Technical Manual

Thermo Scientific Varioskan LUX

Rev. 2.3, Cat. No. N16045

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Preface

About this guide

Thermo Scientific™ Varioskan™ LUX is a modular multi-technology microplate reader, controlled by Thermo Scientific™ SkanIt™ Software for Microplate Readers.

This guide gives a thorough description of the instrument installation procedures, and also recounts the main operations, routine maintenance and troubleshooting of the instrument.

Related documentation

In addition to this guide, Thermo Fisher Scientific provides the following documents:

- *Thermo Scientific™ Varioskan™ LUX User Manual* (Cat. No. N16044).
- *Thermo Scientific™ SkanIt™ Software for Microplate Readers Technical Manual* (Cat. No. N16046).

The software also provides Help.

In an effort to produce useful and appropriate documentation, we appreciate your comments on this Technical Manual to your local Thermo Fisher Scientific representative.

Safety and special notices

Make sure you follow the precautionary statements presented in this guide. The safety and other special notices appear in boxes.

Safety and special notices include the following:

CAUTION! Highlights hazards to humans, property, or the environment. Each CAUTION notice is accompanied by an appropriate CAUTION symbol.

IMPORTANT! Highlights information necessary to prevent damage to system, loss of data, or invalid test results; or may contain information that is critical for optimal performance of the system.

Note! Highlights information of general interest.

Tip! Highlights helpful information that can make a task easier.

Instrument safety and guidelines for use

1. Always follow basic safety precautions when using the Varioskan LUX to reduce the risk of injury, biohazardous contamination, fire, or electrical shock.
2. Read this user manual in its entirety prior to operating the instrument. Failure to read, understand, or follow the instructions in the manual may result in damage to the instrument, injury to laboratory and operating personnel or poor instrument performance.
3. Observe all “CAUTION”, “IMPORTANT”, “Note” and “Tip” statements as well as safety symbols and markings on the instrument and in the documentation.
4. Do not open any other covers of the Varioskan LUX than the dispenser sliding cover (Figure 2–2) or measurement chamber door (Figure 2–2) while the instrument is plugged into a power source.
5. Do not open the measurement chamber door while the instrument is in operation (when the LED indicator is orange).
6. Do not push in the tray manually unless the instrument is switched off.
7. Do not force a microplate into the instrument.
8. The Varioskan LUX is intended for laboratory research use only. Observe proper laboratory safety precautions, such as wearing protective clothing and following approved laboratory safety procedures. It is recommended that Good Laboratory Practice (GLP) is followed to ensure reliable analyses.
9. Follow the preventive maintenance instructions closely to keep the instrument in the best condition for maximum reliability. A poorly maintained instrument will not give the best results.

Emergency situations

If there is any abnormal situation during the operation, such as fluids spilling inside the instrument:

1. Switch off the instrument (Figure 2–2).
2. Unplug the instrument immediately from the power supply (Figure 3–33).
3. Carry out appropriate corrective measures. However, do not disassemble the instrument.

If these corrective measures taken do not help, contact authorized technical service or your local Thermo Fisher Scientific representative.

Contacting us

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Introduction to Varioskan LUX

Overview

Thermo Scientific™ Varioskan™ LUX (Figure 1–1) is a modular multi-technology microplate reader. Varioskan LUX is controlled by Thermo Scientific™ SkanIt™ Software for Microplate Readers.

End point, kinetic and spectral measurements can be carried out in the UV/Vis/NIR range from appropriate microplate formats. In fluorescence intensity, time-resolved fluorescence, luminescence and AlphaScreen™ measurements 6- to 1536-well plates can be used, and correspondingly 6- to 384-well plates in absorbance measurements.

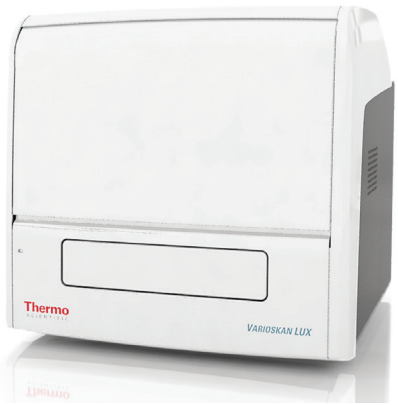


Figure 1–1 Thermo Scientific™ Varioskan™ LUX

The instrument is always equipped with the following detection technologies:

- Absorbance
- Fluorescence intensity (FI)

Depending on the instrument model, the following optional detection technologies (LAT module) may be included:

- Luminescence
- AlphaScreen
- Time-resolved fluorescence (TRF)

The instrument selects the measurement wavelength either by using filters or monochromators depending on the measurement technology.

- Monochromators are used in absorbance and fluorescence intensity measurements.
- Filters are used in AlphaScreen and TRF measurements.
- Most luminescence measurements do not require any wavelength selection. But if required, filters can be used.

The LAT module has built-in excitation filters for TRF and AlphaScreen. The TRF and AlphaScreen (and luminescence) emission filters you need to install yourself.

Note! All measurement technologies, except AlphaScreen, allow spectral scanning measurements with monochromators.

The instrument has an incubator for temperature control up to 45°C and a plate shaking capability with orbital shaking mode.

The instrument can also be equipped with:

- Dispensers (up to two) for automatic reagent addition
- Integrated gas module for controlling the gas atmosphere (CO_2 & O_2) inside the instrument.

The optical system of the instrument allows you to perform:

- Fluorescence intensity measurements from the top or bottom of the well
- Luminescence, TRF and AlphaScreen measurements from the top of the well
- Absorbance measurements through the well

Note! Fluorescence measurements from the bottom of the well require an instrument model supporting bottom reading.

Note! Your instrument may not have all of the features presented in this guide. As the instrument is modular, you can upgrade it with missing features later.

Intended use

The Varioskan LUX modular multi-technology reader (Figure 1 – 1) is used to measure fluorescence intensity, absorbance, luminescence, time-resolved fluorescence and AlphaScreen from samples in appropriate microplates. The instrument also has incubating, atmospheric control, shaking and reagent dispensing capabilities.

It is used with an external computer control software. The reader is intended to be used in research laboratories by professional personnel. The multi-technology reader is not intended for diagnostic use.

For validation of the entire system, it is recommended that Good Laboratory Practice (GLP) is followed to ensure reliable analyses.

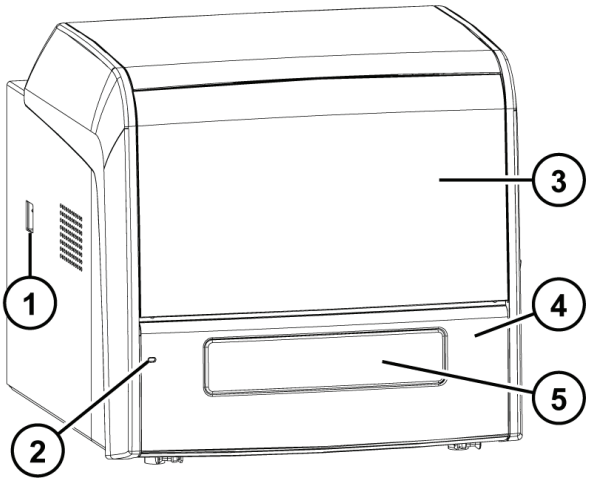
2

Functional Description

Instrument layout

Front view

The front view of the Varioskan LUX instrument is shown in Figure 2–2.



1. Power switch
2. LED indicator
3. Dispenser sliding cover
4. Front cover
5. Measurement chamber door

Figure 2–2 Varioskan LUX front view

Back view

The back view of the Varioskan LUX instrument is shown in Figure 2–3 and Figure 2–4.

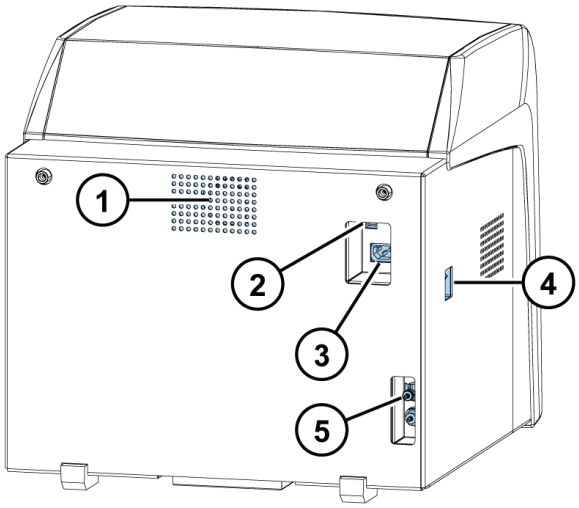


Figure 2–3 Varioskan LUX back view

1. Cooling fan outlets
2. USB connector
3. Mains power supply connector
4. Power switch
5. Gas connectors

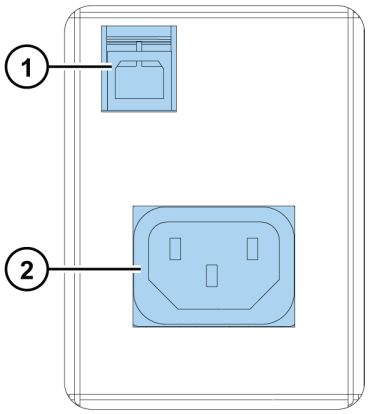
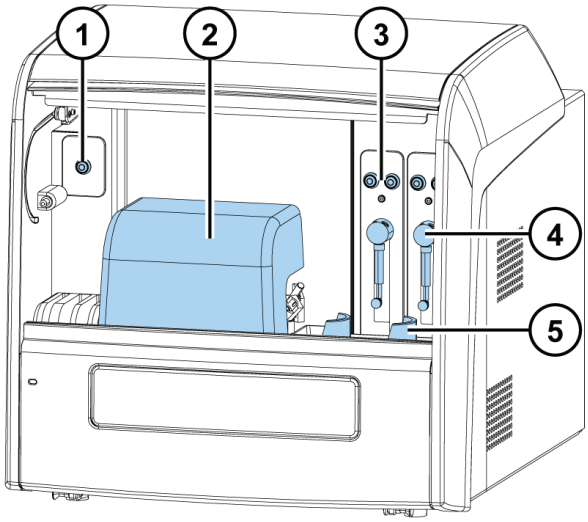


Figure 2–4 Close-up of the computer and mains supply connectors

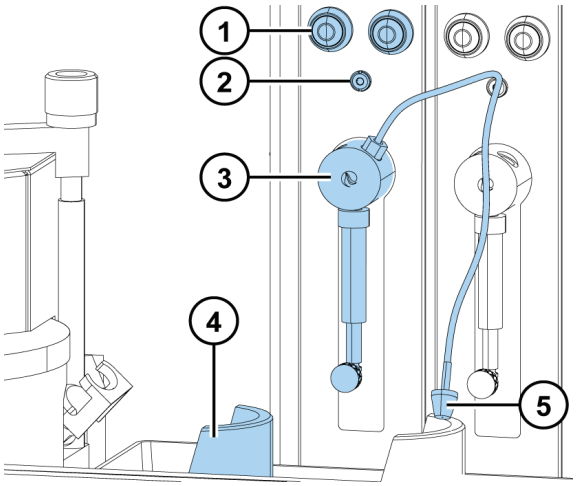
1) USB connector
2) Mains power supply connector

Internal view

The internal view of the Varioskan LUX instrument is shown in Figure 2–5. The **blue** color alerts the user to find units/parts that may be handled.



1) Plate In/Out button
2) LAT module
3) Prime and Empty buttons
4) Dispensers 1 and 2
5) Reagent bottle holder



1) Prime and Empty buttons
2) Male connector of the dispensing tube assembly
3) Dispenser
4) Reagent bottle holder
5) Aspirate tube

Figure 2–5 Varioskan LUX internal views

Optical system

The Varioskan LUX uses:

- Fluorescence intensity
- Time-resolved fluorescence
- Luminescence
- Absorbance, and
- AlphaScreen measurement techniques.

Fluorescence intensity measurements are conducted from the top or bottom of the well; luminescence, AlphaScreen and time-resolved fluorescence measurements from the top of the well, and absorbance measurements through the well.

The principle of the Varioskan LUX optical measurement modules is shown in the following block diagram (Figure 2–6). Each submodule is described separately in the subsequent lower-level block diagrams (Figure 2–7 through Figure 2–13).

Principle of the optical system

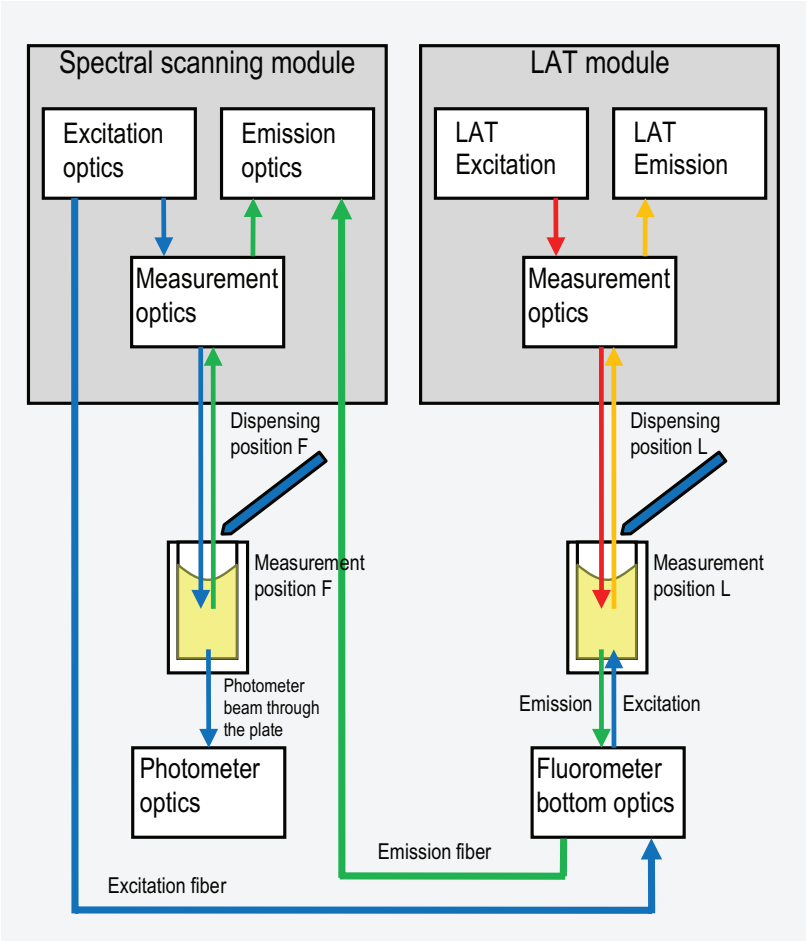


Figure 2–6 Varioskan LUX optics and measurement positions F and L

The Varioskan LUX optical unit consists of six subunits (Figure 2–6):

- **Excitation optics** produces light of selected wavelength for fluorescence measurement and also for absorbance measurement. The excitation optics module consists of the light source and wavelength selection devices, namely, diffraction order selection filters and monochromators. Refer to "Excitation optics" on page 19.
- **Measurement optics** produces a high-definition optical beam for fluorescence and absorbance measurements at measurement position F (Figure 4–43 and Table 4–5). The excitation light reference detector is incorporated into the measurement optics module. Simultaneously the measurement optics module collects emission light, which is fed to the emission reading channel. Refer to "Measurement optics" on page 21.
- **Emission optics** carries out the reading of a selected wavelength for fluorescence and spectral scanning module-based luminescence. The emission optics module is basically similar to the excitation optics module. Refer to "Emission reading module" on page 21.
- The **absorbance measurement module** measures light-beam intensity passing through the well. Absorbance measurement is carried out by using the excitation optics module as the absorbance measurement light source. Refer to "Absorbance measurement module" on page 22.
- **Fluorescence bottom reading optics** directs the excitation and emission light from the spectral scanning module to measure fluorescence at the bottom of the microplate. Refer to "Fluorescence bottom reading" on page 22.
- The **LAT module** consists of Luminescence measurement capability. Optionally, it may also contain AlphaScreen and/or Time-resolved fluorescence measurement capabilities.

The LAT module is an option that is mounted in the front of the unit with the dispensers to the right.

The LAT measurement optics module collects with a wide angle emitted light that is produced in the microplate well and measured by a photomultiplier tube. The wavelengths are differentiated by filters not monochromators. The shutter and filter selector incorporates positions for open, blocked and eight configurable filters. Refer to "LAT measurement module" on page 23.

The LAT module has a capability to measure spectral Luminescence and Time-resolved fluorescence. For these measurement modalities the Spectral scanning module is used instead of LAT module photo-multiplier tube.

Excitation optics

Excitation optics (Figure 2–7) consists of the light source and the wavelength selection devices.

CAUTION! Do not open the optical covers under any circumstances. There is a risk of ultraviolet radiation injury.
Only authorized service personnel have permission to open the optical covers.

Figure 2–7 Excitation optics

Light source

A xenon flash lamp is used as the light source. The lamp provides the wide spectral range needed for absorbance and fluorescence. The lamp is pulsed at a 100 Hz rate and activated only when measuring. A short light pulse enables accurate TRF measurements.

One measurement consists of 1 to 1000 flash pulses according to measurement quality and measurement speed requirements.

Diffraction order selection filters

Excitation diffraction order filters, namely, cut-off filters, are used to block unwanted harmonic transmission of monochromators. The correct diffraction order filter is selected automatically.

Monochromators

The monochromator is based on the diffraction grating. A grooved surface of the grating diffracts the different colors into different angles and a bandpass wavelength is selected by rotating the grating (Figure 2–8). The final pickup of the desired wavelength band is made by an entrance/exit slit combination.

Two monochromators are serially connected for high spectral quality and this essentially minimizes leakage of undesired wavelengths, namely, stray light.

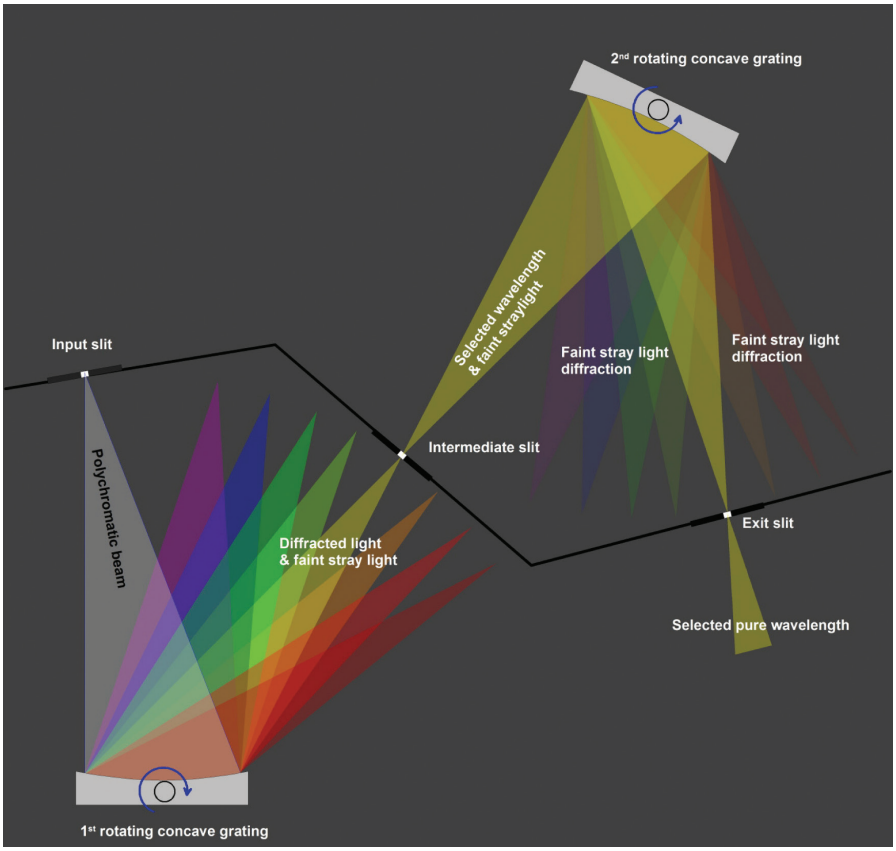


Figure 2–8 Principle of the double monochromator

Bandwidth selector

The bandwidth is set by means of the monochromator slit width. A selection of two bandwidths, 5 nm and 12 nm, is made by controlling the slits.

Measurement optics

The measurement optics module (Figure 2–9) is the front surface mirror optics system to generate a wavelength-independent, high-definition beam for fluorescence measurement and for absorbance measurement. Simultaneously the measurement optics collects emission light, which is fed to the emission reading channel.

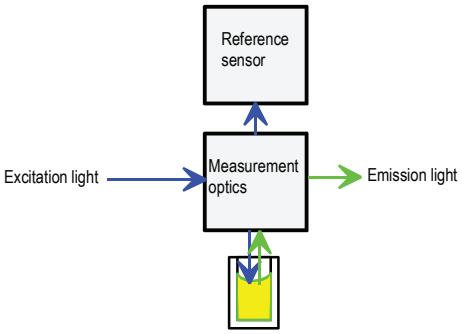


Figure 2–9 Measurement optics

The excitation beam intensity is measured by the reference sensor before the measurement beam enters the well. The reference sensor value is used to correct the result level to compensate for long-term and short-term flash intensity fluctuations.

Emission reading module

Emission optics (Figure 2–10) is basically similar to excitation optics. Refer to "Excitation optics" on page 19.

CAUTION! Do not open the optical covers under any circumstances. There is a risk of ultraviolet radiation injury.
Only authorized service personnel have permission to open the optical covers.

Figure 2–10 Emission optics

Emission monochromators

Two diffraction grating monochromators are connected serially as in excitation optics to gain high stray-light rejection. The monochromator bandwidth is 12 nm.

Emission diffraction order filters

Emission diffraction order filters are used to block unwanted harmonic transmission from the monochromators.

Emission detector

Emission light is converted into electrical signals by the photomultiplier tube (PMT). The dynamic range is adjusted automatically (AutoRange *default*) or manually according to the measurement situations.

Besides fluorescence, the emission optics is also used for generating luminescence spectra.

Absorbance measurement module

Absorbance measurement (Figure 2–11) is carried out by using the excitation optics module as the absorbance measurement light source.

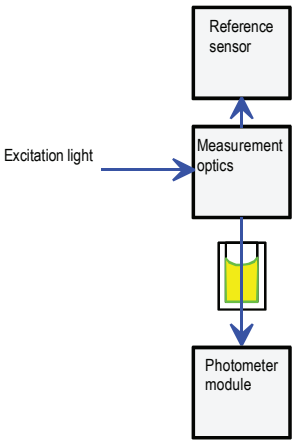


Figure 2–11 Absorbance measurement module

Fluorescence bottom reading

Fluorescence intensity bottom reading is based on fiber optics that transmits the light from the spectral scanning module to the fluorescence bottom reading optics (Figure 2–12).

