



# Thermo Scientific Varioskan LUX

Rev. 1.0, Cat. No. N16045

## **Copyright**

© 2015 Thermo Fisher Scientific, Inc. All rights reserved. AlphaScreen, AlphaLISA, DELFIA and LANCE are trademarks of PerkinElmer, Inc. or its subsidiaries, in the United States and other countries. Decon is a trademark of Decon Laboratories Limited. ENLITEN and Steady-Glo are trademarks of Promega Corporation. Microside SQ is a trademark of Global Technologies, Inc. Neoflon is a trademark of Daikin Industries Limited. Virkon is a trademark of E.I. du Pont de Nemours and Company or its affiliates. All other trademarks are the sole property of Thermo Fisher Scientific Inc. and its subsidiaries.

Reproduction of the accompanying user documentation in whole or in part is prohibited.

## **Patents**

This product is protected by the following patent: US 6144455. The Thermo Scientific™ Varioskan™ LUX also has an international patent pending.

## **Disclaimer**

Thermo Fisher Scientific reserves the right to change its products and services at any time to incorporate technological developments. This manual is subject to change without prior notice as part of continuous product development. Although this manual has been prepared with every precaution to ensure accuracy, Thermo Fisher Scientific assumes no liability for any errors or omissions, nor for any damages resulting from the application or use of this information. This manual supersedes all previous editions.

## **Remarks on screenshots and pictures**

The version number displayed in screenshots may not always be the one of the currently released version. Screenshots and pictures are only replaced if the content related to the application has changed.

## **No liability for consequential damages**

Thermo Fisher Scientific shall not be liable for any indirect or consequential damages whatsoever arising out of the use or inability to use this product.

## **Power failure**

The system requires uninterrupted power supply in order to operate correctly. Thermo Fisher Scientific has no responsibility whatsoever for system malfunctions arising from power failures.

## **Manufacturer**

Thermo Fisher Scientific Oy  
Ratastie 2, P.O. Box 100  
FI-01621 Vantaa  
Finland

# 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

For the latest information on products and services, visit our websites at:

<http://www.thermoscientific.com>

<http://www.unitylabservices.com>

# Table of Contents

|                                                                               |           |
|-------------------------------------------------------------------------------|-----------|
| Preface . . . . .                                                             | 3         |
| About this guide . . . . .                                                    | 3         |
| Related documentation . . . . .                                               | 3         |
| Safety and special notices . . . . .                                          | 3         |
| Instrument safety and guidelines for use . . . . .                            | 4         |
| Emergency situations . . . . .                                                | 4         |
| Contacting us . . . . .                                                       | 4         |
| <b>Chapter 1 Introduction to Varioskan LUX . . . . .</b>                      | <b>9</b>  |
| Overview . . . . .                                                            | 9         |
| Intended use . . . . .                                                        | 11        |
| <b>Chapter 2 Functional Description . . . . .</b>                             | <b>13</b> |
| Instrument layout . . . . .                                                   | 13        |
| Front view . . . . .                                                          | 13        |
| Back view . . . . .                                                           | 14        |
| Internal view . . . . .                                                       | 15        |
| Optical system . . . . .                                                      | 16        |
| Principle of the optical system . . . . .                                     | 16        |
| Excitation optics . . . . .                                                   | 17        |
| Measurement optics . . . . .                                                  | 19        |
| Emission reading module . . . . .                                             | 19        |
| Absorbance measurement module . . . . .                                       | 20        |
| Fluorescence bottom reading . . . . .                                         | 20        |
| LAT measurement module . . . . .                                              | 21        |
| Control buttons . . . . .                                                     | 22        |
| Plate trays and adapters . . . . .                                            | 22        |
| Tray composition . . . . .                                                    | 23        |
| Universal tray with adapters . . . . .                                        | 24        |
| Robotic tray and adapter . . . . .                                            | 25        |
| How to change the location of the holder for the tip priming vessel . . . . . | 26        |
| How to remove or replace the robotic tray adapter . . . . .                   | 27        |
| <b>Chapter 3 Installation . . . . .</b>                                       | <b>29</b> |
| What to do upon delivery . . . . .                                            | 29        |
| How to unpack . . . . .                                                       | 29        |
| Checking delivery for completeness . . . . .                                  | 30        |
| Checking for damage during transport . . . . .                                | 30        |
| Environmental requirements . . . . .                                          | 30        |
| Technical prerequisites . . . . .                                             | 30        |
| Installation setups . . . . .                                                 | 31        |
| How to release the transport locks . . . . .                                  | 31        |
| Tray holder transport lock . . . . .                                          | 31        |
| How to install the plate tray and adapter . . . . .                           | 33        |
| How to set up the dispensers . . . . .                                        | 35        |
| How to set up the Integrated gas module . . . . .                             | 37        |

