the internal printer or sent via the interface and recorded on the external printer or the computer, according to the selection (see Section 6.8.1). Check from the printout that the used general and measurement parameters were as intended.



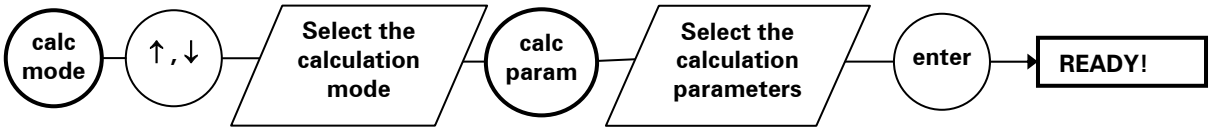
1. Select the program module. See Table 4.1.



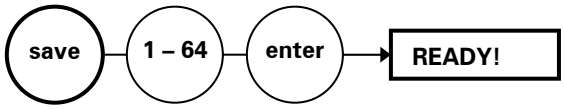
2. Select the measurement mode and measurement parameters.
   See Table 6.3 on p. 53 and Table 6.4 on p. 53.



3. Select the calculation mode and calculation parameters.
   See Table 6.5 on p. 55, Table 6.6 on p. 57, and Table 6.7 on p. 59.



4. You have now made a program. Save it to the instrument memory.



5. Select shaking if required. See Section 6.8.3 on p. 49 and Table 6.8 on p. 59.

   Also see examples in Section 6.9.1.

Certificate of Decontamination

The decontamination procedure is required prior to shipping the instrument to Thermo Fisher Scientific Oy, e.g., for repair. If, for any reason, the instrument is shipped back to Thermo Fisher Scientific Oy, it must be accompanied by a dated and signed Certificate of Decontamination, which must be attached to the outside of the package containing the instrument. See Section 7.8 Decontamination procedure.

Failure to confirm decontamination will incur additional labor charges or at worst the items will be returned for proper cleaning.

Before returning any instrument(s) or item(s), ensure that they are fully decontaminated. Confirm A or B status:

Name: _____

Address: _____

Tel./Fax: _____

Name: _____ Serial no.: _____

A)
I confirm that the returned items have not been contaminated by body fluids, toxic, carcinogenic or radioactive materials or any other hazardous materials.

B)
I confirm that the returned items have been decontaminated and can be handled without exposing the personnel to health hazards.

Materials used in the unit: Chemicals + Biological • Radioactive *)

Specific information about contaminants: _____

_____

_____

Decontamination procedure[1]: _____

_____

_____

Date and place: _____

Signature: _____

Name (block capitals): _____

*) The signature of a Radiation Safety Officer is also required when the unit has been used with radioactive materials.

This unit is certified by the undersigned to be free of radioactive contamination.

Date and place: _____

Signature: _____

Name (block capitals): _____

[1] Please include decontaminating solution used.

Please send to Thermo Fisher Scientific Oy
Fax: +358-9-32910415

Thermo Scientific Multiskan EX Feedback Form

Cat. no.	Serial no.
PURCHASED BY	**PURCHASED FROM**
Company/Organization	Distributor
Department	
Address	Address
Tel.	Tel.
Fax	Date of delivery
Internet home page	
Date of purchase	
Your research area	
Dr. ☐ Mr. ☐ Mrs. ☐ Ms. ☐ Job title/Position	
Surname (block capitals)	First name (block capitals)
Internet e-mail address	

	Excellent	Above expectations	As expected	Below expectations	Comments
Reagent kit/Instructions	☐	☐	☐	☐	
Instrument/User manual	☐	☐	☐	☐	
Operational reliability	☐	☐	☐	☐	
Design	☐	☐	☐	☐	
Ease of use	☐	☐	☐	☐	
Operational costs	☐	☐	☐	☐	
Customer support	☐	☐	☐	☐	

Further instrument/system developments desired:

Further applications desired:

Where did you first learn about the product?

Would you like to receive information about other Thermo Fisher Scientific products?

Addresses

For the latest information on products and services, visit our worldwide web sites on the Internet at:

http://www.thermo.com

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Notes

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