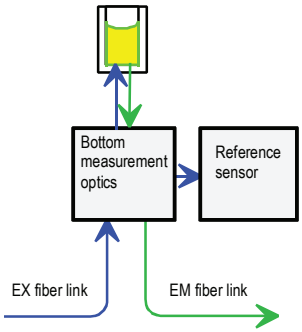


Figure 2–12 Fluorescence bottom reading optics

LAT measurement module

The LAT module is an option that is mounted in the front of the unit to the left of the dispensers.
For an overview of the module, see Figure 2–13.

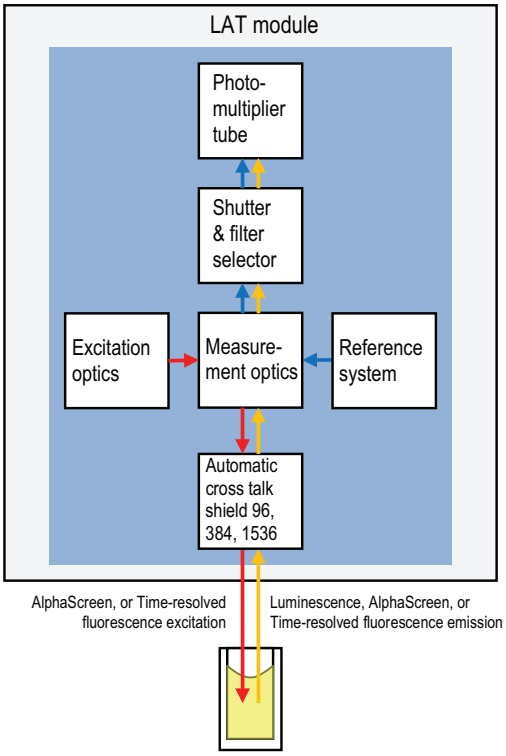


Figure 2–13 LAT measurement module

The LAT module measurement optics collects with a wide angle emitted light that is produced in the microplate well and measured by a photomultiplier tube.

A crosstalk shield blocks light from adjacent wells and automatically sets the correct aperture depending on the microplate format. There are specific apertures for 96-, 384- and 1536-well plates. If larger than 96-format wells are used, the module will use the 96 aperture.

The shutter and filter selector contains positions for open, blocked and eight configurable filters. The blocked position is automatically used to eliminate background drifting of electronic components and the photomultiplier tube. A reference system is used to compensate for photomultiplier gain drift.

The wavelength selection for Luminescence, AlphaScreen, and Time-resolved fluorescence measurements are made with a set of filters.

LAT excitation module produces excitation light for AlphaScreen and Time-resolved Fluorescence measurements by a light-emitting diode and a xenon flash lamp, respectively.

Measurement of excitation light in spectral scanning Luminescence and Time-resolved fluorescence is performed by Spectral scanning module.

Control buttons

There are five control buttons:

- One **blue** Plate In/Out button for driving the plate carrier in or out (Plate In/Out function) (Figure 2–14), and
- Two **blue** Prime and Empty buttons for priming and emptying the dispenser tubing (Prime/Empty function) of each dispenser (Figure 2–14).

Note that the **Prime** and **Empty** buttons are only present if there is a dispenser fitted.

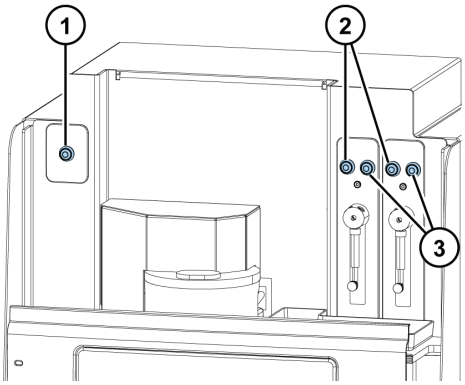


Figure 2–14 Control buttons

1. Plate In/Out control button
2. Prime control buttons
3. Empty control buttons

Plate trays and adapters

There are two types of plate trays: *universal* and *robotic*.
Refer to Table 2–1 and Table 2–2.

The universal tray is for basic use (Figure 2–15). It is compatible with all plate formats (6- to 1536-well plates). Always use a plate adapter with a universal tray. Refer to “Universal tray with adapters” on page 26.

A robotic plate tray is for automated use with robots (Figure 2–16). It is compatible with 96- to 1536-well plate formats. Remove the plate adapter when using a plate with a lid on a robotic tray. Refer to “Robotic tray and adapter” on page 27.

Note! The universal plate tray is also compatible for robotic use with most of the robotic systems when gripping from the long sides of the plate is used.

Tray composition

The universal tray composition is shown in Figure 2–15 and described below.

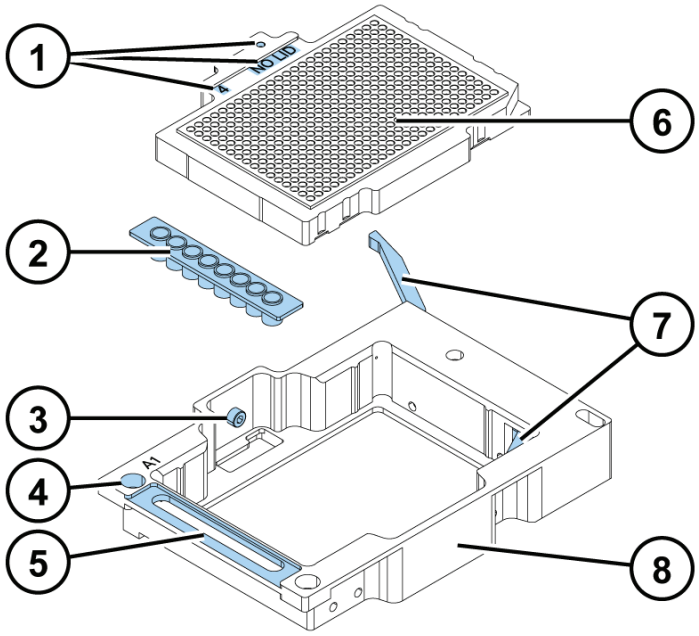


Figure 2–15 Assembly picture of the universal tray

1. Means of identification of tray/adapter combinations

For automatic identification of tray/adapter combinations, there are codes that refer to the coding system employed. The adapters are also marked with a visual identification number and the text WITH LID or NO LID to help differentiate them.

2. Tip priming vessel

The tip priming vessel is an 8-well plate strip (1x8 Thermo Scientific™ Microtiter™ Solid Strip Assembly).

3. Screw fix

The tray is fastened to the tray holder, which is part of the track mechanism, by a screw fix. Refer to "How to install the plate tray and adapter" on page 35.

4. Position calibration hole(s)

There are three holes for the automatic calibration and alignment of the track mechanism. The hole marked is used for the positional check of the track mechanism at start-up and when changing the tray.

5. Holder for tip priming vessel

The plate tray has a cavity for the tip priming vessel.

6. Adapter

The adapter is a detachable part that is fitted into the universal tray. It lifts the microplate to the optimum height for measurement and dispensing.

7. Positioning lever

The positioning lever is used for automatic positioning of the microplate.

8. Universal frame

Universal tray with adapters

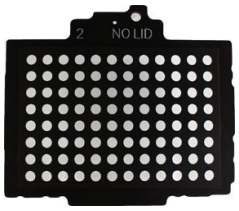
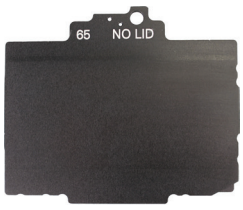
Plate adapters are used for adapting plates that are of different heights. Adapters lift the plates to the optimum height for measuring and dispensing.

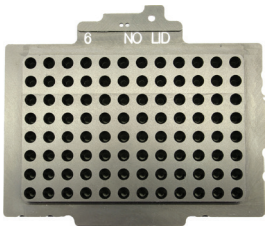
Before you run a measurement, check that the correct plate adapter is in the plate tray. Choose the adapter based on the plate format you have and whether you are using a lid or not.

IMPORTANT! Do not use plates with dimensions exceeding the top rim of the tray. Note that the maximum total height of plates is manufacturer specific.

Refer to Table 2–1 and Chapter 8: "Ordering Information". For more information on plate type settings, refer to the *SkanIt Software Technical Manual*.

Table 2–1 Compatibility of the universal tray and plate-specific adapters

Adapter	ID no.	Cat no.	Description	Dispensing
	#2	N02692	**96-well adapter for plate without lid*)** To be used with the most common 96-well plate formats without lids.	yes
	#3	N02693	**96-well adapter for plate with lid** To be used with the most common 96-well plate formats with lids.	no
	#4	N02690	**384-well adapter for plate without lid*)** To be used with the most common 384-well plate formats without lids. Recommended for reading of 1536-well plates, 15 mm high plates in all measurement modes and 10 mm high plates in fluorescence mode.	yes 384 no 1536
	#5	N02691	**384-well adapter for plate with lid** To be used with the most common 384-well plate formats with lids.	no
	#65	N06210	**1536-well adapter for plate w/o lid** To be used with the most common 10 mm high 1536-well plate formats without lids in luminescence mode.	no

	#80	N02696	**6–48-well adapter for plate without lid*)** To be used with the most common 6- to 48-well plate formats without lids.	yes
	#48	N02697	**6–48-well adapter for plate with lid** To be used with the most common 6- to 48-well plate formats with lids.	no
	#6	N03395	**96-well adapter for PCR plate without lid** 96-well adapter for PCR plate without lid. To be used with 0.2 mL PCR plates.	yes

*) included in standard deliveries

**) Thermo Scientific™ Nunc™

Robotic tray and adapter

The robotic tray comes equipped with the elevation adapter for plate without lid, #126 and is thus directly ready for measurement of 96- to 1536-well plates and dispensing of 96- and 384-well plates (Figure 2–16).

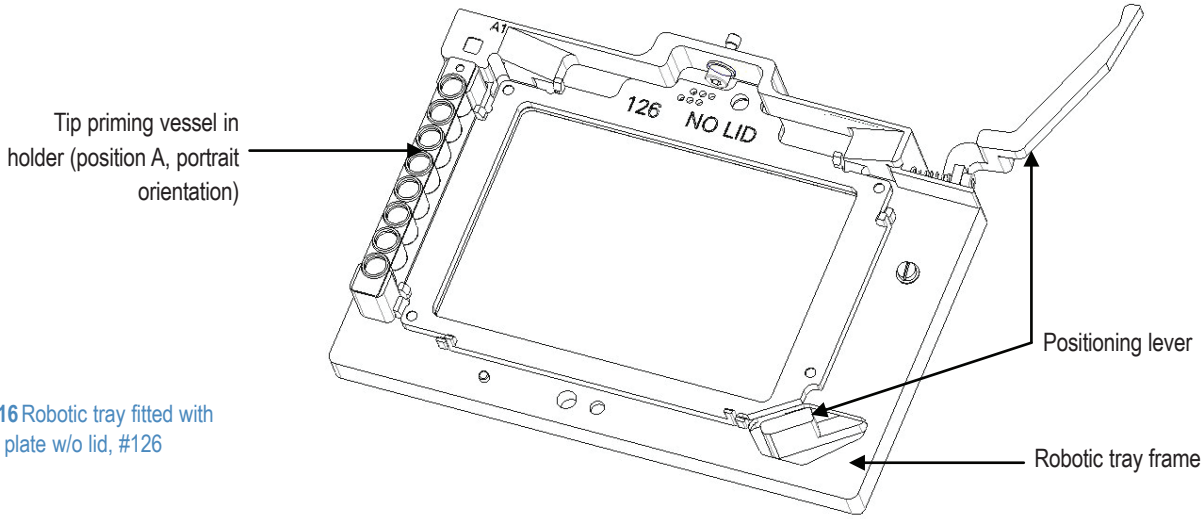


Figure 2–16 Robotic tray fitted with adapter for plate w/o lid, #126

Remove the adapter when you use microplates with lids. Refer to "How to remove or replace the robotic tray adapter" on page 29.

Fixed side supports are located on both the robotic tray and the adapter. When the tray comes out, the side supports prevent the plate from moving.

Refer to Table 2–2 and Chapter 8: "Ordering Information".

Table 2–2 Compatibility of the robotic tray and plate-specific adapter

Picture	ID no.	Cat no.	Description	Dispensing
	#126	N03079*	**Robotic tray with adapter for plate without lid** To be used with the most common 96- to 1536-well plate formats without lids.	yes 96 & 384 no 1536
	#127	N03079*	**Robotic tray without adapter for plate with lid** To be used with the most common 96- to 1536-well plate formats with lids	no

*Cat no N03079 includes both adapters #126 and #127. See figure 2-18 for more details.

How to change the location of the holder for the tip priming vessel

The robotic tray frame designed for robot compatibility has a cavity for the tip priming vessel located in either of two optional locations: on the left side (= position A) (Figure 2–17), or in the front (= position B) (Figure 2–17) of the robotic tray frame. This is due to the space requirements of the optional *portrait* and *landscape* orientations of the robotic arms. If the robotic access is portrait, the tip priming vessel must be located on the left side of the microplate. However, if the robotic arm accesses the microplate in *landscape* orientation, the tip priming vessel must be located in front of the microplate.

To change the location of the holder for the tip priming vessel from position A (*portrait* orientation) to position B (*landscape* orientation), or vice versa (Figure 2–17):

1. Remove the holder for the tip priming vessel (Figure 2–17) by unfastening the holder retaining screw (Figure 2–17) fitted with a washer.
2. Place the holder for the tip priming vessel in the new position so that the guide pin fits in its hole (Figure 2–17). The guide pin controls that the holder is placed correctly. Then fasten the holder retaining screw fitted with a washer.

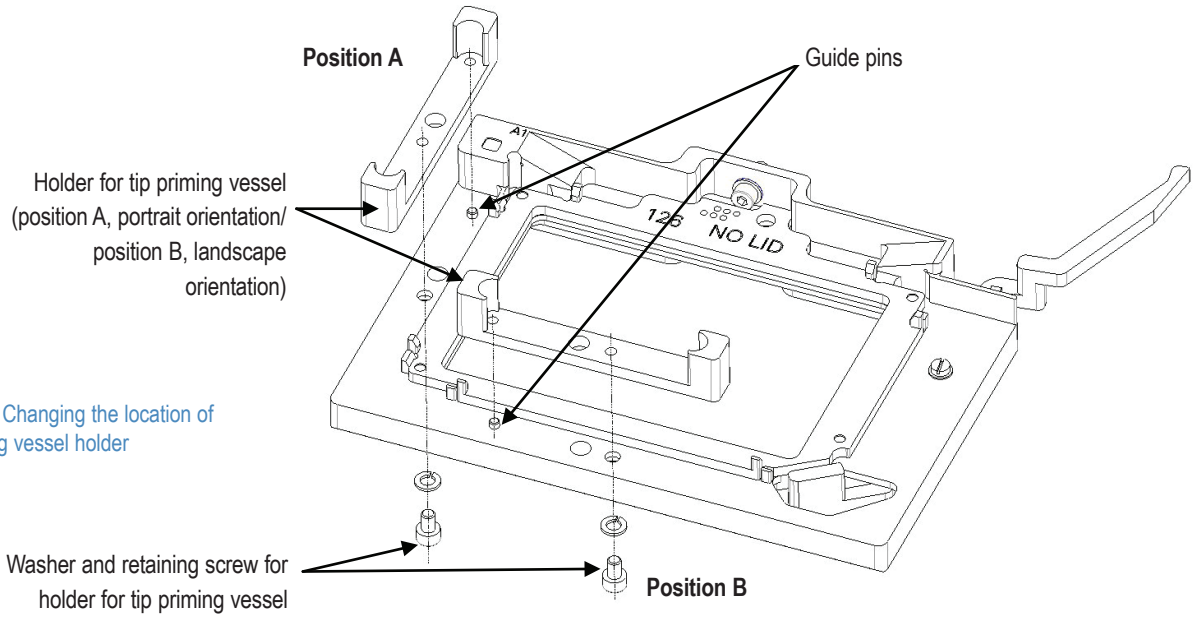


Figure 2–17 Changing the location of the tip priming vessel holder

How to remove or replace the robotic tray adapter

The elevation adapter is used for microplates without lids. Remove the adapter, however, when you use microplates with lids.

To remove or replace the robotic tray adapter (Figure 2–18):

1. To remove the factory installed adapter, unfasten the four adapter retaining screws fitted with washers (Figure 2–18) by turning them counterclockwise. Keep the retaining screws and washers for future use by screwing them back onto the adapter.
2. To replace the adapter (Figure 2–18), first fasten loosely all four adapter retaining screws fitted with washers by turning them clockwise. Then take a firm grip of the adapter and push the adapter towards the A1 corner and fasten the A1 corner adapter retaining screw firmly. Finally fasten the rest of the adapter retaining screws firmly to the tray.

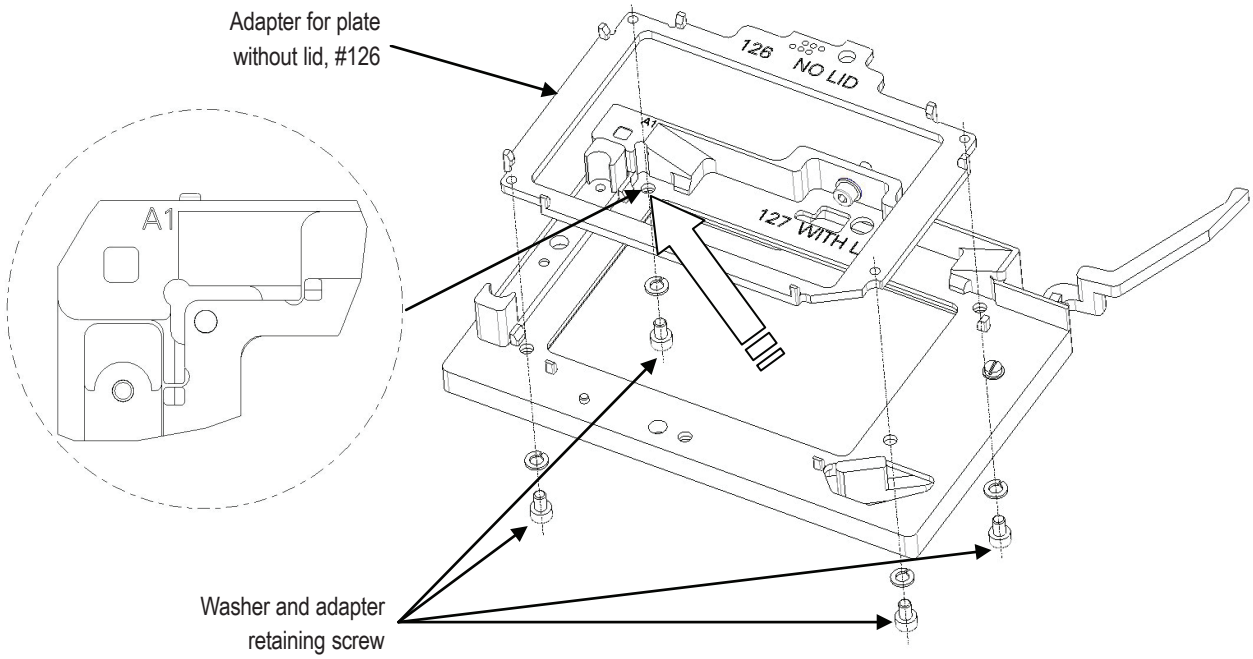


Figure 2–18 Removing or replacing the adapter for plate w/o lid, #126

Refer to Table 2–2 and Chapter 8: "Ordering Information".

3

Installation

CAUTION! The Varioskan LUX weighs 53 to 60 kg [117-131 lbs.] depending on the configuration and care must be taken when lifting it. Two persons must lift the instrument, one on each side, by hooking their fingers under the sides.

What to do upon delivery

This section covers the relevant procedures to be carried out upon arrival of the instrument.

How to unpack

Move the packed instrument to its site of operation. To prevent condensation, the instrument should be left in its protective plastic wrapping until the ambient temperature has been reached. Unpack the Varioskan LUX 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:

- Packing instructions for Varioskan LUX reader
- Packing list for Varioskan LUX reader
- Warranty Certificate card
- Varioskan LUX reader performance measurements

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

Retain the original packaging 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 you relocate your instrument or ship it for service, refer to “Sending the instrument to service” on page 83.

Checking delivery for completeness

Check the enclosed packing list against order. If any parts are missing, contact your local Thermo Fisher Scientific representative or Thermo Fisher Scientific Oy.

Checking for damage during transport

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

If the box 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.

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

Environmental requirements

When you install Varioskan LUX, avoid sites of operation with excess dust, vibrations, strong magnetic fields, direct sunlight, draft, excessive moisture or large temperature fluctuations. Make sure that:

- The working area is flat, dry, clean and vibration-proof and leave additional room for cables, covers, and so on.
- There is at least 10 cm of free space around the instrument on the laboratory bench for ventilation.
- There is sufficient room behind the instrument to enable disconnecting the device.
- The ambient air is clean and free of corrosive vapors, smoke and dust.
- The ambient temperature range is between +10°C (50°F) and +40°C (104°F).
- Humidity is low so that condensation does not occur (relative humidity is between 10% and 80%, non-condensing).
- CO_2 and O_2 sensors are present on the wall of the room where the Varioskan LUX with a Integrated gas module is installed.

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

IMPORTANT! Do not operate the instrument in an environment where potentially damaging liquids or gases are present.

Technical prerequisites

Place the instrument on a normal sturdy laboratory bench. The net weight of the unit is 53 to 60 kg [117−131 lbs.] depending on the configuration.

The instrument operates at voltages of 100−240 Vac and the frequency range 50/60 Hz.

Installation setups

This section describes the installation setups that have to be carried out before instrument operation.

How to release the transport locks

There is a transport lock for the tray holder in the instrument (Figure 3–19).

Make sure the transport lock has been released before you put the instrument into operation.

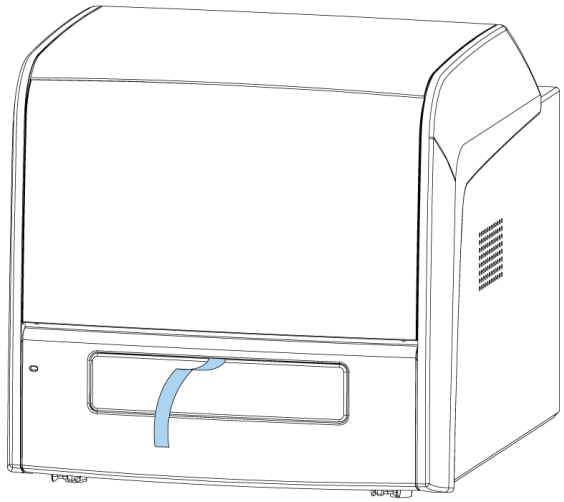


Figure 3–19 Transport locks and transport lock tags present

Tray holder transport lock

To release the tray holder transport lock:

1. Lift up the dispenser sliding cover (1)(Figure 3–20).

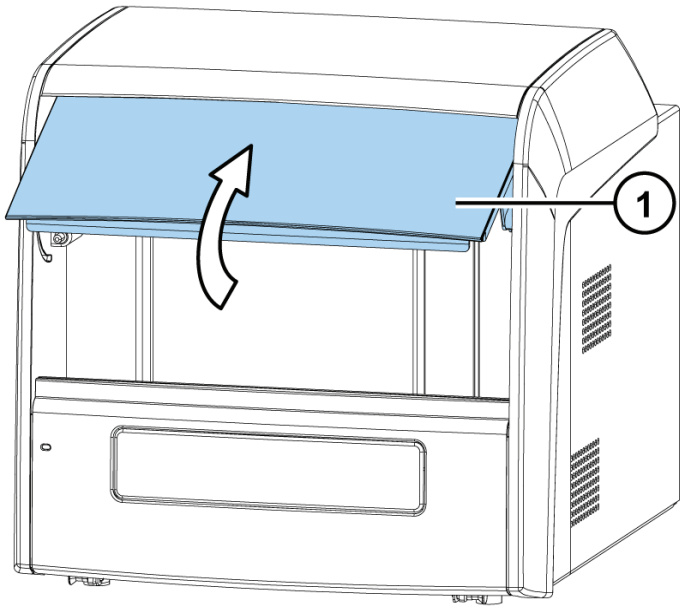


Figure 3–20 Dispenser sliding cover opened

2. Remove the front cover by pulling the two bolts (1), one on each side at the bottom, sideways, then turning the bottom of the cover (2) 30° and lifting it off according to Figure 3–21.

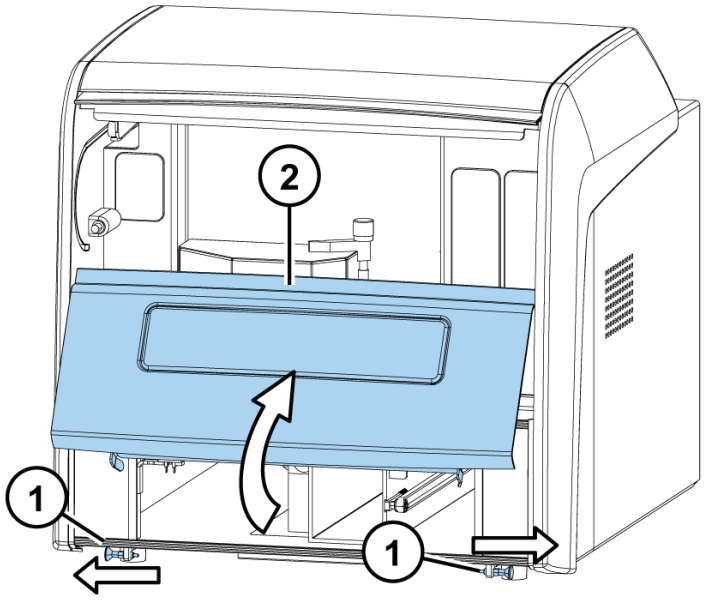


Figure 3–21 Front cover removed

The metallic transport lock support is fastened with four screws (Figure 3–22). Two screws (1 and 2) are fastened to the tray holder, and two screws (3 and 4) are fastened to the track mechanism bar.

3. Remove the tray holder screws (1 and 2), and the transport lock tag. Store the lock tag for future use.
4. Gently push the track mechanism (where screws 1 and 2 were fastened) into the instrument.
5. Remove screw 3 and loosen screw 4.

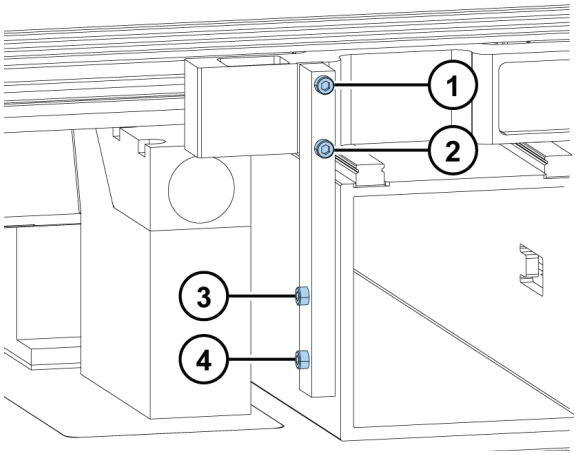


Figure 3–22 Tray holder screws (1 and 2) and track mechanism bar screws (3 and 4) on the transport lock.

6. Turn the transport lock into its horizontal storage position (Figure 3–23).

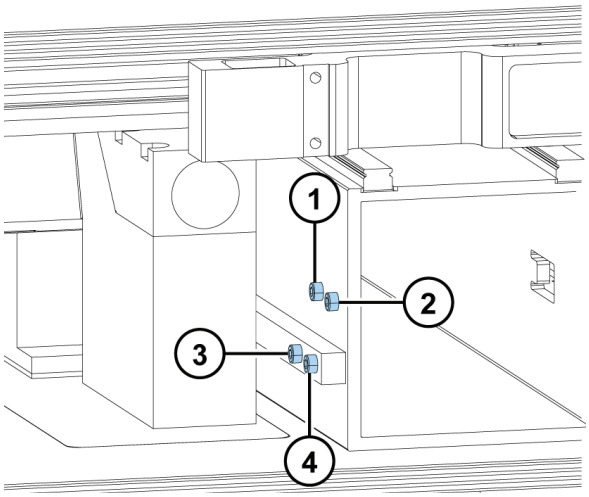


Figure 3–23 Screws 1, 2, 3, and 4, and the released transport lock.

7. Tighten screw 4. Fasten screw 3 back into the same hole from which it was unfastened.
8. Fasten screws 1 and 2 onto the track mechanism bar. Keep the screws there until needed for future relocation or transportation of the instrument.

The transport lock is now in its storage position.

How to install the plate tray and adapter

First install the tray, then the adapter. The tray /adapter combinations are individually coded for automatic identification.

1. Gently pull the tray holder out and slide it to the left (Figure 3–24).

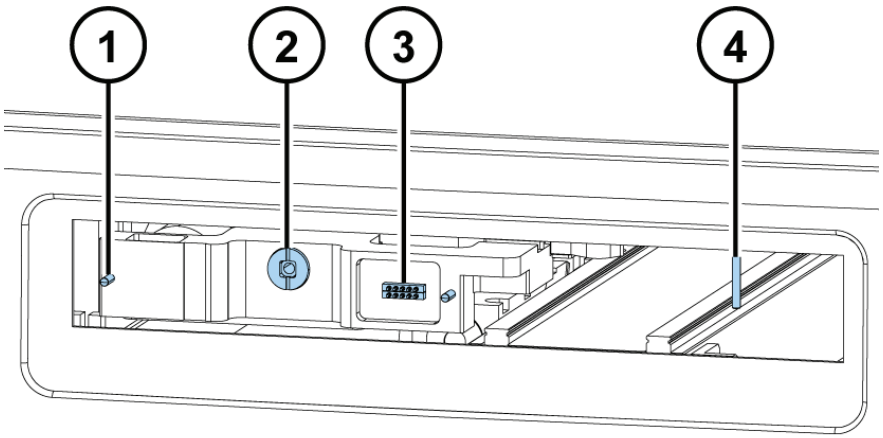


Figure 3–24 Tray holder

1) Guide pins
2) Screw fix hole
3) Contact pins
4) Lever opening bar

2. Install the tray into the tray holder. Make sure you first push the positioning lever to the left of the lever opening bar. Make sure the two guide pins located on both sides of the tray holder are inserted into the tray.

Note! Install the universal tray without the adapter.

3. Fasten the tray to the tray holder by the screw fix by turning the key clockwise.(Figure 3–25).

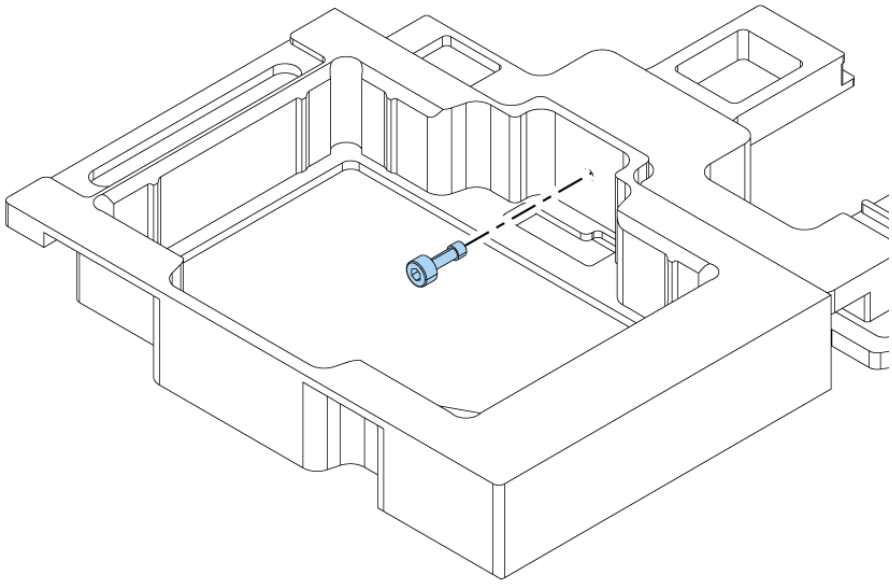


Figure 3–25 Tray and tray holder.

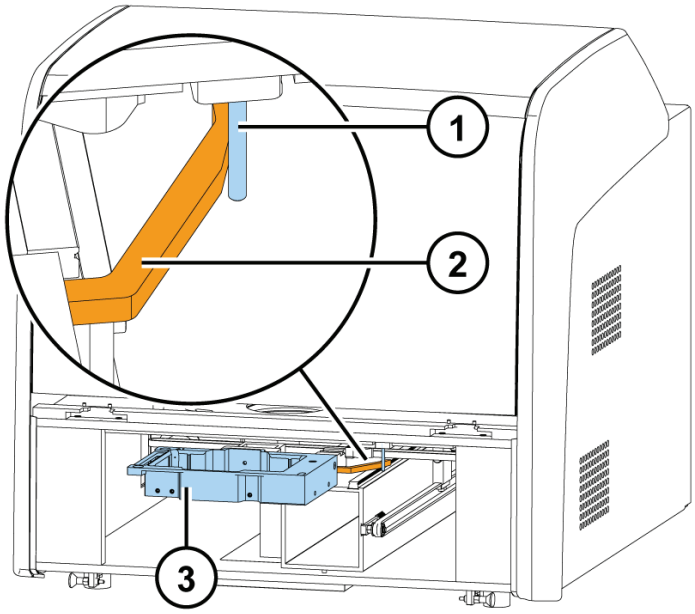


Figure 3–26 Close-up of the positioning lever when the tray is out

4. Take a strip from the strip plate delivered with the instrument. Use it as a tip priming vessel and put it to the hole on the left edge of the tray.
5. Choose the detachable adapter according to the plate type you are using. Refer to "Plate trays and adapters" on page 24.

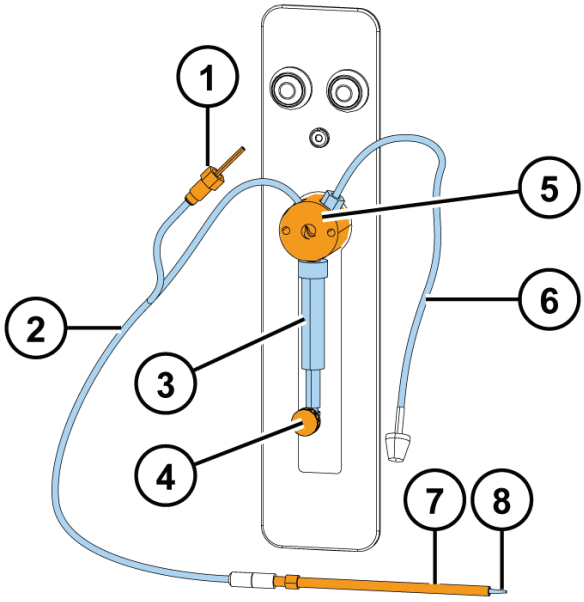


Figure 3–27 Detachable adapter for a 96-well plate.

6. Place the adapter at the very bottom of the tray and make sure it is level. It may be a tight fit. A click sound indicates a successful installation.

Note! The adapter will not go to the bottom of the tray if the positioning lever is in the way.

7. Push the plate tray into the instrument.
8. Replace the front cover by inserting the two top door latches into place while turning the cover 30° and then snapping it shut.

How to set up the dispensers

The two optional dispensers are factory installed (Figure 3–28). Although they are factory installed, you have to install the dispensing tube assembly manually. The complete dispensing tube assembly is packed with the accessories.

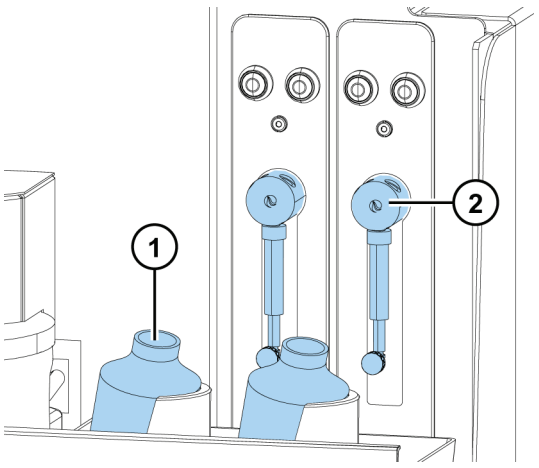


Figure 3–28 Varioskan LUX with the dispenser sliding cover open

1) Reagent bottles
2) Dispensers

To set up the dispensers:

1. Fit the complete dispensing tube assembly (Figure 3–30) into the left hole (Dispenser 1 and Dispenser 2) of the valve and tighten it finger tight. The dispensing tube is used to dispense reagent from the syringe into a microplate.
2. Fit the aspirate tube assembly (Figure 3–30) to the right hole (Dispenser 1 and Dispenser 2) of the valve and tighten it finger tight. The aspirate tubing is used to fill the syringe with reagent.
3. Each dispenser is equipped with an individual electronic dispensing head position sensor. Connect the male connector of the dispensing head position sensor to the corresponding female connector on the instrument.
4. Insert the dispensing heads into their respective dispensing head holder slots on the left-hand side (Dispenser 1 and Dispenser 2) of the dispenser.
5. Remove the protective cap, which protects the thin dispensing tip (Figure 3–29).

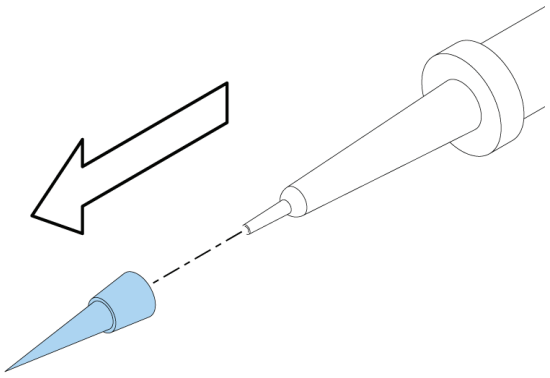


Figure 3–29 Protective cap removed from the dispensing tip (0.40 mm)

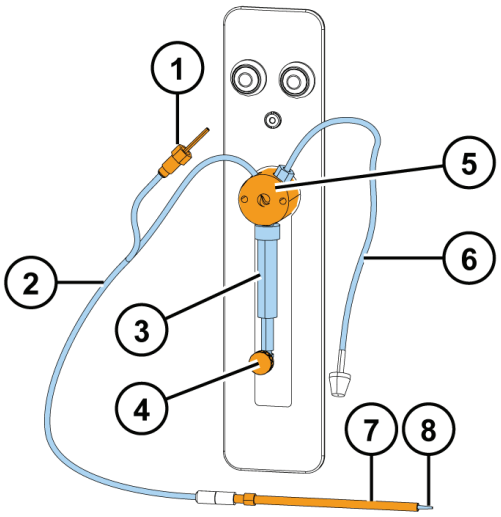


Figure 3–30 Dispenser assembly

1) Male connector of the dispensing head position sensor
2) Dispensing tube assembly
3) Dispenser syringe and plunger
4) Plunger lock screw
5) Valve
6) Aspirate tube assembly
7) Dispensing head
8) Dispensing tip

IMPORTANT! If the dispensers are not properly installed, leakage may occur.

How to set up the Integrated gas module

The optional Integrated gas module is integrated in the instrument. You just need to attach the supplied tubes (Figure 4–31) between the instrument and a gas supply system.

The gases required for the module (CO_2 and / or N_2) are supplied to the device from a separate gas supply system, either from gas cylinders or from a central pressurized gas container.

The layout of the gas supply system must ensure that the operating pressure of the gas supply lines can be set to a range between 0.8 bar (min.) to 1 bar (max.) and that the pressure cannot be changed.

Ventilation

When feeding gas inside Varioskan LUX, there is always some gas emission from the instrument to the surrounding atmosphere. Therefore ensure that the working area is well ventilated .

CAUTION! Ensure that the working area is well ventilated. In order to control the gas atmosphere, CO_2 and O_2 sensors must be present on the wall of the room where the Varioskan LUX with a Integrated gas module is installed. Follow the instructions of the sensor manufacturer.

Table 4 – 3 Ventilation efficiency

Room size (m^2/ft^2)	Ventilation efficiency ($l/m^2/s$ or cfm/ft^2)
>30/320	0.9/0.18
12-30/130-320	2.0/0.4
6-12/65-130	4.0/0.8

Do not use gas control module in a room smaller than 6 square meters (65 sq. feet).

The above requirements for ventilation efficiency are calculated based on the limits defined by US Department of Labour / Occupational Safety & Health Administration (OHSA).

OSHA has determined the limit values for the safe working environment as follows:

- CO_2 concentration must not raise above 0.1% (OSHA Technical Manual TED 01-00-015, Section 3, Chapter 2)
- O_2 concentration must not drop below 19.5% (OSHA Respiratory Protection Standard 29 CFR 1910.134, paragraph (d)(2)(iii))

Note! The national regulations may differ from the OHSA regulations. Check the regulations of your area before use. According to our current understanding the OSHA limits are the most conservative.

CAUTION! If ventilation is not sufficient to keep the gas concentrations within recommended levels, working in the room may cause headache, nausea or in extreme situations even death.

The CO_2 and O_2 concentrations in the room can be affected also by other instruments that are connected to gas cylinders. Human respiration also produces CO_2 to the surrounding environment.

Gas cylinders

The person installing the gas supply system to Varioskan LUX must be a professional.

For security the gas cylinders must be properly fastened to a wall. Make sure the tubes between the instrument and the gas supply system are connected tightly.

The layout of the gas supply system must ensure that the operating pressure of the gas supply lines can be set to a range between 0.8 bar (min.) to 1 bar (max.) and that the pressure cannot be changed.

Installation

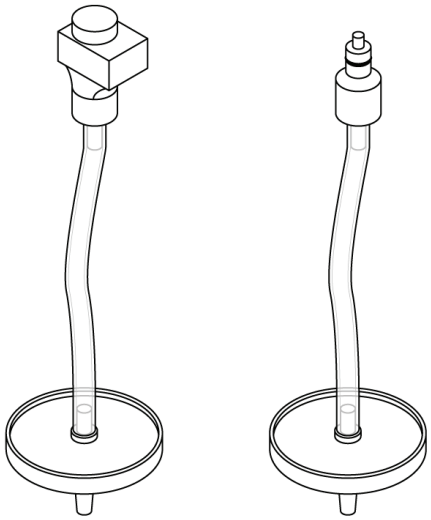


Figure 4–31 Supplied tubes for O_2 (left) and CO_2 (right)

1. Attach the gas supply system to the filters using silicon tubing (or similar) with 4 mm internal diameter.
2. Attach the connectors at the other ends of the tubes to the gas connectors on the back panel of the instrument (see Figure 4–32 and Figure 2–3).

   Attach CO_2 gas line to the connector 1 and N_2 gas line to the connector 2.

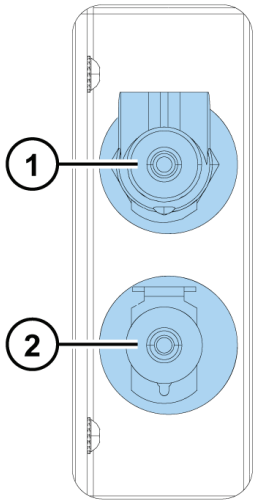


Figure 4–32 Gas connectors

1) Connector for CO_2 gas line
2) Connector for N_2 gas line

How to connect cables

This section shows the location of all relevant connectors and how to connect the mains supply cable.

CAUTION! Ensure that the mains switch (Figure 2–2) on the left side panel is in the off position. Do not operate your instrument from a power outlet that has no ground connection.

1. Connect the mains supply cable to the mains power supply connector (Figure 3–33) on the back panel. If you need to use any other type of mains supply cable than supplied, use only cables certified by the local authorities.
2. Connect the instrument mains supply cable to a correctly installed line power outlet that has a protective conductor that is grounded.

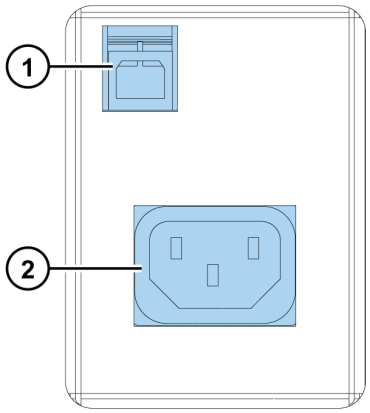


Figure 3–33 Connecting the mains supply cable

1) USB connector
2) Mains power supply connector

3. Connect the instrument to the PC using the USB communication cable supplied.

How to install SkanIt Software

Refer to the *SkanIt Software Technical Manual* for installing SkanIt Software.

Installing upgrade kits

As the instrument is modular, you can upgrade it with uninstalled features later. The additional upgrades may include the LAT module, including the luminescence module, the AlphaScreen module and/or the TRF module, as well as up to two dispensers.

IMPORTANT! Installation of the upgrade kits must be carried out only by trained and authorized expert service personnel.

How to align the LAT measurement position

Varioskan LUX has a function to optimize the LAT module luminescence, AlphaScreen and time-resolved fluorescence measurement position.

Note! You do not have to align the measurement position if the LAT module has been factory installed. Alignment is normally not necessary to be done with 6-96 well plates. With those factory alignment is accurate enough. When 384 or 1536 well plates are used, performing alignment with the same plate type that is used for real assays will improve assay precision and decrease luminometric crosstalk. The measurement position alignment should be run after the installation of a new LAT module and when the LAT base has been removed for cleaning or service.

The measurement position is determined according to the plate dimension information in the plate templates. However, the optimal position is somewhat different for each instrument because of individual mechanical variations between the units.

Optimizing the measurement position for each unit will ensure the specified crosstalk performance of the instrument. The LAT module is fully functional and can also be used without this luminescence alignment, but slightly increased crosstalk is to be expected with 384 and 1536-well plates.

When the alignment is run, the instrument will search for the exact position of the defined well within the plate and store the correction information. This correction will be used in all subsequent measurements and it will minimize luminescence crosstalk from adjacent wells in luminescence.

To execute the alignment sequence a white 384-well plate with 30 µl of luminous solution in well H12 is needed.

The luminescence intensity of the solution should be in the range of 10^5 to 10^8 RLU.

Any luminescent sample with steady glow type luminescence can be used for the alignment. For example, the following luminous solutions or samples can be used:

- Bioluminescent sample with Firefly luciferase - ATP reaction (e.g. with Promega's Steady-Glo™ Luciferase Assay System, BioThema's Luciferase Assay Kit, Promega's ENLITEN ATP kit or BioThema's ATP Biomass kit)
- Chemiluminescent sample with luminol luminescence
- Any other reagent producing a stable luminescence signal

Detailed instructions on how the alignment plate can be prepared using Promega's ENLITEN ATP kit are given in Appendix B: "Preparation of Luminescence Alignment Plate".

Refer to the *SkanIt Software Technical Manual* on how to start the measurement position alignment in SkanIt Software.

How to install LAT module filters

The LAT module has built-in AlphaScreen and TRF excitation filters. You need to install the AlphaScreen, TRF, and luminescence emission filters.

IMPORTANT! Do not touch the surfaces of filters with bare hands.

1. Turn on the instrument and open SkanIt Software.
2. Open the dispenser sliding cover and the LAT module cover.
3. Select the filter position in SkanIt Software:
   a. Click **Settings** on the application menu.
   b. Click **Instruments**.
   c. Click the icon (on the right side of the instrument name) to open the **Edit instrument parameters** window.
   d. Click the **Filter definition** tab.
   e. Click **Add**.
   f. Select a free filter position from the filter wheel and add the new filter information.
   g. Click **Next**.
   The filter wheel is now turned to the selected position.

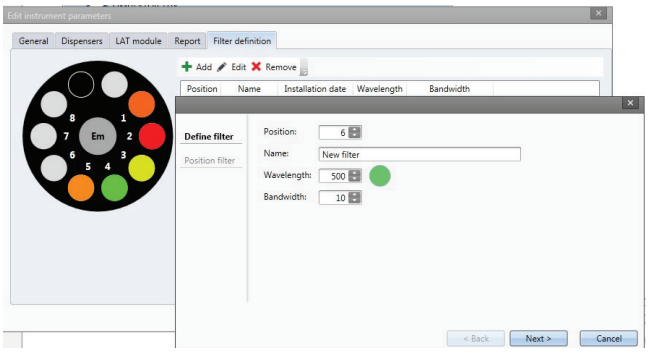


Figure 3 – 34 The Add new filter pop-up window

4. Open the blue filter nest lid on the LAT module.
5. Loosen the filter wheel screw on the selected position.

6. Place the filter on a clean, dust free surface with the arrow on the side of the filter pointing upwards.
7. Use the filter pick-up tool to place the filter into the bottom of the filter nest (Figure 3 – 35).
8. Tighten the filter wheel screw.

Note! It is critical that the filter wheel screw is tightened. If it is left open the screw will prevent the filter wheel from rotating and can lead to serious jamming of the filter system

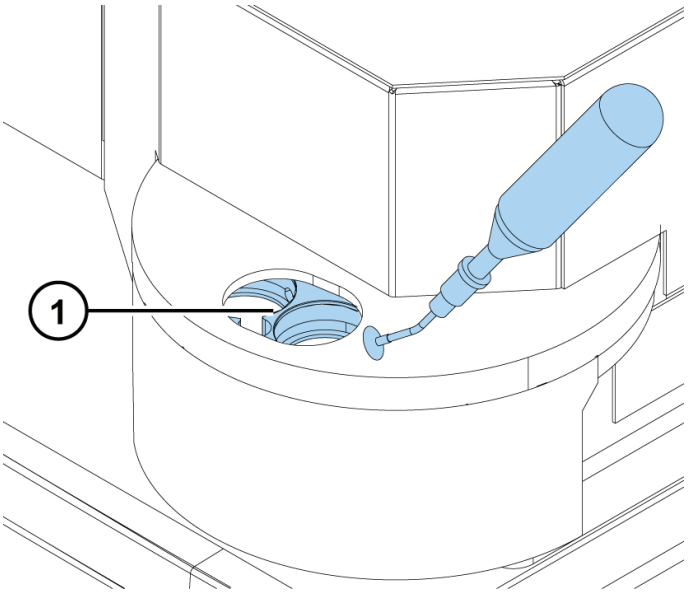


Figure 3 – 35 Filter nest and pick-up tool

1) Filter nest

9. Close and fasten the filter nest lid.
10. Click **Finish**.

4

Operations

The operation of the Varioskan LUX modular multi-technology reader is controlled by an external computer and run on SkanIt Software.

CAUTION! Do not operate your instrument from a power outlet that has no ground connection.

CAUTION! Do not smoke, eat or drink while using the Varioskan LUX. 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. Do not spill fluids in or on the equipment.

IMPORTANT! Operate the instrument only with software and hardware specifically designed for it. Thermo Fisher Scientific assumes no liability for the use of third-party software applications.

IMPORTANT! It is recommended that the assay includes internal quality control samples to verify operation.

Operational check

First switch the Varioskan LUX on (Figure 2–2).

The instrument has a sophisticated control system. The instrument automatically performs a complete set of initialization tests and adjustments. The mechanical, electrical and optical functions of the instrument are checked at start-up, for example:

- Instrument configuration
- Tray positioning
- Measurement selectors positioning
- Excitation and emission double monochromators
- Excitation and emission diffraction order filters
- Non-volatile memory

- Temperature measurement electronics
- Measurement electronics
- Excitation bandwidth selector
- Light sources
- Reference detectors
- LAT filter positioning
- LAT crosstalk shield positioning
- Dispensers, and
- The measurement channel's dark level.

When the initialization tests and adjustments have been successfully completed, the LED indicator (Figure 2–2) turns from orange to green.

After start-up the instrument is ready for operation. Since the instrument calibrates itself, you can start measuring immediately as soon as the instrument has been turned on. However, stabilization of the incubator can take up to 10 minutes. The complete stabilization of the electronics will take about one hour so for the best possible performance, the instrument should be allowed to stay continuously on for at least one hour. It is further recommended to carry out an empty run to verify proper instrument operation.

The instrument also performs automatic signal long-time stability checks during runtime.

If anything fails in the initialization tests or adjustments, the LED indicator will turn red. In this case, try switching the instrument off and on again. If the failure is repeated, contact authorized technical service.

All error messages are stored in the internal memory log file of Varioskan LUX. The error log file can be accessed with SkanIt Software by selecting Settings > Instrument > Edit instrument parameters > Reports > Instrument Error Log > *Run Report*. Refer to "Error and warning codes" on page 93.

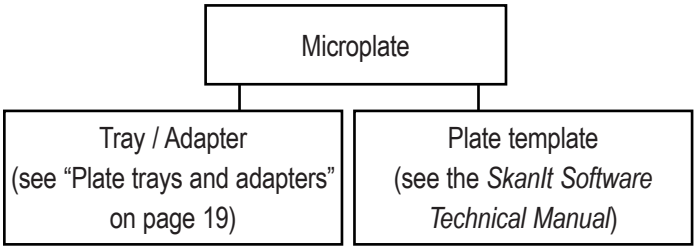
Loading the microplate

IMPORTANT! Ensure that you select a correct plate type. Too high a plate may become jammed, and with too low a plate the dispensing might fail and skip over. Also with too low a plate, the plate may not be at the optimal height for measurement.

Note! When placing a microplate onto the tray, always make sure the correct plate type has been selected in SkanIt Software (*Plate template*) before you do anything else.

To load the microplate:

1. Ensure that the plate type, tray, adapter and the SkanIt Software plate template match. Refer to "Plate trays and adapters" on page 24 and "How to install the plate tray and adapter" on page 35.



2. The tray is driven out, after which the microplate can be loaded.
3. If the tray is in, first drive the tray out by pressing the *Plate Out* button or by selecting *Run plate out* in SkanIt Software.

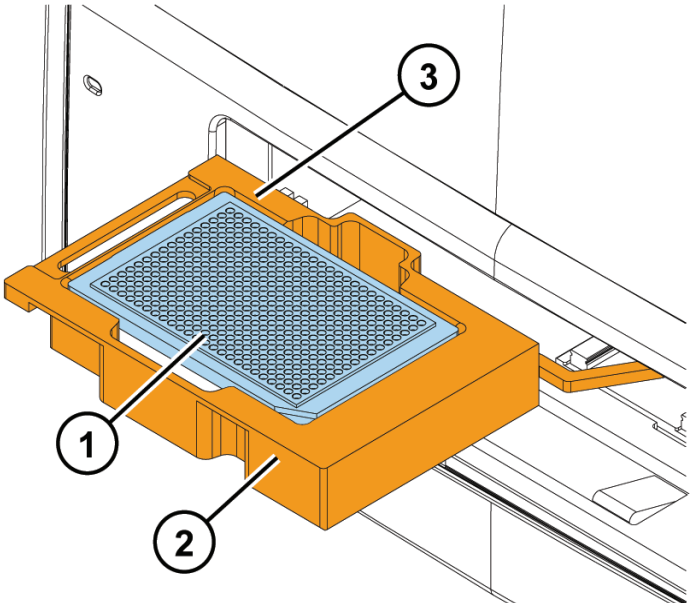


Figure 4–36 Microplate loaded

1) Microplate
2) Plate tray
3) A1 corner

4. Load the microplate onto the plate tray for measurement (Figure 4–36).

   The tray is able to handle microplates of different sizes, therefore, the free space in the tray is slightly larger than, for example, the standard 96-well plate. The positioning lever in the tray (Figure 2–15) will automatically position the plate correctly into the upper left corner of the tray when the tray is driven in.

   Always insert the microplate so that the A1 corner is positioned in the top left corner of the tray (Figure 4–36). The tray frame is marked with A1 to facilitate correct insertion of the microplate.

5. Select the measurement parameters to define the measurement. After this the measurement is executed with SkanIt Software. Refer to the *SkanIt Software Technical Manual*.

Automatic runtime calibration

Runtime calibration is always automatically performed at the beginning of the protocol execution. The instrument also performs calibrations during protocol execution if it does not violate the timing requirements of the assay. For example, in a kinetic assay, if a long enough kinetic interval time is defined so that there is time for calibration before each kinetic repeat, then calibration can be performed between the repeats.

Note! If any measurement is performed after a specific time (10 minutes or an hour) after the previous calibration, a warning appears about calibration validity. This may happen if an assay takes a long time to execute and there is no sufficient time slot to perform calibration during protocol execution. However, the warning does not mean that the measurement failed, only that the accuracy of the results may have suffered.

Absorbance

Each selected wavelength is calibrated automatically. A typical calibration time when less than 10 wavelengths are used is a few seconds, but the calibration for a spectrum scan from 200 to 1000 nm with a 1 nm increment takes over 1.5 minutes.

An automatic runtime calibration expiry period is one hour in absorbance. Recalibration is performed 45 minutes after the previous calibration depending on the measurement procedure.

Fluorescence intensity & Time-resolved fluorescence

The automatic calibration expiry period is 10 minutes. Recalibration is performed 7.5 minutes after the previous calibration depending on the measurement procedure.

Luminescence & AlphaScreen

The automatic calibration expiry period is 10 minutes. Recalibration is performed 7.5 minutes after the previous calibration depending on the measurement procedure. In luminescence calibration a dark level control measurement is also performed to compensate for possible electronic component and photomultiplier signal level drift.

Measurements and scanning

CAUTION! Do not open the measurement chamber door (Figure 3–25) during measurement because this causes stray light to enter and aborts the measurement. The dispenser sliding cover can, however, be left open.

Fluorescence measurement

In fluorescence intensity (FI) or time-resolved fluorescence (TRF) measurements, the following actions are carried out by the instrument:

1. The tray is driven in.
2. In fluorescence intensity measurements, excitation and emission wavelengths are selected by rotating the excitation and emission monochromatic gratings. On the other hand, in time-resolved fluorescence measurements the emission wavelengths are selected by rotating the filter wheel.

3. In the signal level calibration procedure the instrument reads the fluorescence from the reference chip, compares it to the value in non-volatile memory and sets a factor to correct the reading. In long measurement procedures calibration is performed in a suitable phase without disturbing the measurement timing. The default calibration interval is 10 minutes.
4. The instrument uses the dynamic range setting the user has selected in the SkanIt Software measurement session (Figure 4 – 37):
   - AutoRange
   - Manual range
     - High range
     - Medium high range
     - Medium low range
     - Low range

The measured values are comparable regardless of the dynamic range selection, AutoRange or any of the fixed manual ranges.

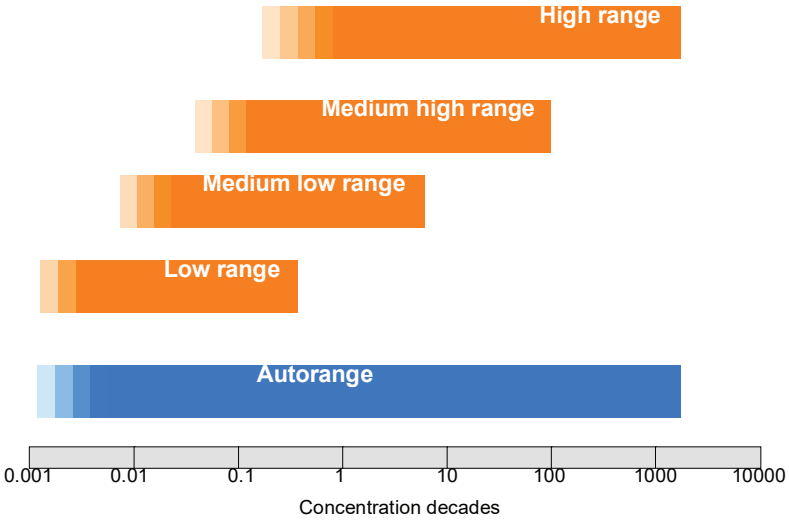


Figure 4 – 37 Dynamic range selection

a. Automatic dynamic range selection:

   AutoRange (*default*) selects automatically the optimal reading range. It is based on signal intensity in the well and uses the lowest possible reading range to obtain best sensitivity.

Tip! Do not adjust the dynamic range selection if you do not know which dynamic range to use. AutoRange is almost always the optimal reading range.

However, if you need the fastest possible operating speed, use the manual dynamic range selection of Low, Medium low, Medium high or High range.

Overrange values can sometimes also occur if the settle delay is off. Sometimes it is necessary to set the settle delay on in SkanIt Software. For more details, refer to "Settle delay" on page 56.

b. Select manual dynamic range according to the following principles:

High range is intended for samples that are expected to produce high intensity signal to be measured. It covers a wide dynamic range with somewhat lower sensitivity than with other dynamic ranges.

Low range, on the other hand, is intended for samples with low result signal and produces the highest sensitivity with a limited dynamic range.

Medium low and *Medium high ranges* offer sensitivities and dynamics in between the Low and High ranges.

When selecting a fixed gain, the principle for achieving the best sensitivity is to select the lowest possible range, without receiving overrange results in the measurement.

5. The wells are measured with a selected measurement time that can vary from 10 to 1000 ms in fluorescence intensity measurements and from 10 to 10 000 ms in time-resolved fluorescence (TRF) measurements. There is one xenon lamp flash for each 10 ms period of measurement time.

The amount of xenon lamp flashes affects the quality of the measurement result. Thus, the more flashes, the better the quality of the result. The amount of flashes can be set to 1 to 100 flashes per measurement (10–1000 ms) for fluorescence intensity measurements and 1 to 1000 flashes per measurement (10–10 000 ms) for TRF measurements.

It is recommended to measure using a 100 ms measurement time in fluorescence intensity measurements and 1000 ms in TRF measurements, which normally produces good results. If it is necessary to improve the quality of the results, the flash amount should be increased.

The result is the mean value of individual 10 ms readings during the total measurement time.

With TRF measurements there are two additional user-defined measurement parameters: *TRF delay time* and *TRF integration time*. The TRF delay time defines the time difference between the excitation flash and the start of emission signal collection, while the TRF integration time defines the time used for emission signal collection. When the Varioskan LUX performs a TRF measurement, it excites the sample with a very short light pulse, waits for the defined TRF delay time and then collects the signal during the defined TRF integration time. These actions form one TRF measurement cycle (Figure 4–38), which is performed within a 10 ms period. The cycle is repeated as many times as defined by the measurement time.

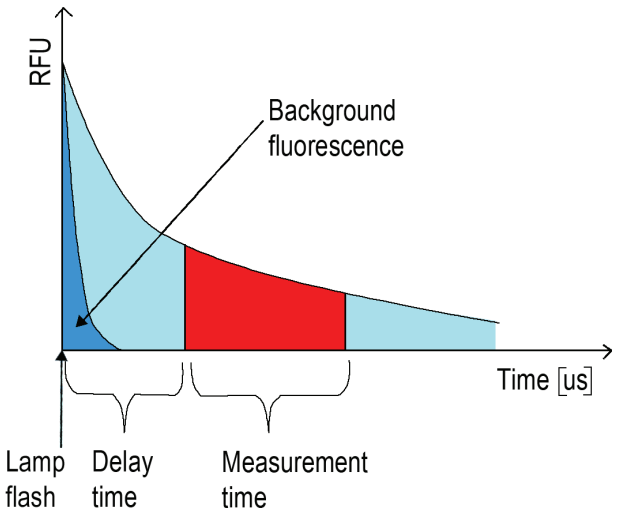


Figure 4–38 Structure of the TRF measurement cycle

6. If necessary, set the settle delay in SkanIt Software. For more details, refer to "Settle delay" on page 56.

IMPORTANT! Because of the relative nature of fluorescence, it is recommended to use known samples or controls to verify instrument operation.

Fluorescence spectrum scanning

The phases of the fluorescence spectrum scanning measurement are the same as for the fluorescence measurement but with a continuous range of wavelengths. Refer to "Fluorescence measurement" on page 50.

Absorbance measurement

In absorbance (Abs) measurements, the following actions are carried out by the instrument:

1. The tray is driven in.
2. The measurement wavelength is selected by rotating the excitation gratings.
3. In the absorbance calibration procedure the instrument reads the air blank level. In long measurement procedures calibration is performed in a suitable phase without disturbing the measurement timing. The calibration is valid for 1 hour.
4. The wells are measured with a selected measurement time that can vary from 10 to 1000 ms. There is one xenon lamp flash for each 10 ms period of measurement time.
5. The amount of xenon lamp flashes affects the quality of the signal. Thus, the more flashes, the better the quality of the result. The amount of flashes can be set to 1 to 100 flashes per measurement (10–1000 ms).

   It is recommended to measure using a 100 ms measurement time (*default*), which produces good results. If there is a necessity to improve the quality of the results, the flash amount should be increased.

The result is the mean value of the number of 10 ms readings during the total measurement time. Longer than 100 ms measurement times are recommended to reduce noise if the measured absorbance level is high.

6. If necessary, set the settle delay in SkanIt Software. For more details, refer to "Settle delay" on page 56.

Absorbance spectrum scanning

The phases of the absorbance spectrum scanning measurement are the same as for the absorbance measurement but with a continuous range of wavelengths. See "Absorbance measurement" on page 53.

The air blank spectrum is also measured in absorbance spectrum scanning measurements.

Luminescence measurement

In luminescence intensity measurements, the following actions are carried out by the instrument:

1. The tray is driven in.
2. The LAT filter selector position is rotated to the blocked position.
3. In the signal level calibration procedure the instrument reads the internal luminescence reference signal in the blocked mode, compares it to the value in the non-volatile memory and sets a factor to correct the reading. In long measurement procedures, calibration is performed in a suitable phase without disturbing the measurement timing. The default calibration interval is 7.5 minutes.
4. The instrument uses the optics setting the user has selected in the SkanIt Software measurement session:
   - Normal (no filter)
   - Filter

   The normal mode uses the LAT module without placing any filters in the lightway. The filter mode uses user-defined and installed filter(s).
5. The instrument uses the dynamic range setting the user has selected in the SkanIt Software measurement session (Figure 4 – 37):
   - AutoRange
   - Manual range for the luminescence normal and filter optics is:
     - High range
     - Medium range
     - Low range
   - Manual range for the luminescence monochromator optics is equivalent to the fluorescence measurement. Refer to Figure 4 – 37.

   a. Automatic dynamic range selection:
   AutoRange (*default*) selects automatically the optimal reading range used. It is based on signal intensity in the well and uses the lowest possible reading range to obtain best sensitivity.

Tip! Do not adjust the dynamic range selection if you do not know which dynamic range to use. AutoRange is almost always the optimal reading range.

However, if you need the fastest possible operating speed, use the manual dynamic range selection of Low, Medium or High range.

b. Select manual dynamic range according to the following principles:

High range is intended for samples that are expected to produce a high intensity signal to be measured.. It covers a wide dynamic range with somewhat lower sensitivity than with other dynamic ranges.

Low range is intended for samples with a low result signal and produces on the other hand the highest sensitivity with a limited dynamic range.

When selecting a fixed gain, the principle for achieving best sensitivity is to select the lowest possible range to prevent receiving overrange results in the measurement.

The measured values are comparable regardless of the dynamic range selection, AutoRange or any of the fixed manual ranges.

6. The wells are measured with a selected measurement time that can vary from 10 to 10 000 ms.

   The amount of used measurement time affects the quality of the measurement result. Thus, the more time, the better the quality of the result.

   It is recommended to measure using a 1000 ms measurement time. If there is a necessity to improve the quality of the results, the measurement time should be increased.

   The result is the mean value of individual 10 ms readings during the total measurement time.

7. If necessary, set the settle delay in SkanIt Software. For more details, refer to "Settle delay" on page 56.

Luminescence spectrum scanning

The phases of the luminescence spectrum scanning measurement are the same as for the luminescence measurement, but it always uses the spectral scanning module monochromators for controlling the wavelengths. Refer to "Luminescence measurement" on page 54.

AlphaScreen measurement

In AlphaScreen™ measurements, the following actions are carried out by the instrument:

1. If not already installed, install the AlphaScreen/AlphaLISA™ filter before starting the session.
2. The tray is driven in.
3. The filter selector position is rotated to the selected AlphaScreen/AlphaLISA position.
4. In Steps 4-7 the instrument uses the settings the user has selected in the SkanIt Software session. The excitation time is selected.
5. The delay time is selected.
6. The integration time is selected.
7. The measurement time [ms] equals the sum of the excitation, delay and integration times. It is shown on the user interface but is not user-selectable. The time can vary from 20 to 1000 ms.

Settle delay

When liquid in the well is exposed to acceleration or deceleration, surface resonance waves occur in the wells. As the plate moves fast from one well and stops at the next well prior to a measurement, the surface waves start propagating in the liquid. Propagation continues for a certain time depending on the liquid and the well size.

The surface waves may affect the results and thus it is necessary to ensure that certain actions are taken to optimize measurement. The surface wave effect can be seen as noise in the signal in certain cases. There are two methods to minimize surface wave effects when they occur:

1. Use detergent in the well, if possible.
2. Set on the settle delay in SkanIt Software. The used settle delay time is automatically selected according to the plate format.
   - Settle delay is the time for waiting for the liquid surface to settle before the reading is carried out.
   - Settle delay times are dependent on the plate format (Table 4–4).

Table 4–4 Settle delay times vs. plate formats

Plate format	Settle delay time (ms)
6-well plates	1750
12-well plates	1300
24-well plates	400
48-well plates	200
96-well plates	100
384-well plates	50
1536-well plates	20

For more information on the settle delay, refer to the *SkanIt Software Technical Manual*.

Measurements under controlled atmosphere

In measurements under controlled atmosphere where the user wants to follow a long-term process with cultivated cell cultures, the following actions are carried out:

1. The user sets the desired gas concentration using SkanIt Software. Wait till the concentration has been reached.

   Adjust either the CO_2 or the O_2 concentration or both to the desired level.

2. The user sets the desired temperature using SkanIt Software. Wait till the temperature has been reached.
3. The user loads the cell plate onto the device and starts the kinetic run in which the desired reaction is followed.
4. The session can maintain measurements using any measurement technology, as well as shaking, dispensing and incubating adjustments.

   The system contains warning mechanisms in case of any error situations occurring.

Other functions

The Varioskan LUX also has shaking, incubating and reagent dispensing features, which are presented below.

Track mechanism

The track mechanism (Figure 4 – 39) has been specifically designed to obtain excellent measurement results for different plate formats. The position calibration hole on the top left corner of the tray is read at start up, and plate positioning is adjusted accordingly. Also, if the tray is changed, the calibration hole is read again.

The home sensors of the X and Y carriages are used for checking the correctness of the plate position. The check is done each time the carriage passes the home position, and also always when the plate is driven out.

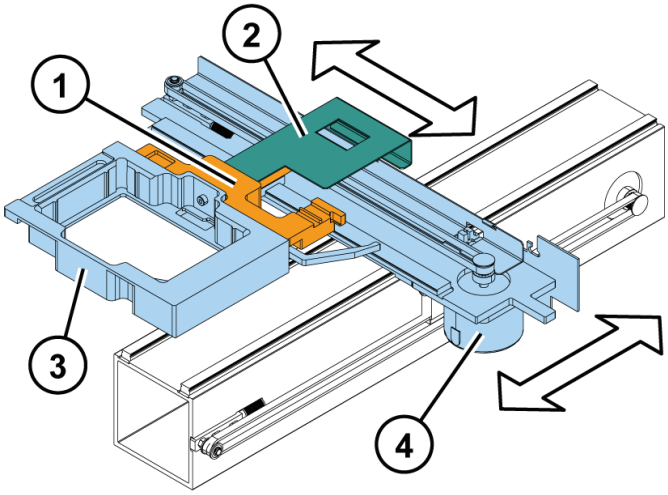


Figure 4–39 Part of the Varioskan LUX track mechanism

1) Tray holder
2) X-carriage
3) Tray
4) Y-carriage

Orbital shaking

The orbital shaking function is used for shaking the microplate to mix the samples. Movement of the track mechanism (Figure 4–39) can perform the shaking action.

The shaking action can be intermittent and consist of so-called ON (shaking periods) and OFF times (pause periods between shaking periods) (Figure 4–40), or be a constant shake. You can also select whether the shaking sequence starts or ends with a shaking ON time. Refer to the *SkanIt Software Technical Manual*.

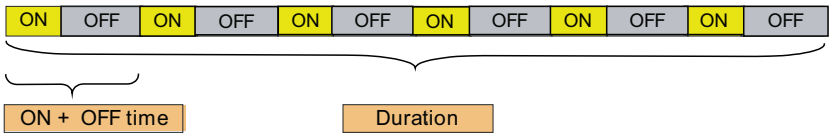


Figure 4–40 ON-OFF period time and total shaking time

The speed and shaking force can be selected by the user in the SkanIt Software session. The speed is adjustable from 60 to 1200 rpm (revolutions per minute) in 60 rpm increments.

The shaking force selection is Low, Medium or High and corresponds to a certain diameter of the orbital movement. Centrifugal forces greater than 1 G are automatically prevented.

IMPORTANT! The system only allows certain shaking speed and force combinations to help avoid liquid spillage inside the instrument. However do not fill the wells too full (Figure 5–46).

Note! When shaking the plate, do not exceed 50% of the maximum well volume or the plate manufacturer recommendation, if it is lower.

Incubator

The instrument has an accurate incubator for temperature control up to 45°C. It is useful for temperature-critical applications, for example, certain enzyme assays and cell-based applications. Set the temperature via SkanIt Software.

The universal tray is specially designed for precise and uniform temperature control.

The incubator consists of two main parts (Figure 4–41):

- A *fixed* upper heater, and
- A *moving* universal tray.

The microplate (Figure 4–41) is surrounded by temperature-controlled heaters with the exception of a narrow space between the upper heater and the universal tray and the reading windows (Figure 4–41). The tray and the upper heater together form the isothermal chamber.

The upper element is slightly warmer than the lower element to avoid condensation on the plate lid.

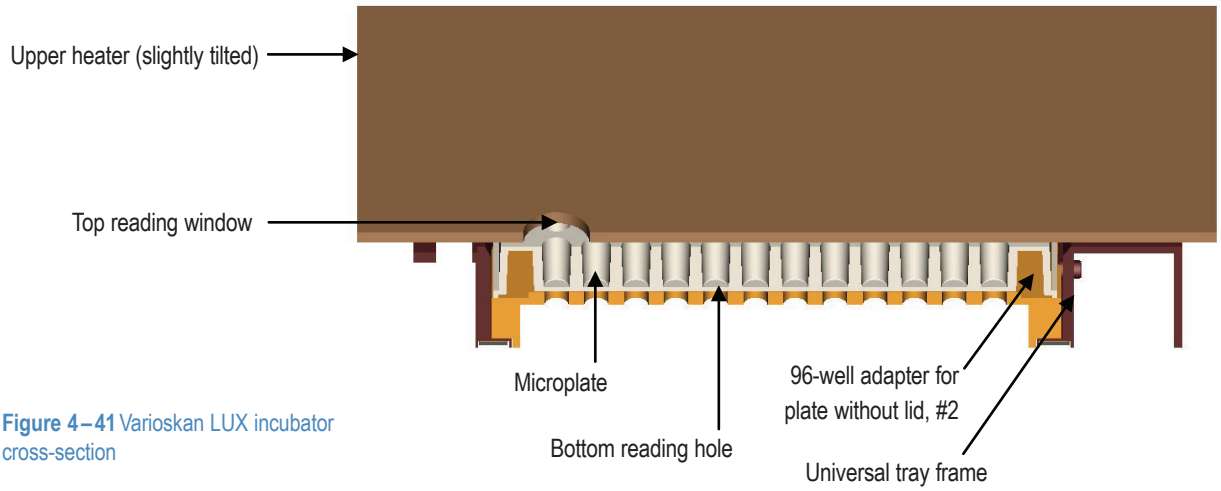


Figure 4–41 Varioskan LUX incubator cross-section

Note! The samples in the microplate reach the target temperature usually much later than the instrument.

Dispensers

The instrument is equipped with up to two optional dispensers (Figure 2–5) for automatic and accurate reagent addition. The dispensers are located in the instrument housing (Figure 2–2) under the dispenser sliding cover and consist of a pump with a valve, a syringe (1 ml), tubing and a dispensing head (Figure 4–42).

The instrument supports simultaneous dispensing and reading, enabling fast signal monitoring from the very start of the reaction.

Syringe

Varioskan LUX uses 1 ml syringes and the dispensing volume range is from 2 µl to 5 000 µl in 1 µl increments. The upper limit of the range is 80% of the maximum well volume, which is supported by SkanIt Software when using multiple dispensings into the same well.

Reagent consumption

The dispensers are located close to the measurement positions to achieve a low dead volume and minimal reagent consumption. This is important when using expensive reagents. Optimal design of the reagent bottle holder (Figure 2–5) also helps in using all the reagent.

The combination of a special dispensing tip (Figure 4–42) and the tip priming feature ensures that even very small volumes can be dispensed accurately.

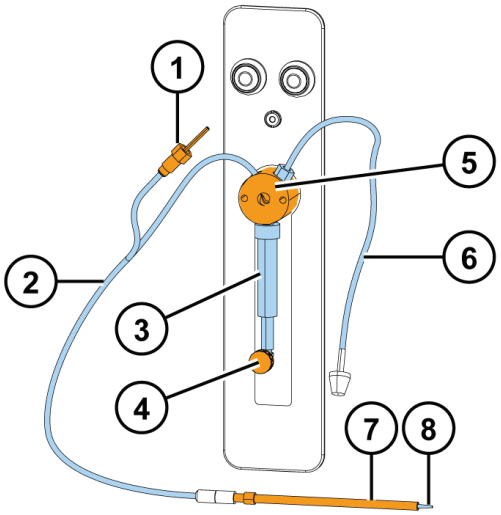


Figure 4–42 Varioskan LUX dispensing system

1) Male connector of the dispensing head position sensor
2) Dispensing tube assembly
3) Dispenser syringe and plunger
4) Plunger lock screw
5) Valve
6) Aspirate tube assembly
7) Dispensing head
8) Dispensing tip

Dispensing tip

Varioskan LUX uses dispensing tips that have 0.40 mm tip diameter) for all dispensing volumes.

Dispensing

This section provides valuable information on how to use and maintain the optional dispensers.

IMPORTANT! When using a dispenser, make sure the aspiration tube end is completely submerged in the contents of the reagent bottle and there is a sufficient volume of the reagent in the bottle (for all priming and actual dispensing).

IMPORTANT! The instrument carries out automatic checks but, nevertheless, make sure you do not dispense into the instrument by mistake. Ensure that:

- A correct microplate has been inserted into the plate tray.
- The microplate or tip priming vessel is not too full.
- The recommended *Check plate before session execution* in SkanIt Software (Settings > *General settings*) is ticked.

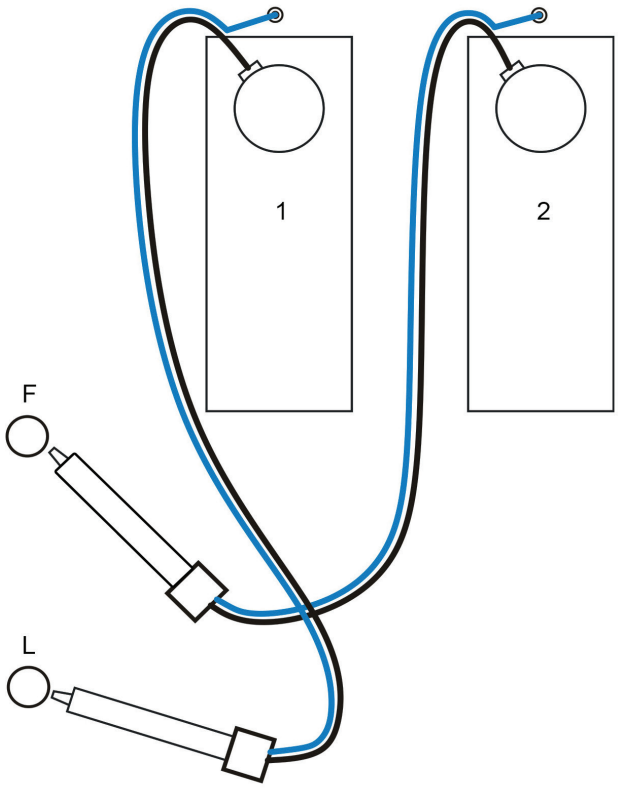


Figure 4–43 Identification of the dispensing tip position

The two *dispensing positions* are marked F and L (Figure 4–43). The F and L dispensing positions can be used with either Dispenser 1 or 2.

Dispensing position F points the dispensing head towards the measurement position F.

Dispensing position L points the dispensing heads towards the measurement position L.

The readings that are carried out in both of these measurement positions are presented in Table 4–5.

If you want to start the measurement simultaneously to dispensing without any delay time between them, place the dispensing head into the dispensing position which points at the correct measurement technology. For example, flash luminescence measurements require simultaneous measurement and dispensing.

However, both dispensers and dispensing positions can be used to dispense into any well using any measurement mode(s). If you are using a dispensing position which does not point at the measurement position of the correct measurement technology, an extra plate movement may be carried out before the measurement step. This may cause minor time delays.

Table 4–5 Readings carried out in measurement positions F and L

Measurement position F	Measurement position L
absorbance	luminescence
fluorescence (top of the well)	fluorescence (bottom of the well)
spectral TRF	TRF
spectral luminescence	AlphaScreen

The dispensers are each equipped with a *dispensing head position sensor* (Figure 4–43 and Figure 3–30). The instrument recognizes a dispensing head placed into the dispensing position. Dispensing will not take place if the instrument does not recognize that the dispensing head is in the dispensing position, that is, the dispensing head positioner. The controller can consequently detect which dispensing head is in which dispensing position. The controller can also detect whether the tip assembly is properly inserted or not. Refer to "How to set up the dispensers" on page 37.

When the dispensers are not in use, the dispensing heads can be stored in the dispensing head holders (Figure 2–5).

IMPORTANT! To avoid light from entering the measurement chamber, use blind plugs to close empty dispensing positions!

Note! When performing dispensing and measurement simultaneously, remarkably high, very rapid signal peaks even in blank wells can occur. These peaks can be generated by the large static electricity charges that some microplates can carry. When solution with high conductivity (e.g. saline) is dispensed into wells, this charge can release as sparks that the instrument detector measures. To overcome this problem, remove the charge with a de-ionization device before using the plate, change the plate manufacturer and/or the product to find a plate without static charge or add 0.1- 0.2 s lag time between dispensing and measurement in the assay allows.

Priming

Priming means filling the tubing with liquid to be dispensed. The dispensers can be primed using SkanIt Software or control buttons for priming the dispensers. Prime the dispenser tubing, if necessary. Either click on the *Prime* icon in SkanIt Software or use the *Prime* control button located on top of each dispenser (Figure 2–5 and Figure 2–14).

1. To prime, remove the dispensing heads (Figure 2–5) from the dispensing head positioners (Figure 2–5) and prime the dispensers by discarding the liquid into an external waste container.

   Priming can also be carried out with the dispensing head in the dispensing head holder and with a small vessel underneath.

2. Insert an empty plate of the same type as the actual assay plate into the tray.

   For safety reasons there must be a plate on the tray during priming. The dispensing head position sensor will prevent priming if the dispensing head is located in the dispensing head positioner. However, the empty plate is used as a safety plate if the dispensing heads would be incorrectly inserted into the dispensing head positioners during priming.

3. Press the **Prime** button and visually check that the dispensing jets are straight.
4. Insert the dispensing heads properly into the dispensing head positioners.

IMPORTANT! Carefully insert the dispensing head straight into the dispensing head holder without damaging or contaminating the dispensing tip.

Tip priming

The instrument has a Prime tip (µl) feature (see the *SkanIt Software Technical Manual*). This function can be selected in SkanIt Software or it can be turned off.

If selected, the dispenser automatically dispenses 2 to 10 µl reagent the tip priming vessel every time the instrument fills the dispenser syringe, provided that the dispenser volume is within the range of 2 to 50 µl. Tip priming is also performed if the time period from the priming or last dispensing action to the use of the dispenser is longer than 2 min. This is done to eliminate the possible effect of the liquid evaporation from the tip."

This makes the volume of the first well equal to that of the others, thus, compensating for the so-called drawback phenomenon. It is recommended to use the tip priming feature to achieve greater accuracy when the dispensing volumes are small.

Note! Tip priming is a different procedure from manual priming that must be performed when a reagent bottle (Figure 3–28) is installed next to the dispenser and the dispenser tubes are completely empty.

The *tip priming vessel* is an 8-well plate strip (1x8 Thermo Scientific™ Microtiter™ Solid Strip Assembly). There is a cavity for the tip priming vessel in the left side of the universal tray (position A) (Figure 2–15). The robotic tray has two optional locations for the tip priming vessel, either position A or in the front of the tray (position B) (Figure 2–17), depending on the robotic integration of either *portrait* or *landscape* orientation.

The 8-well plate strip piece should be changed after about 250 tip primings if the priming volume is 10 µl and after 2500 tip primings if the priming volume is 2 µl.

Pull-back feature

The pull-back feature prevents liquid droplets from forming on the dispensing tip between dispensings. Thus, the liquid is pulled slightly inwards.

This function can be set in SkanIt Software or it can be turned off. If set, the dispenser automatically pulls back 1 to 10 µl reagent into the syringe every time the instrument dispenses.

Dispensing and measurement

The dispensing and measurement operations can be synchronized with an exact time interval on a well-to-well basis. Thus, the instrument supports simultaneous dispensing and reading, enabling fast kinetic measurements from the very start of the reaction. However, to support simultaneous dispensing and reading, the dispensers have to be in their correct positions (Figure 4–43). To minimize the delay before the measurement, place the dispensing head into the corresponding dispensing position. Refer to Figure 4–43 and Table 4–5.

Measurement and dispensing in normal and filter mode luminescence measurements is fastest when you use 96-well plates. When you use 384-well plates, the crosstalk shield moves between dispensing and measurement, which causes a small delay.

IMPORTANT! Do not use any liquids with automatic dispensers that can cause precipitation or coagulation or that contain any mechanical particles.

You may need to adjust the dispensing speed. The default setting is for water. You can find the adjustments and selections in SkanIt Software.

Emptying

The dispensers can be emptied either manually by using the control buttons for emptying the dispensers or by clicking the *Empty* icon in SkanIt Software.

To avoid wasting reagents, you may wish to empty reagent that is in the tubing back into the bottles. This may well be the case if expensive reagents are used. The total dispenser tubing volume is <800 µl. The dead volume (reagent loss) is <100 µl.

To empty the dispenser:

1. Keep the aspirate tube in the reagent bottle.
2. Press the *Empty* button until you have emptied all the liquid into the reagent bottle.
3. Remove the aspirate tube carefully from the reagent bottle.

Dispenser washing

The dispensers can be washed using SkanIt Software or the control buttons for priming the dispensers. Wash the dispenser tubing, if necessary. Refer to the washing instructions in the *SkanIt Software Technical Manual*.

To wash the dispenser:

1. Carry out dispenser washing with the dispensing head located in the dispensing head holder and with a small vessel underneath.
2. Either select the *Wash* function in SkanIt Software or use the *Prime* control button located on top of each dispenser (Figure 2–5 and Figure 2–14).

   When you press the *Prime* control button continuously, the instrument fills and then empties the syringe by 20% of the syringe volume for the first ten times, after which it fills and empties the syringe to the whole volume as long as the button is continuously pressed. The syringe will remain empty when the user stops pressing the button.

3. Change the washing and rinsing solutions manually.

IMPORTANT! Carefully insert the dispensing head straight into the dispensing head holder without damaging or contaminating the dispensing tip.

Chemical resistance of the dispensers

Table 4–6 provides guidelines for compatibility with materials used in the fluid path of the dispensers. Compatibility information is based on charts provided by the material manufacturer. It is recommended that each laboratory determines compatibility for their respective applications.

IMPORTANT! Failure to determine compatibility of chemicals used in individual applications with the dispensers, may result in damage to the dispensers and/or test results.

Plastic materials used in the dispensers:

Teflon (PTFE, TFE, FEP): tubing; valve plug, and seal
Kel F: valve body
Polypropylene (PP): fittings for tubing, and dispensing tip
Silicone: tube between dispensing tip and dispensing tube

Note! Kel F is the brand name for 3M's PCTFE, that is, polychlorotrifluoroethylene. The present brand name is Neoflon™ CTFE, manufactured by Daikin.

Note! Check the chemical resistance of microplates. Most microplates are made of polystyrene that has very limited chemical resistance and should not be used, for example, with any organic solvents. Refer to microplate suppliers' documentation regarding the chemical resistance of their microplates.

Classification in the table:

— No data available
0 No effect — excellent
1 Minor effect — good
2 Moderate effect — fair
3 Severe effect — not recommended
* Polypropylene — satisfactory to 22°C (72°F)
** Polypropylene — satisfactory to 49°C (120°F)

Table 4–6 Compatibility chart of solvents suitable with the plastic materials used in the dispensers

Solvent	Teflon	Kel F	Polypropylene
Acetaldehyde	0	0	0
Acetates	—	0	0
Acetic acid	0	0	0
Acetic anhydride	—	0	—
Acetone	0	0	0
Acetyl bromide	0	—	—
Ammonia	0	—	0
Ammonium acetate	0	—	—
Ammonium hydroxide	0	0	0
Ammonium phosphate	—	0	0

Continued

Cont.

Solvent	Teflon	Kel F	Polypropylene
Ammonium sulfate	—	0	0
Amyl acetate	0	—	3
Aniline	0	0	0
Benzene	0	3	*
Benzyl alcohol	0	0	0
Boric acid	0	0	0
Bromine	0	0	*
Butyl alcohol	0	0	1
Butyl acetate	0	—	*
Carbon sulfide	0	—	*
Carbon tetrachloride	0	1	3
Chloroacetic acid	0	0	—
Chlorine	0	1	3
Chlorobenzene	—	—	3
Chloroform	0	—	3
Chromic acid	0	0	—
Cresol	0	—	*
Cyclohexane	0	—	3
Dimethyl sulfoxide (DMSO)	0	0	0
Ethers	0	—	**
Ethyl acetate	0	—	0
Ethyl alcohol	0	—	0
Ethyl chromide	0	1	3
Formaldehyde	0	0	0
Formic acid	0	0	0
Freon	0	2	0
Gasoline	0	0	3
Glycerin	0	0	0
Hydrochloric acid	0	0	0
Hydrochloric acid (conc.)	0	0	0
Hydrofluoric acid	0	0	*
Hydrogen peroxide	0	0	0
Hydrogen peroxide (conc.)	0	0	0
Hydrogen sulfide	0	0	0
Kerosene	0	0	0
Methyl ethyl ketone (MEK)	0	—	0
Methyl alcohol	0	—	0
Methylene chloride	0	0	3
Naphtha	0	1	0
Nitric acid	0	0	0
Nitric acid (conc.)	0	0	—
Nitrobenzene	0	—	**
Phenol	0	—	0
Pyridine	0	—	—
Silver nitrate	0	—	0

Continued

Cont.

Solvent	Teflon	Kel F	Polypropylene
Soap solutions	0	—	0
Stearic acid	0	—	*
Sulfuric acid	0	0	0
Sulfuric acid (conc.)	0	0	—
Sulfurous acid	0	0	0
Tannic acid	0	0	0
Tanning extracts	—	—	—
Tartaric acid	0	—	—
Toluene	0	1	**
Trichloroethylene	0	3	3
Turpentine	0	0	**
Water	0	0	0
Xylene	0	0	*

Gas control

The instrument can be equipped with an optional Integrated gas module to achieve a controlled atmosphere inside the instrument. The module consists of CO_2 and O_2 sensors, valves and the gas supply system. The sensors are placed in a measurement chamber. The CO_2 and O_2 concentrations are controlled independently by tuning the valves according to the readings of the sensors.

Atmosphere

In the space of the instrument, the particular physiological ambient conditions for the preparation and cultivation of cell and tissue cultures are simulated. The atmosphere is determined by the following factors:

- CO_2 concentration, and
- O_2 concentration.

CO_2 supply

To ensure the growth conditions for the cell and tissue cultures, the instrument should be supplied with CO_2.

The pH of bicarbonate-buffered culture media largely depends on the CO_2 content of the atmosphere. The CO_2 content of the atmosphere can be controlled within a range of 0.1% to 15%.

The CO_2 supply must have either of the following quality characteristics:

- Purity 99.5% min.,
- Medical gas quality.

N_2 supply

If the oxygen content during operation is to be lowered to less than 21% (air oxygen content), the instrument is supplied with nitrogen. The O_2 content of the atmosphere can be controlled within a range of 1% to 21%.

Use

The Integrated gas module is a laboratory device for preparing and cultivating cell and tissue cultures. The device allows the simulation of the special physiological ambient conditions for these cultures due to the exact control of:

- CO_2 content and
- O_2/N_2 content.

The Integrated gas module:

- Offers a comprehensive solution for a variety of cell-based applications, such as cell toxicity, cell proliferation and stem cell cultivation
- Can be used in conjunction with all measurement technologies
- Enables simultaneous, independent control of CO_2 and O_2 concentrations
- CO_2 concentration is generally adjusted to ca. 5-6%
- O_2 concentration is adjusted with nitrogen (N_2)

To use the Integrated gas module:

1. Turn on the instrument and open SkanIt Software.
2. Open the CO_2or N_2 gas cylinder and ensure that the operating pressure is correct
3. Set the desired gas concentration using SkanIt Software.
   a. Click the gas atmosphere icon above the **Start** button to open the pop-up window (Figure 5–44).
   b. Set the O_2 and CO_2 levels as needed and click OK.
   You can now see the current and target gas concentrations above the **Start** button.

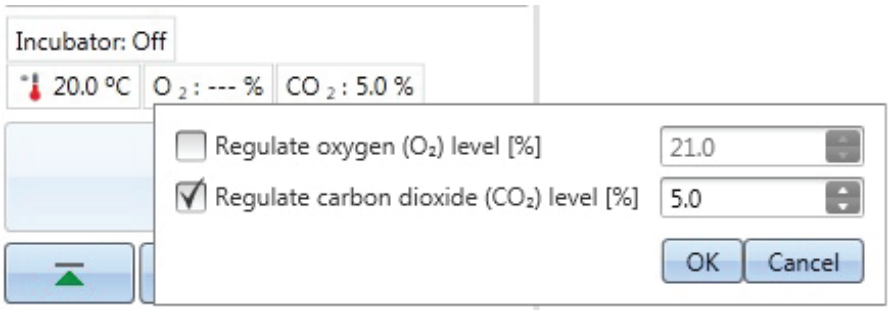


Figure 5–44 The gas atmosphere pop-up window

4. Wait till the concentration has been reached. The time required for this depends on the used gas type and the gas concentration.

CAUTION! The module must only be used by trained and authorized personnel.

CAUTION! Do not use cell or tissue cultures in the device that are not in accordance with the regulations of safety levels L1, L2, and L3.

CAUTION! Ensure that the working area is well ventilated. In order to detect gas leakages, CO_2 and O_2 sensors must be present on the wall of the room where the Varioskan LUX with a Integrated gas module is installed. Follow the instructions of the sensor manufacturer.

IMPORTANT! The O_2 sensor inside the Varioskan LUX must be changed annually. The disposable gas filters must also be changed during the same service or more frequently if necessary.

IMPORTANT! If the O_2 sensor inside the Varioskan LUX sounds an alarm, close the gas cylinder and ventilate the space.

5

Maintenance

Contact local authorized technical service or your local Thermo Fisher Scientific representative for assistance, if necessary.

IMPORTANT! It is recommended to service the instrument at least yearly.

Preventive maintenance

For reliable daily operation, keep the instrument free of dust and liquid spills.

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

It is recommended to clean the case of the instrument periodically to maintain its good appearance. A soft cloth dampened in a warm, mild detergent solution will be sufficient.

IMPORTANT! 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.

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

If you believe that liquid has entered the Varioskan LUX, first switch the instrument off (Figure 2–2) and unplug the instrument. Carry out corrective measures. Refer to "How to clean the measurement chamber" on page 72 and "Sending the instrument to service" on page 83 for aid. If necessary, contact your local Thermo Fisher Scientific representative or the Thermo Fisher Scientific technical service department.

Although the Varioskan LUX is constructed from high-quality materials, you must immediately wipe away spilt saline solutions, solvents, acids or alkaline solutions from outer surfaces to prevent damage.

IMPORTANT! If local or laboratory regulations prescribe regular decontamination, it is not advisable to use formaldehyde, since even small traces of formaldehyde negatively affect the enzyme being used in EIA tests resulting in inconsistent test results.

CAUTION! If any surfaces have been contaminated with biohazardous material, a mild sterilizing solution should be used.

IMPORTANT! Do not autoclave any part of this instrument.

IMPORTANT! Do not use alkaline or chlorite solutions for cleaning any parts of the measurement chamber (Figure 3–21), which may result in immediate damage to the instrument.

How to clean the measurement chamber

1. Switch the Varioskan LUX off by turning the power switch (Figure 2–2) on the left side panel of the instrument into the off position.
2. Lift up the dispenser sliding cover (Figure 3–20).
3. If you suspect that liquids have entered the measurement chamber (Figure 5–46), remove the front cover by first pulling the two bolts (1), one on each side at the bottom, sideways, then turning the bottom of the cover (2) 30° and finally by lifting it off according to Figure 5–45.

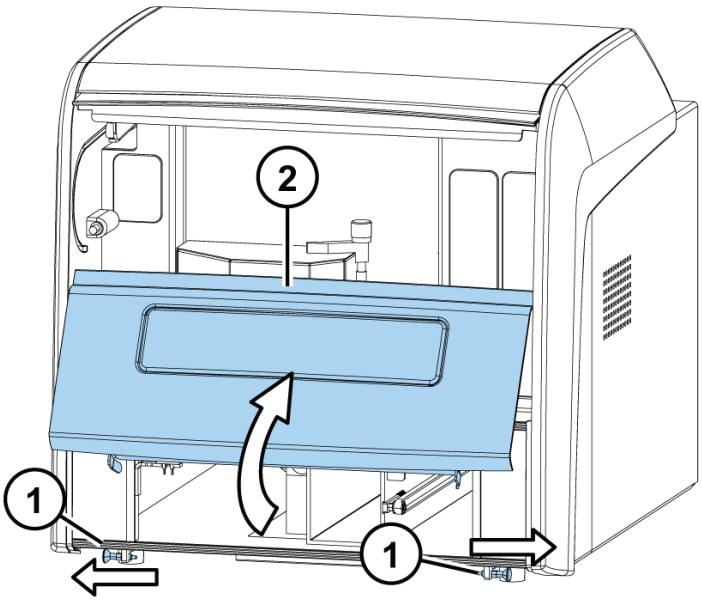


Figure 5–45 Front cover removed

4. If you have spilt infectious agents into the measurement chamber (Figure 5–46), decontaminate according to "Sending the instrument to service" on page 83. Otherwise, clean the measurement chamber surface using a soft cloth or tissue paper soaked in a mild detergent solution, soap solution or 70% ethanol.

IMPORTANT! Do not leave or store corrosive materials inside the measurement chamber.

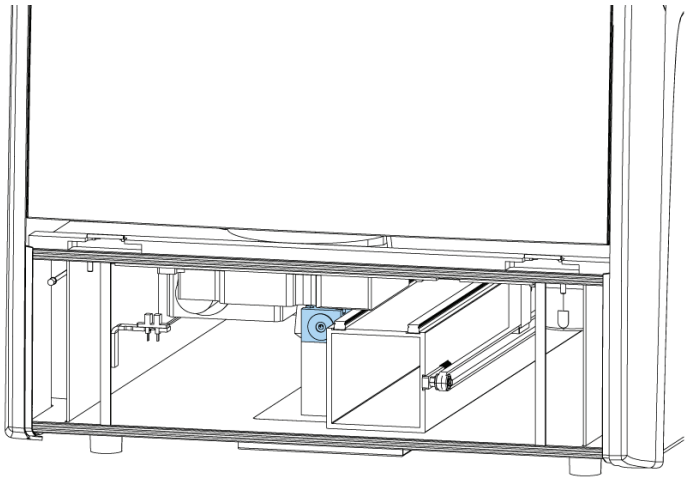


Figure 5–46 Internal view of the measurement chamber

IMPORTANT! Do not touch the photometric or the bottom reading optics lens with bare hands (on the top)!

5. Replace the front cover by first inserting the two top door latches into place while at the same time turning the cover 30° and then snapping it shut (Figure 2–2 and Figure 5–45). Also close the dispensing sliding cover (arrows in the opposite direction than in Figure 3–21).

How to clean the optics in the measurement chamber

To clean the optics, that is, the absorbance lens and the fluorescence bottom reading optics:

1. Soak a lint free tissue in 70% ethanol.
2. Wipe over the lens in a straight movement from inside to out. Do not use any circular movements when cleaning the optics.
3. Repeat the procedure if the lens is not clean.

IMPORTANT! Do not touch the optical lenses with bare hands. Avoid touching the lens of the absorbance window (Figure 5–46) and the white reference chip with bare hands.

How to clean the tray

To clean the tray, follow the instructions below.

Keep the instrument tray(s) (Figure 2–15 and Figure 2–16) clean to avoid dust and dirt from entering the measurement chamber (Figure 5–46). Clean the tray surface, including the tray adapters in use (Table 2–1 and Table 2–2), at least once a week using a soft cloth or tissue paper soaked in a mild detergent solution, soap solution or 70% ethanol. Wipe up spills immediately. Do not use formaldehyde.

If you have spilt infectious agents on the tray, decontaminate according to "Sending the instrument to service" on page 83.

CAUTION! Ensure that the bottom of each microplate is dry. Fluid on the bottom of a microplate may constitute a contamination hazard. Use proper laboratory practices when handling any hazardous materials.

Keep all the holes in the adapter clean, both the identification holes (Figure 2–15) and the well holes (Table 2–1 and Table 2–2).

IMPORTANT! Do not autoclave the tray (Figure 2–15 and Figure 2–16).

How to clean the reagent basin and dispensing area

To clean the reagent basin and dispensing area, follow the instructions below.

CAUTION! If any surfaces have been contaminated with biohazardous material, a mild sterilizing solution should be used.

Keep the reagent basin (Figure 2–5) and dispensing area (Figure 3–28) clean. Clean the surface daily using a soft cloth or tissue paper soaked in a mild detergent solution, soap solution, or 70% ethanol. Wipe up spills immediately. Do not use formaldehyde.

How to clean the LAT module

1. Switch off the Varioskan LUX by turning the power switch (Figure 2–2) on the left side panel of the instrument into the off position.
2. Place the dispensing heads into the dispensing head holders.
3. Remove the LAT module according to Figure 5–47.

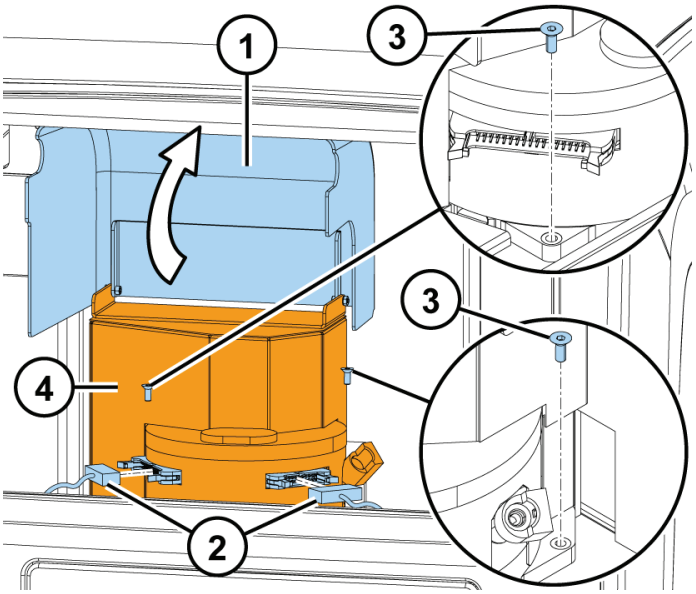


Figure 5–47 Removing the LAT module

1) Lift the chamber door.
2) Remove the flat cable 34 pin (lumino) and the flat cable 20 pin (LAT).
3) Remove the two (2) module screws.
4) Lift the module out.

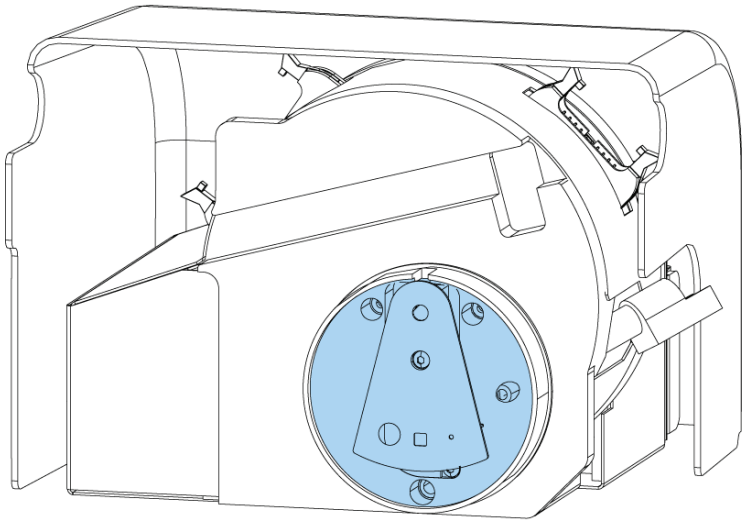


Figure 5–48 Crosstalk shield

4. Turn the module over to expose the crosstalk shield.
5. Carefully clean the dirt from the bottom using a lint free tissue or a cotton stick soaked in a mild detergent solution, soap solution, or 70% ethanol. Do not use formaldehyde.

IMPORTANT! Do not loosen the crosstalk shield. Do not wash any electronic parts.

6. Remove everything between 6-9.

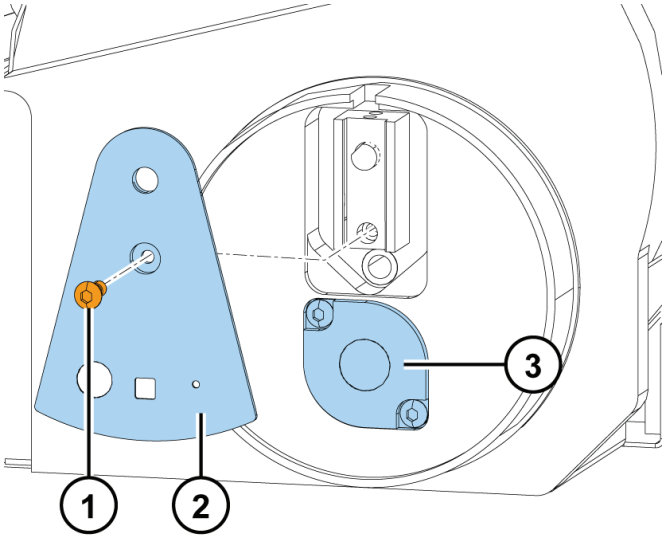


Figure 5–49 Removing the crosstalk shield

1) Unfasten the fastening screw
2) Remove the crosstalk shield
3) Remove the lens cover

7. Soak a lint free tissue in lens cleaning solution or isopropyl alcohol.
8. Wipe over the optical lens in a straight movement from inside to out. Do not use any circular movements when cleaning the optics.

IMPORTANT! Do not touch the surfaces of filters or optical lenses with bare hands.

9. Replace the crosstalk shield with the fastening screw (2).
10. Replace the LAT module unit.
11. Fasten the two bottom screws (3).
12. Attach the two connectors (2).
13. Run the LAT measurement alignment. Refer to "How to align the LAT measurement position" on page 43.

Routine maintenance of the dispensers

To obtain optimal performance and maximum useful life for the dispensers (Figure 3–28), it is important that the recommended cleaning maintenance instructions are followed. Refer also to "Dispenser washing" on page 65. For use of the Wash functionality, refer to the *SkanIt Software Technical Manual*.

The Varioskan LUX is a very sensitive instrument. Therefore, take special care to avoid any contamination of any parts of the dispenser tubing and follow all GLP (Good Laboratory Practices) recommendations.

Daily maintenance

The basic maintenance procedure should be performed regularly and on a daily basis to ensure proper dispenser operation.

1. Flush the dispenser tubings (Figure 3–30) out thoroughly with distilled deionized water after each use. Leave the fluid pathway filled for storage.
2. Inspect the dispensers for leaks, and correct any problems immediately.
3. Wipe up all spills on and around the dispensers immediately.

IMPORTANT! Do not allow the dispensers to run dry for more than a few cycles.

Weekly maintenance

Clean the fluid path thoroughly on a weekly basis to remove precipitates, such as salts, eliminate bacterial growth, and so on, using one of the procedures outlined below. There are three agents with which the dispensers may be cleaned:

- Weak detergent
- 10% bleach (for example, sodium hypochlorite)
- Weak base and acid

Remove the dispensing heads (Figure 2–5) from the dispensing head positioners (Figure 2–5) and do not let any cleaning fluids enter the measurement chamber (Figure 5–46). Use external containers.

Weak detergent or 10% bleach

To clean the dispensers (Figure 3–28) with weak detergent or 10% bleach:

1. Prime the dispenser with a weak detergent solution or a 10% bleach solution. Make a solution of 10% bleach by adding one part of commercial bleach to nine parts of water. Leave the solution in the dispenser with the syringe (Figure 3–30) fully lowered for 30 minutes.
2. After the 30-minute period, remove the aspirate tubing (Figure 3–30) from the detergent or bleach solution and remove all the fluid from the syringe and tubing into a waste container.
3. Prime the dispenser a minimum of 10 cycles with distilled or deionized water. Leave the fluid pathways filled for storage.

Weak base and acid in sequence

To clean the dispensers (Figure 3–28) with weak base and acid:

1. Prime the dispenser with 0.1 M NaOH and leave the solution in the dispenser for 10 minutes with the syringe (Figure 3–30) fully lowered.

IMPORTANT! Do not spill any alkalines onto any instrument surfaces to avoid damage to the instrument. If needed, use suitable protection covering.

2. Flush the dispenser with distilled or deionized water.
3. Prime the dispenser with 0.1 M HCl, and leave the solution in the dispenser for 10 minutes with the syringe fully lowered.
4. After the 10-minute period, remove the aspirate tubing (Figure 3–30) from the 0.1 M HCl solution, and remove all the fluid from the syringe and tubing into a waste container.
5. Prime the dispenser a minimum of 10 cycles with distilled or deionized water.

Periodic maintenance

There are three parts which require periodic maintenance: tubing, syringe, and valve. If they become worn out, you are likely to notice these symptoms:

- Poor precision and accuracy
- Air bubbles
- Leakage
- Drops and spills

The frequency of replacement will depend on the duty cycle, fluids used, and instrument maintenance.

If any of these symptoms occur and it is not obvious which component is causing the problem, it is easiest and most economical to replace one component at a time in the following order:

(1) dispensing or aspirate tubing – that is, the input and output tubing (Figure 5–52) – and/or the dispensing tip (Figure 5–50), (2) syringe (Figure 5–52), and (3) valve (Figure 5–52).

If the plunger is stuck

Improper washing of a syringe may cause the plunger to get jammed. The following may help:

1. Remove the syringe (see "Replacing a dispenser syringe" on page 80) and soak it in alcohol or detergent solution.
2. If the plunger does not move after this, you will need to replace it.
3. If the plunger moves, rinse the syringe carefully with distilled or deionized water, remove the plunger, rinse it and allow the syringe and the plunger to dry separately.

IMPORTANT! If the dispensers are not properly installed, leakage may occur.

Replacing the aspirate tube assembly or the complete dispensing tube assembly

To remove either the aspirate tube assembly, that is, the input tubing (Figure 3–30) or the complete dispensing tube assembly, that is, the output tubing (Figure 3–30):

1. To remove either the dispensing tube or the aspirate tube assembly from the valve, gently loosen the fittings manually. Unscrew the fittings and remove the tubing.
2. Insert the fitting into the valve and tighten it finger tight to fit the new tubing.

Replacing a dispensing tip

To replace a dispensing tip (Figure 5–50):

1. Remove the dispensing head tube (Figure 5–50) from the brass tube holder (Figure 5–50) by turning the dispensing head tube counterclockwise and the brass part closest to it clockwise.

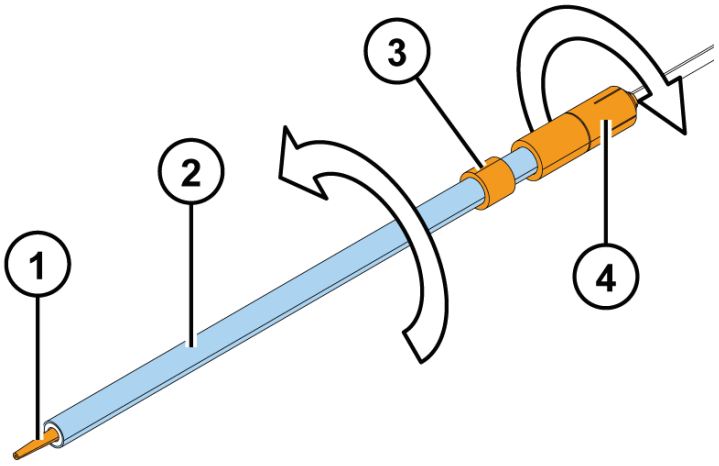


Figure 5–50 Replacing the dispensing tip (A)

1) Dispensing tip (0.40 mm)
2) Dispensing head tube
3) Dispensing head position sensor
4) Brass tube holder

2. Replace the dispensing tip connected with a small piece of silicone tube in the dispensing tube (Figure 5–51). Use the dispensing head tube as a dispensing tip installation tool. Insert the fragile tip into the smaller hole of the tool and then install it into the small piece of silicone.

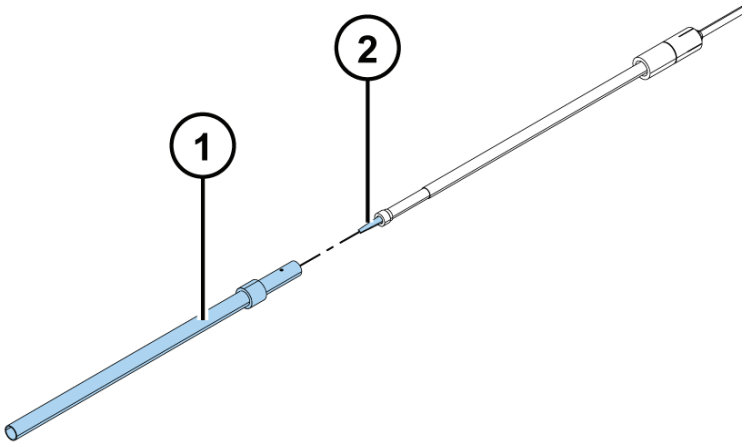
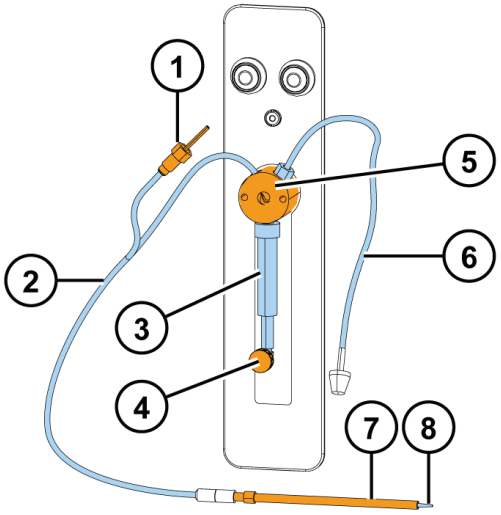


Figure 5–51 Replacing the dispensing tip (B)

1) Dispensing head tube
2) Dispensing tip to be discarded

3. Replace the dispensing head tube (Figure 5–51). Fasten the parts by turning in the opposite directions than shown in Figure 5–50.
4. Change the tip size setting in SkanIt Software if you have changed the tip size.

Replacing a dispenser syringe



1) Male connector of the dispensing head position sensor
2) Dispensing tube assembly
3) Dispenser syringe and plunger
4) Plunger lock screw
5) Valve
6) Aspirate tube assembly
7) Dispensing head
8) Dispensing tip

To replace a dispenser syringe (Figure 5–52)

1. Remove the liquid from the dispenser syringe (Figure 5–52) and from the tubing.
2. Switch off the power from the instrument by turning the mains switch into the off position (Figure 2–2).
3. Loosen the plunger lock screw (Figure 5–52) approximately three full turns clockwise (Figure 5–52, item c).
4. Pull the plunger holder arm (Figure 5–52) firmly down (Figure 5–52, item b).
5. Unscrew the syringe from the valve (Figure 5–52, item a).
6. To fit the new dispenser syringe, screw the syringe into the valve, pull the syringe plunger down to the plunger holder arm, and screw the syringe into place. Make sure the plunger lock screw is securely tightened (Figure 5–52).

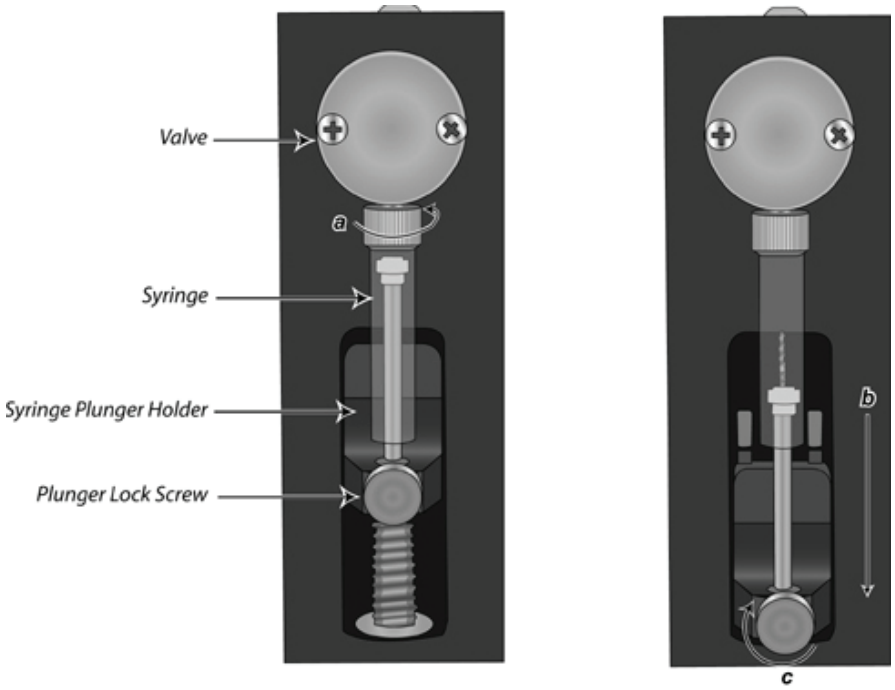


Figure 5–52 Replacing the dispenser syringe

7. Define the syringe size in SkanIt Software if you have changed the size.

Replacing the 3-port valve

To replace the 3-port valve (Figure 5–52 and Figure 5–53), it is recommended that you contact authorized technical service:

1. Remove the fluid from the dispenser(s).
2. Remove the syringe and tubing.
3. Remove the two Phillips head screws on the front of the valve, and then remove the valve from the dispenser(s).
4. Install the new valve by placing it on the front panel so the screw holes are aligned. The valve coupler fitting mates to the valve motor shaft. The valve should be oriented with the tube fittings on top and the syringe on the bottom. Replace the valve screws.
5. Install the syringe and pull the syringe plunger until it is above the carriage.
6. Align the valve using the plunger as a guide and tighten from 1/8 to ¼ turn after the syringe touch-off.
7. Pull the syringe plunger all the way into the carriage and secure by tightening the plunger lock screw

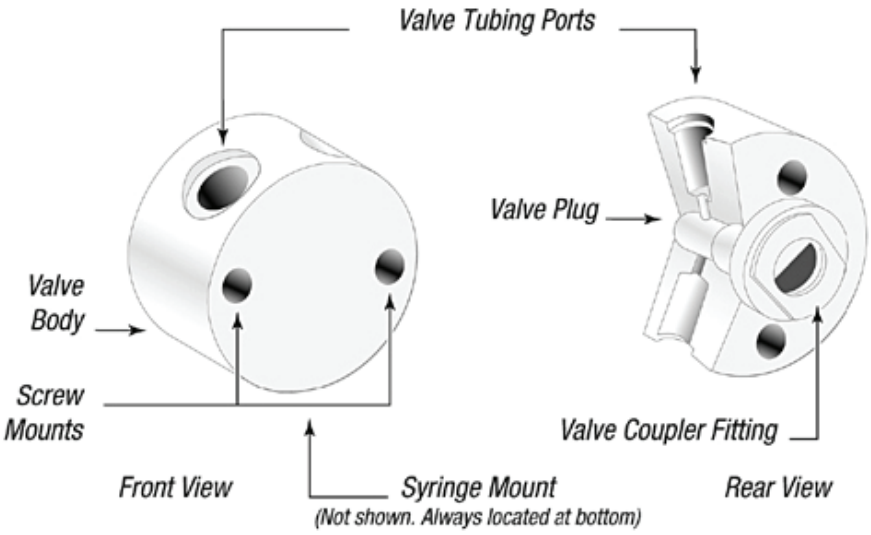


Figure 5–53 3-port valve replacement

8. .

Disposal information

Disposal of materials

Follow laboratory and country-specific procedures for biohazardous or radioactive waste disposal. Refer to local regulations for the disposal of infectious material.

CAUTION! The samples can be potentially infectious. Dispose of all used plates, strips, priming vessels, disposable gloves, syringes, disposable tips, and so on as biohazardous waste.

Disposal of the instrument

If the Varioskan LUX is exposed to potentially infectious chemical samples, toxic or corrosive chemicals or radioactive chemicals, waste management of the complete instrument must be carried out to ensure that there is no risk of contamination.

CAUTION! Decontaminate the instrument before disposal. Refer to "Sending the instrument to service" on page 83 about decontamination.

Note! Observe all federal, state and local environmental regulations.

Follow laboratory and country-specific procedures for biohazardous or radioactive waste disposal.

All device components can be disposed of after they have been decontaminated properly.

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.

Pollution degree	2 (see "Safety specifications" on page 91)
Method of disposal	Electronic waste Contaminated waste (Infectious waste)

Do not treat electrical and electronic equipment as unsorted waste. Collect waste from electrical and electronic equipment separately.

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

Note! Thermo Fisher Scientific offers a recycling service for discarded components at the owner's expense.

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

Sending the instrument to service

If you need to send the instrument to the Thermo Fisher Scientific Service, contact contact your local Thermo Fisher Scientific representative for further instructions. Obey the instructions to decontaminate and pack the instrument before you send the instrument to the Thermo Fisher Service.

How to refit the transport locks

When you relocate the instrument or ship it for service, make sure you refit the transport lock of the tray holder.

Tray holder transport lock

Note that the tray holder transport lock support piece is easily recognizable having a metallic color and a yellow label (Figure 3–22). Refer to "How to release the transport locks" on page 33 (work phases in reverse order to refitting).

1. Unfasten the attached tray from the screw fix of the tray holder (Figure 3–25).
2. Push the tray holder gently into the instrument by hand.
3. Lift up the dispenser sliding cover (Figure 3–20).
4. Remove the front cover by first pulling the two bolts, one on each side at the bottom, sideways, then turning the bottom of the cover 30° and finally by lifting it off according to Figure 5–54.

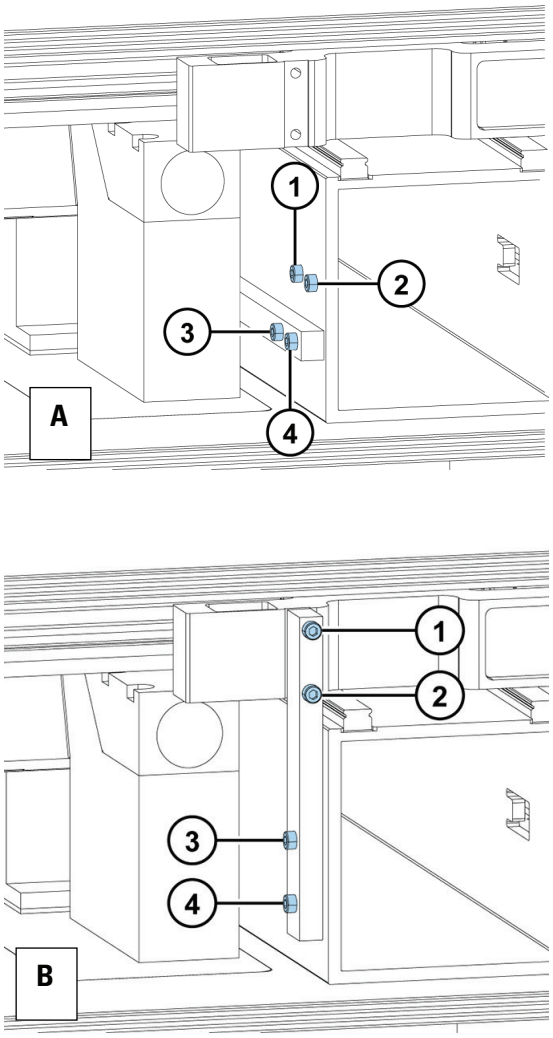


Figure 5–54 Transport lock released (A) and fastened (B) (screws 1–4 shown)

5. Remove the two screws marked 1 and 2 of the transport lock from their storage site on the track mechanism bar (Figure 5–54 A).
6. Remove the screw marked number 3 (Figure 5–54 A).
7. Loosen the screw marked number 4 of the transport lock slightly by using the hexagonal screwdriver supplied (Figure 5–54 A).

   When you have loosened the screw number 4 so that the transport lock bar moves, turn the transport lock bar into a vertical position towards the front of the instrument (Figure 5–54 B). Pull the tray holder gently from inside the instrument so that you can fit the transport lock bar into its groove in the tray holder.
8. Refit the two screws marked 1 and 2 into the holes designated for them using the hexagonal screwdriver supplied (Figure 5–54 B).

   At the same time, replace the transport lock tag under the topmost screw marked number 1 before tightening the screw marked number 2.
9. Tighten the screws marked number 3 and 4 firmly once you have fastened the screws marked number 1 and 2 of the transport lock (Figure 5–54 B).
10. Replace the front cover by first inserting the two top door latches into place while at the same time turning the cover 30° and then snapping it shut (Figure 2–2 and Figure 5–45). Also close the dispenser sliding cover.

6

Technical Specifications

General specifications

Thermo Fisher Scientific reserves the right to change any specifications without prior notice as part of our continuous product development program (Table 6–7 through Table 6–16).

Table 6–7 General specifications

General specifications	
Overall dimensions	526 mm (W) x 579 mm (D) x 509 mm (H)
Weight	53– 60 kg, depending on the configuration
Operating conditions	+10°C to +40°C; maximum relative humidity 80% for temperatures up to 31°C. Decreasing linearly to 50% relative humidity at 40°C. Indoor use only!
Performance specification conditions	All performance specifications shall be fulfilled within an ambient temperature range of 20 – 25°C in humidity range of 10 – 80%.
Transportation conditions	-40°C to +70°C, packed in transport packaging
Storage conditions	-25°C to +50°C, packed in transport packaging
Mains power supply	100–240 Vac, 50/60 Hz, nominal
Power consumption	200 VA max.
User interface	The instrument is under PC software control.
Computer interface	USB 2.0
Measurement types	Fluorescence intensity, time-resolved fluorescence, photometry, luminometry, and AlphaScreen
Incubator	Incubator included (heating)
Shaker	Orbital shaking
Dispensers	Up to two optional dispensers with automatic dispensing position control
Plate size	Plate maximum dimensions: Universal tray: 127.8 mm (W) x 85.8 mm (D) x 23.5 mm (H) Robotic tray: 128.6 mm (W) x 86.0 mm (D) x 18.0 mm (H)

Performance specifications in room temperature

This section provides the performance specifications for the relevant measurement techniques and other instrument capabilities.

Table 6 – 8 Fluorometry

Performance specifications	Fluorometry
Light source	Xenon flash lamp
Detector	Photomultiplier tube
Wavelength selection	Double excitation and double emission monochromators
Excitation wavelength range	200–822 nm
Emission wavelength range	270–840 nm
Excitation bandwidth	5 nm and 12 nm
Emission bandwidth	12 nm
Wavelength setting resolution	1 nm
Wavelength accuracy	Excitation ± 2 nm, emission ± 3 nm
Wavelength repeatability	< 0.2. Note that Emission wavelength must be greater than Excitation wavelength
Xenon flash lamp	Lamp lifetime typically 10^9 flashes (10^6 96-well microplates using 100 ms integration time per well)
Sensitivity / dynamic range	Top reading: < 0.4 fmol fluorescein/well (black 384-well plate), > 6 decades Bottom reading: < 4 fmol fluorescein/well, (clear bottom black 384 square well plate), > 5.5 decades
Measurement time	Fluorescence intensity: 10 – 1000 ms
Measurement speed	Reads a 96-well plate in 15 s, a 384-well plate in 45 s, and a 1536-well plate in 135 s (minimum kinetic interval time from A1 back to A1)
Spectral scanning speed	< 2.2 s/well 400 – 500 nm, 1 flash, 2 nm steps
Plate types	6 – 1536-well plates (top reading) 6 – 384-well plates (bottom reading)

Table 6 – 9 Photometry

Performance specifications	Photometry
Light source	Xenon flash lamp
Wavelength selection	Double monochromators
Detector	Photodiode
Wavelength range	200 – 1000 nm
Bandwidth	5 nm
Wavelength setting resolution	1 nm
Wavelength accuracy	± 2 nm
Wavelength repeatability	< 0.2
Linear measurement range	0 – 4 Abs (96-well plate) at 450 nm, ± 2% 0 – 3 Abs (384-well plate) at 450 nm, ± 2%
Absorbance resolution	0.001 Abs
Accuracy	0.003 Abs or ± 2%, at 200 – 399 nm (0 – 2 Abs) 0.003 Abs or ± 1%, at 400 – 1000 nm (0 – 3 Abs)
Precision	SD < 0.001 Abs or CV < 0.5%, at 450 nm (0 – 3 Abs)
Stray light	< 0.005% at 230 nm
Measurement time	10 – 1000 ms
Measurement speed	Reads a 96-well plate in 15 s and a 384-well plate in 45 s (minimum kinetic interval time from A1 back to A1)
Spectral scanning speed	< 2.2 s/well 400 – 500 nm, 1 flash, 2 nm steps
Plate types	6 – 384-well plates

Table 6 – 10 Luminometry

Performance specifications	Luminometry
Wavelength selection	Filter wheel with no filter and up to 8 optional filter positions
Filter size	Diameter: 25.0 (+0,-0.3) mm Thickness: 3.5 – 7.0 mm
Detector	Photomultiplier tube
Wavelength range	360 – 670 nm
Sensitivity	< 7 amol ATP/well (white 384-well plate)
Dynamic range	7 decades
Crosstalk	< 1%, white 384-well plate
Measurement time	10 – 10 000 ms
Measurement speed	Reads a 96-well plate in 15 s, a 384-well plate in 45 s, and a 1536-well plate in 135 s (minimum kinetic interval time from A1 back to A1)
Plate types	6 – 1536-well plates
Scanning optics	
Wavelength selection	Double monochromators
Detector	Photomultiplier tube
Wavelength range	270–840 nm
Emission bandwidth	12 nm
Wavelength setting resolution	1 nm
Wavelength accuracy	± 3 nm
Measurement time	10–10 000 ms
Spectral scanning speed	< 2.2 s/well 400 – 500 nm, 1 flash, 2 nm steps
Plate types	6–384-well plates

Table 6 – 11 Alpha

Performance specifications	AlphaSceen/AlphaLISA
Light source	LED
Detector	Photomultiplier tube
Alpha measurement excitation wavelength	680 nm
Emission wavelength selection	Filter wheel with up to 8 optional filter positions
Alpha measurement emission wavelength range	400 – 660 nm
Alpha measurement limit of detection	< 100 amol phosphotyrosine/well (white 384-well plate)

Table 6 – 12 TRF

Performance specifications	TRF
Light source	Xenon flash lamp
Detector	Photomultiplier tube
TRF excitation wavelength	334 nm
Emission wavelength selection	Filter wheel with up to 8 optional filter positions
TRF emission wavelength range	400 – 670 nm
Sensitivity	< 1 amol Europium / well (white low volume 384-well plate)
Dynamic range	> 6 decades

Table 6 – 13 Integrated Gas Module

Performance specifications	Integrated Gas Module
Measurement chamber O_2 concentration accuracy	±1.0% (37°C, 1% O_2)
Measurement chamber CO_2 concentration accuracy	±1.0%. (37°C, 5% CO_2)
Measurement chamber O_2 concentration	1-21%
Measurement chamber CO_2 concentration	0.1-15%
Gas concentration recovery time	10 minutes

Table 6 – 14 Incubator

Performance specifications	Incubator
Temperature range	From ambient + 4°C to 45°C
Setting range	From 10°C to 45°C in 0.1°C increments
Liquid warm-up time	1 h from 25°C to 37°C, covered 96-well plate, 200 µl water/well

Table 6 – 15 Shaker

Performance specifications	Shaker
Shaking method	Orbital shaking
Shaking speed	60 – 1200 rpm
Maximum centrifugal force	1 G

Table 6 – 16 Dispensers

Performance specifications	Dispensers
Syringe size	1 ml
Dispensing tip sizes	0.40 mm
Dispensing volume	2 – 5 000 µl with 1 µl increments Automatic safety control based on maximum well volume.
Dispensing accuracy and precision	Accuracy: < 1 µl with 50 µl Precision: < 1 µl with 50 µl
Dispensing speed	96-well plate: 30 s 384-well plate: 80 s (5 µl/well)
Dead volume	< 100 µl, total tubing volume < 800 µl
Tip priming volume	2 – 10 µl
Plate sensing	Photometric
Plate types	6 – 384-well plates

Safety specifications

This section describes the safety specifications for the Varioskan LUX instrument.

In conformity with the requirements

Varioskan LUX bears the following markings:
Type 3020
100–240 Vac, 50/60 Hz, 200 VA
CE marking
cTÜVus

The safety specifications are also met under the following environmental conditions in addition to or in excess of those stated in the operating conditions:	
Altitude	Up to 2000 m
Temperature	+5°C to +40°C
Humidity	Maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C
Mains supply fluctuations	± 10% from nominal
Installation category (overvoltage category)	II according to IEC 60664-1 (see Note 1)
Pollution degree	2 according to IEC 60664-1 (see Note 2)

Note! 1) The installation category (overvoltage category) defines the level of transient overvoltage which the instrument is designed to withstand safely. It depends on the nature of the electricity supply and its overvoltage protection means. For example, in CAT II which is the category used for instruments in installations supplied from a supply comparable to public mains, such as hospital and research laboratories and most industrial laboratories, the expected transient overvoltage is 2500 V for a 230 V supply and 1500 V for a 120 V supply.

Note! 2) The pollution degree describes the amount of conductive pollution present in the operating environment. Pollution degree 2 assumes that normally only nonconductive pollution, such as dust, occurs with the exception of occasional conductivity caused by condensation.

7

Troubleshooting

IMPORTANT! Do not use the instrument if it does not appear to function properly.

Error and warning codes

When an error is detected, the current operation is terminated. After an error, it is best to abort the current run and restart from the beginning after the problem is fixed. The error (Table 7 – 17) and warning codes (Table 7 – 18) that may appear in SkanIt Software are presented below.

Table 7 – 17 Error codes reported

Code	Explanation	Suggested action
0	The command was executed successfully.	
1	Internal firmware error.	Contact service.
2	The instrument did not recognize the command it received.	Contact service.
3	The arguments of the received command are not valid.	Contact service.
4	The XY table X position is incorrect.	Contact service.
5	The XY table Y position is incorrect.	Contact service.
6	The 1st excitation grating position is incorrect.	Contact service.
7	The 2nd excitation grating position is incorrect.	Contact service.
8	The 1st emission grating position is incorrect.	Contact service.
9	The 2nd emission grating position is incorrect.	Contact service.
10	Excitation diffraction order filter position is incorrect.	Contact service.
11	Emission diffraction order filter position is incorrect.	Contact service.
12	Excitation polarization filter / above /below selector position is incorrect.	Contact service.
13	Emission polarization filter / above /below selector position is incorrect.	Contact service.
14	LAT module filter position is incorrect.	Contact service.
15	Excitation bandwidth selector position is incorrect.	Contact service.
16	Beam diameter selector position is incorrect.	Contact service.
19	The requested plate position is outside the mechanical limits of the XY table.	Contact service.
20	The offset voltage of the temperature measurement electronics is too high.	Contact service.

Continued

Cont.

Code	Explanation	Suggested action
21	Integrated gas module is not installed.	Gas control feature not available.
22	A background noise on the analog board is too high.	Contact service.
23	Error when checking the analog board reference voltage.	Contact service.
24	Integrated gas module communication error.	Errors detected in communication with the Integrated gas module. Contact service.
25	Analog signal outside measuring range.	Contact service.
26	Flash lamp failure.	Contact service.
27	Attempt to set the instrument serial number when it already has been set.	Contact service.
28	Integrated gas module failure.	Contact service.
29	A dispenser is not responding.	Contact service.
30	Non-volatile parameters lost.	Contact service.
31	Incomplete factory calibration.	Contact service.
32	The requested measurement method is not available.	Contact service.
33	Dispensing or priming was attempted when there was no plate inserted into the plate tray.	Insert a plate into the plate tray.
34	Dispenser tip priming was attempted when there were no waste wells inserted into the plate tray.	Insert the waste wells.
35	Excitation gratings zero reflection angle not found.	Contact service.
36	Excitation grating 1 335 nm calibration failed.	Contact service.
37	Excitation grating 1 823 nm calibration failed.	Contact service.
38	Excitation grating 20 nm calibration failed.	Contact service.
39	Excitation grating 2 823 nm calibration failed.	Contact service.
40	Emission gratings 405 nm calibration failed.	Contact service.
41	Emission gratings 695 nm calibration failed.	Contact service.
42	Flash lamp calibration failed.	Contact service.
43	PMT relative spectral sensitivity calibration failed.	Contact service.
44	PMT gain calibration failed.	Contact service.
45	XY table position calibration failed.	Contact service.
46	No factory calibration for the current measurement method.	Contact service.
47	Plate tray alignment error.	Check that the plate tray is properly inserted. Contact service.
48	LAT module calibration failed.	Contact service.
49	No plate tray attached to the X carriage. The XY table will not move unless there is a plate tray.	Attach a plate tray to the X carriage of the XY table.
50	Too high background level.	Clean away any possible liquid spills inside the measurement chamber. Contact service if the error persists.
51	A dispenser has failed to initialize properly.	Contact service.
52	A dispenser received an unknown command.	Contact service.
53	Invalid dispenser command operand.	Contact service.
54	Invalid sequence of dispenser commands.	Contact service.
56	Dispenser parameter memory error.	Contact service.
57	Attempt to use a dispenser before it is set up.	Contact service.
59	Dispenser plunger overload.	If you are trying to dispense a viscose liquid with high speed, reduce the dispensing speed. Contact service if the error persists.

Continued

Cont.

Code	Explanation	Suggested action
60	Dispenser valve overload.	Contact service.
61	Valve position does not allow moving the plunger.	Contact service.
65	Dispenser command buffer overflow.	Contact service.
66	Attempt to dispense when the dispenser is not primed.	Prime the dispenser before dispensing.
67	Dispenser is not installed.	Contact service.
68	The drift compensation factor is too far from the nominal value of 1.0.	Contact service.
69	Not enough memory for a new user defined parameter.	Contact service.
73	Emission first bandwidth selector position is incorrect.	Contact service.
74	Emission second bandwidth selector position is incorrect.	Contact service.
75	Default PMT voltages calibration failed.	Contact service.
76	Expanded dynamic range PMT voltages calibration failed.	Contact service.
77	The dark level signal on some of the board input channels is too high.	Contact service.
78	PMT linearity calibration failed.	Contact service.
80	Measurement chamber door is open.	See that nothing is obstructing the measurement chamber door from closing when the plate is driven in. Do not open the door while the instrument is measuring.
81	Any error during start-up preventing the execution of some commands. [1]	The measurement chamber door must be closed during start-up. If it is not, contact service.
82	The number of filter pairs does not match the number of delay/integration time pairs. This error may be reported in response to a measurement command when a TRF measurement is selected.	Contact service.
83	LAT module aperture plate position is incorrect.	Contact service.
84	LAT module reference LED failure.	Contact service.
85	Dispensing tip is in wrong position.	When priming or washing a dispenser, the dispensing tip must not be inserted into any dispensing position. When dispensing or carrying out tip priming, the dispensing tip must be inserted into one of the dispensing positions.
86	The command cannot be executed for the wrong plate type.	Use a suitable plate type. Contact service if the error persists.
88	LAT module base is installed but the LAT module itself is not.	Contact service.
89	LAT module position calibration failed. There is no signal peak found from the measured well.	Make sure that you have the luminating reagent in the correct well and correct plate type is selected.
90	LAT module position calibration failed. The signal to noise ration from the measured well is too low.	Make sure that you have the luminating reagent in the correct well and correct plate type is selected.
91	TRF lamp fail.	Contact service.
92	AlphaScreen LED failure.	Contact service.
94	Integrated gas module CO_2 sensor failure.	Contact service.

95	Invalid integrated gas module CO_2 calibration.	Contact service.
97	Integrated gas module O_2 sensor failure.	Contact service.
98	Invalid integrated gas module O_2 calibration.	Contact service.

Table 7 – 18 Warning codes reported

Code	Explanation	Suggested action
100	Unable to comply with the defined lag time.	[2]
101	Unable to comply with the defined well interval.	[2]
102	Unable to comply with the defined wavelength interval.	[2]
103	Unable to comply with the defined kinetic interval.	[2]
104	Unable to comply with the defined group interval.	[2]
105	The timer referenced in the WAI timer command is not (anymore) running. Your timing requirement is not met.	Contact service.
106	The lamp lifetime has reached its end.	Arrange for the replacement of the lamp as soon as convenient.
107	Calibration validity has expired because there was no time to perform the automatic calibration.	The accuracy of the measurement results may have suffered. If there is no waiting time in the assay, then you have to accept the possible accuracy reduction.
108	Command has no effect.	This just informs that a command has been used which has no effect in the current measurement method.
109	The interval time defined with a SYN command for the next two measurements was too short. The second measurement started later than requested.	[2]
110	Dark level interpolation for luminescence results was requested, but the results buffer became full before it could be applied.	Do not use dark level interpolation or use it between each well. Alternately, try reducing the well group size. The instrument cannot apply dark level interpolation if more than 1 536 results are measured between the dark level measurement points. See command SET 11.
111	Set gas concentration not reached.	Requested gas concentration not reached. Check that the gas bottle is not empty and the bottle is connected to the instrument. If the error persists, contact service.
112	Integrated gas module communication error.	Contact service if occurs frequently.
113	Integrated gas module failure.	Contact service.
114	Integrated gas module O_2 sensor failure.	Contact service.
115	Invalid integrated gas module O_2 calibration.	Contact service.
116	Integrated gas module CO_2 sensor failure.	Contact service.
117	Invalid integrated gas module CO_2 calibration.	Contact service.

[1] The following commands will not execute if there is such a start-up error that there is a possibility for an incorrect measurement result: CAL, DIS, DME, MEA, PRI, PTI, and SCA. Also, the command FCA executes, but will fail at the end with error 81, unless it fails earlier to some other error. Error 81 is persistent; it can be cleared to execute other commands than listed above, but the listed commands return the same error again. A successful start-up sequence is required to clear the error permanently.

[2] The minimum timing depends on the combination of measurement parameters, plate movement parameters, dispensing parameters and volume, number of wavelengths and number of measured points.

Troubleshooting guide

The problems covered below are considered faults that require repair or corrective work (Table 7 – 19). If problems occur or reoccur, contact authorized technical service immediately.

Table 7 – 19 Troubleshooting guide

Symptom	Cause	Suggested action
Connection to the instrument fails.	The instrument is switched off.	Switch on the instrument.
	The instrument is not completely initialized.	Wait for the initialization tests to be performed.
	The USB cable is not connected.	Connect the USB cable.
	The USB cable is broken.	Replace the USB cable.
Too low signal or no signal at all.	The plate is missing.	Insert the plate.
	An empty well or an incorrect layout vs. actual layout.	Check that the plate vs. layout matches.
	Measurement at wrong wavelength.	Measure with the correct wavelengths.
Poor measurement precision and inconsistent results.	Incorrect plate template.	Select/Modify the plate template to correspond to the used microplate.
Inconsistent or bad measurement results.	Incorrect or missing adapter (with or without lid).	Place the correct adapter onto the plate tray.
Too high results in fluorescence.	Excitation and emission wavelengths chosen too close to each other.	Excitation and emission wavelengths have to be correct in relation to the used bandwidth.
Inconsistent results in LAT measurements.	Either the emission filters are missing or they are misplaced in the module in relation to the software settings.	Check that the filters are present in the correct filter slots.
CO_2 concentration below target.	The CO_2 gas cylinder closed.	Open the CO_2 gas cylinder.
		Check that all the gas lines are properly connected.

8

Ordering Information

Contact your local Thermo Fisher Scientific representative for ordering and service information (Table 8–20 through Table 8–255).

Varioskan LUX

Table 8–20 Instrument catalog numbers

Cat.no.	Instrument / System
VL0000D0	Varioskan LUX with fluorescence (top) and absorbance
VL0L00D0	Varioskan LUX with fluorescence (top), absorbance and luminescence
VL0L0TD0	Varioskan LUX with fluorescence (top), absorbance, luminescence and TRF
VLB000D0	Varioskan LUX with fluorescence (top & bottom) and absorbance
VLBL00D0	Varioskan LUX with fluorescence (top & bottom), absorbance and luminescence
VLBL00GD0	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and gas module
VLBL0TD0	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and TRF
VLBL0TGD0	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, TRF and gas module
VLBLATD0	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen and TRF
VLBLATGD0	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen, TRF and gas module
VLBL00D1	Varioskan LUX with fluorescence (top & bottom), absorbance and luminescence, 1 dispenser
VLBL00GD1	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and gas module, 1 dispenser
VLBL0TD1	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and TRF, 1 dispenser
VLBL0TGD1	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, TRF and gas module, 1 dispenser
VLBLATD1	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen and TRF, 1 dispenser
VLBLATGD1	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen, TRF and gas module, 1 dispenser
VLBL00D2	Varioskan LUX with fluorescence (top & bottom), absorbance and luminescence, 2 dispensers
VLBL00GD2	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and gas module, 2 dispensers
VLBL0TD2	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and TRF, 2 dispensers
VLBL0TGD2	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, TRF and gas module, 2 dispensers

VLBLATD2	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen and TRF, 2 dispensers
VLBLATGD2	Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen, TRF and gas module, 2 dispensers

Upgrade kits for Varioskan LUX

Table 8 – 21 Catalog numbers for upgrade kits

Cat.no.	Instrument / System
VLUPL0002	Luminometric upgrade kit (L module)
VLUPA003	AlphaScreen upgrade kit, requires L module
VLUPT004	TRF upgrade kit, requires L module
VLUPD005	Dispenser upgrade kit
VLUPLA06	Upgrade kit for luminometry and AlphaScreen
VLUPLT07	Upgrade kit for luminometry and TRF
VLUPLAT08	Upgrade kit for luminometry, AlphaScreen and TRF
VLUPD209	Upgrade kit for two dispensers

Accessories for Varioskan LUX

Table 8 – 22 Catalog numbers for accessories

Cat.no.	Instrument / System
N12391	µDrop Plate
N12391M2	µDrop Duo Plate
N03079	Robotic plate tray for plates with and without lids
N02692	96-well adapter for plate without lid
N02693	96-well adapter for plate with lid
N02690	384-well adapter for plate without lid
N02691	384-well adapter for plate with lid
N02696	6-48-well adapter for plate without lid
N02697	6-48-well adapter for plate with lid
N06210	1536-well adapter for 10 mm plate without lid
N03395	96-well adapter for PCR plate without lid
N02339	Robotic plate tray adapter for plates without lid
N16443	Storage holder for plate adapters
N16484	Emission filter pick-up tool
2805690	Aspirate tube assembly for dispenser
SP-00094	Dispensing tube assembly for dispenser
SP-00096	Dispenser syringe, 1 ml
SP-00720	Microplate package for Varioskan LUX IQ/OQ
N03078	Universal plate tray for plates without lid
N16308S	Liquid protection tray

Verification tools for Varioskan LUX

Table 8 – 23 Catalog numbers for verification tools

Cat.no.	Instrument / System
N03394	Spectrophotometric verification plate
2806460	Lumiwell Verification Plate

SkanIt Software

Table 8 – 24 Catalog numbers for SkanIt Software

Cat.no.	Instrument / System
5187139	SkanIt SW for Microplate Readers, Research Edition
5187149	SkanIt SW for Microplate Readers, Drug Discovery Edition

Filters for Varioskan LUX

Table 8 – 25 Filters

Cat.no.	Product description
F48020	Emission filter 480nm HBW20 D25mm
F53030	Emission filter 530nm HBW30 D25mm
F42550	Emission filter 425nm HBW50 D25mm
F51530	Emission filter 515nm HBW30 D25mm
F51060	Emission filter 510nm HBW60 D25mm
F61060	Emission filter 610nm HBW60 D25mm
F47040	Emission filter 470nm HBW40 D25mm
F52530	Emission filter 525nm HBW30 D25mm
F640LP	Emission filter 640nm Long pass D25mm
F46080	Emission filter 460 nm HBW80 D25
F610LP	Emission filter 610 nm long pass D25
F49210	Emission filter 490 nm HBW10 D25
F52010	Emission filter 520 nm HBW10 D25
F62010	Emission filter 620 nm HBW10 D25
F66510	Emission filter 665 nm HBW10 D25
F57177	Emission filter 571 nm HBW77 D25
F61520	Emission filter 615 nm HBW20 D25

A

Preparation of Luminescence Alignment Plate

Required reagents, materials and equipment

These required reagents, materials and equipment are not provided by Thermo Fisher Scientific unless otherwise indicated.

1. Reagents:
   - ENLITEN™ ATP Assay System, 100 assays, Promega Corporation, prod. no. FF2000
   - Storage conditions: prior to reconstitution, the rL/L Reagent and Reconstitution Buffer must be stored at -20°C. Store the ATP Standard at -20°C.
2. Disposables:
   - Pipette tips (for pipetting 15 µl and 200–1000 µl volumes)
   - Thermo Scientific™ White Microlite™ 1 Plate (384-well plate, Cat. No. 8155) or any other solid white 384-well microplate
   - Disposable 2 ml or 2.5 ml Eppendorf tube, or equivalent
3. Equipment:
   - Thermo Scientific™ Finnpipette™ for 10–100 µl (with 15 µl volume)
   - Thermo Scientific™ Finnpipette™ for 200–1000 µl volumes

Product components

- rL/L Reagent, 1 vial
- Reconstitution Buffer, 12 ml
- ATP Standard (10–7M), 1 vial
- ATP-Free Water, 25 ml (not needed in this test)

Reconstitution of assay components

rL/L Reagent
Before opening, gently tap the rL/L Reagent vial to ensure that the lyophilized material is in the vial bottom. Slowly remove the vial crimp seal and rubber stopper to avoid loss of material. Add the entire contents of the plastic bottle labeled Reconstitution Buffer to the vial, replace the rubber stopper, and gently swirl the vial to dissolve the contents. *DO NOT shake the dissolved rL/L Reagent*. Allow the rL/L Reagent to equilibrate to room temperature before use.

Reconstituted rL/L Reagent can be held at room temperature for 8 hours. If the reagent will be used for longer than 8 hours, dispense the rL/L Reagent into 200–1000 µl aliquots and store them at 4°C, protected from light. Use aliquots as needed. The activity of the reconstituted rL/L Reagent diminishes roughly 15% after 2 days of storage at 4°C. Be sure to allow the rL/L Reagent to return to room temperature prior to use. If long-term storage is needed, the reconstituted rL/L Reagent can be stored in single-use aliquots at -20°C. Avoid multiple freeze-thaws. The activity of the reconstituted rL/L Reagent diminishes by roughly 50% after two weeks at -20°C.

ATP Standard
Pour a small volume of ATP standard solution (approximately 2 ml) into a disposable 2 ml Eppendorf tube, to prevent the solution from getting contaminated.

The ATP standard solution is ready for use.

The ATP Standard should be divided into 200–1000 µl aliquots and stored in the freezer. Avoid multiple freeze-thaw cycles with the ATP Standard.

Ensure that all reagents are at room temperature when preparing the test plate.

Pipetting instructions

Pipette 15 µl of ATP Standard solution and 15 µl of rL/L Reagent into well H12 of a white 384-well plate. Mix the wells gently with the pipette tip. This plate can be used for about 30 minutes after preparation.

Glossary

A

absorbance (optical density)
A logarithmic function of the transmission of a wavelength of light through a liquid. log (I/I_0) dimension [A]

adapter
The elevation device used to hold and raise the microplate in the tray.

AFP
Alpha-fetoprotein, common label in FRET and TR-FRET assays.

AlphaScreen
AlphaScreen (Amplified Luminescent Proximity Homogeneous Assay Screen) is a versatile technology used to detect and quantify a broad range of analytes in complex biological processes.

AlphaLISA™
AlphaLISA extends AlphaScreen technology to allow for high throughput detection and quantification of markers in biomolecular reactions.

aspirate/dispense tubing
Connects the valve output port (1/4–28 thread) to a sample source and destination. The aspirate tubing is used to fill the syringe with reagent. The dispensing tube is used to dispense reagent from the syringe into a microplate.

B

bioluminescence
Naturally occurring chemiluminescence from light-emitting organisms, e.g., glowworms, some deep-sea fish, some bacteria and some fungi.

BRET
Bioluminescence resonance energy transfer.

C

chemiluminescence
Luminescence as a result of pure chemical reactions.

D

decade
Order of magnitude. A logarithmic value that is used for presentation of dynamic range.

decontamination
Removal or neutralization of radiologic, bacteriological, chemical or other contamination.

DELFIA™
Dissociation enhanced lanthanide fluoroimmunoassay, PerkinElmer's product family for TRF reagents and kits.

diffraction
Spreading of light transmitted through a narrow slit or reflected from a narrow groove.

diffraction angle
An angle between incoming and diffracted light, which is the function of the wavelength and groove spacing.

diffraction grating (reflection grating)
Grooved component that diffracts the incoming light into diffraction angles.

disinfection
The destruction of pathogenic bacteria, usually with an antiseptic chemical or disinfectant.

double monochromator
Two serially one after another connected monochromators.

dynamic range
Dynamic range refers to the range of signals an instrument can read, from the minimum to the maximum detectable. For example, dynamic range of seven decades means that the difference between the lowest and highest signals that can be measured is 10^7.

E

emission
The release of light from a fluorochrome when an electron falls from an excited state to a lower energy state of the molecule.

error message
Indication that an error has been detected.

excitation
The absorption of light energy by a fluorochrome, during which electrons in the fluorochrome molecule are boosted to a higher energy level.

F

fluorescein
An example of a fluorescent dye emitting green fluorescence.

fluorescence
The emission of light from a fluorochrome, the wavelength of the light generally being of longer wavelength than that of the absorbed light.

fluorescence lifetime
The period of time elapsed between when a fluorophore is excited and when it emits light. This is between 4 and 10 ns for most standard fluorophores and roughly 1 µs for long-lived lanthanides used for TRF measurements. Cf. T (tau).

fluorochrome (fluorophore)
A molecule or chemical group that emits fluorescence.

fluorometer
Instrument used for measuring the intensity of fluorescent radiation. Also known as fluorimeter.

fluorometry
The measurement of fluorescence. Also known as fluorimetry.

FRET
Fluorescence resonance energy transfer.

grating
Reflective diffraction grating: an arrangement of closely spaced reflecting grooves on a flat (or concave) surface. Light can reflect on the grating but can also be diffracted. An optical grating can contain a thousand lines or more per centimeter.

I

initialization tests
So-called self-tests, which are carried out before operation to ascertain that the necessary instrument adjustments have been carried out.

L

LANCE™
PerkinElmer's TR-FRET kit family using Europium-ACP.

LED
Light-emitting diode.

luciferase
A generic name for enzymes commonly used in nature for bioluminescence.

luminescence
Emission of light (other than from thermal energy causes) such as bioluminescence.

luminometer
An instrument used for measuring the intensity of luminescent radiation.

luminometric label (luminophore)
A substance which emits light at room temperature. A group of atoms that can make a compound luminescent.

M

monochromator
Transmits certain wavelengths of the incoming light. Consists of a rotatable diffraction grating and entrance/exit slits (in this context).

multiplexing
When two or more labels are used in the assay either simultaneously or consecutively, e.g., in fluorometric FRET, luminometric dual reporter gene and dual-label TRF assays.

O

optical density (absorbance)
log (1/transmittance) = log (I/I_0) dimension [*O.D.*]

order sorting
The grating monochromator will transmit multiple wavelengths, which are basic wavelengths divided by an integer. By employing a suitable optical filter the correct wavelength is selected.

P

photometer
A device measuring absorbance or optical density (in this context).

photometry
The measurement of the properties of light, particularly (luminous) intensity.

photomultiplier tube (PMT)
A photoelectric cell that converts light into electric current and amplifies the current.

priming
Completely filling the dispenser tubing and syringe with bubble-free fluid to allow sustained, reproducible dispensing action. The air in an unprimed line acts as a spring, adversely affecting accuracy and precision.

Q

quadruple monochromator
Dual serially connected double monochromators.

quantum yield (Q)
The ratio of the number of emitted photons to the number of excited molecules. Fluorophores differ in quantum yield, the higher the Q value, the more fluorescent the compound is. The theoretical maximum of Q=1 is for a highly fluorescent compound, and Q=0 corresponds to a non-fluorescent compound.

R

reference chip
Reference chip present for validation of the fluorometric optics.

RFU or rfu
Relative Fluorescence/Fluorometric Units. The arbitrary units in which fluorescence intensity is reported.

rpm
Revolutions per minute.

S

self-tests
Initialization tests and adjustments that the instrument performs before operation as well as autocalibration.

Stokes shift
The difference between the wavelengths of the excitation and emission peaks.

T

T (tau)
Fluorescence lifetime of the TRF label.

transmittance
The ratio of transmitted (I) and incident light (I_0), I/I_0.

tray
The plate carrier into which the microplate is loaded for measurement and/or dispensing.

TRF
Time-resolved fluorometry/fluorescence. Fluorescence intensity measurement using special labels.

TRF delay
Waiting period between the excitation flash end and the beginning of the emission light measurement.

TR-FIA
Time-resolved fluoroimmunoassay.

TR-FRET
Time-resolved fluorescence resonance energy transfer.

U

USB
Universal serial bus.

W

w
With.

w/o
Without.

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