|                  |                                                              |           |
|------------------|--------------------------------------------------------------|-----------|
|                  | How to connect cables . . . . .                              | 39        |
|                  | How to install SkanIt Software . . . . .                     | 39        |
|                  | Installing upgrade kits . . . . .                            | 40        |
|                  | How to align the LAT measurement position . . . . .          | 40        |
|                  | How to install LAT module filters . . . . .                  | 41        |
| <b>Chapter 4</b> | <b>Operations . . . . .</b>                                  | <b>43</b> |
|                  | Operational check . . . . .                                  | 43        |
|                  | Loading the microplate . . . . .                             | 44        |
|                  | Automatic runtime calibration . . . . .                      | 46        |
|                  | Measurements and scanning . . . . .                          | 46        |
|                  | Fluorescence measurement . . . . .                           | 46        |
|                  | Fluorescence spectrum scanning . . . . .                     | 49        |
|                  | Absorbance measurement . . . . .                             | 49        |
|                  | Absorbance spectrum scanning . . . . .                       | 50        |
|                  | Luminescence measurement . . . . .                           | 50        |
|                  | Luminescence spectrum scanning . . . . .                     | 51        |
|                  | AlphaScreen measurement . . . . .                            | 52        |
|                  | Settle delay . . . . .                                       | 52        |
|                  | Measurements under controlled atmosphere . . . . .           | 53        |
|                  | Other functions . . . . .                                    | 53        |
|                  | Track mechanism . . . . .                                    | 53        |
|                  | Orbital shaking . . . . .                                    | 54        |
|                  | Incubator . . . . .                                          | 55        |
|                  | Dispensers . . . . .                                         | 56        |
|                  | Syringe . . . . .                                            | 56        |
|                  | Reagent consumption . . . . .                                | 56        |
|                  | Dispensing tip . . . . .                                     | 57        |
|                  | Dispensing . . . . .                                         | 57        |
|                  | Priming . . . . .                                            | 59        |
|                  | Tip priming . . . . .                                        | 60        |
|                  | Pull-back feature . . . . .                                  | 60        |
|                  | Dispensing and measurement . . . . .                         | 60        |
|                  | Emptying . . . . .                                           | 61        |
|                  | Dispenser washing . . . . .                                  | 61        |
|                  | Chemical resistance of the dispensers . . . . .              | 62        |
|                  | Gas control . . . . .                                        | 64        |
|                  | Atmosphere . . . . .                                         | 64        |
|                  | CO <sub>2</sub> supply . . . . .                             | 64        |
|                  | N <sub>2</sub> supply . . . . .                              | 65        |
|                  | Use . . . . .                                                | 65        |
| <b>Chapter 5</b> | <b>Maintenance . . . . .</b>                                 | <b>67</b> |
|                  | Preventive maintenance . . . . .                             | 67        |
|                  | How to clean the measurement chamber . . . . .               | 68        |
|                  | How to clean the optics in the measurement chamber . . . . . | 69        |
|                  | How to clean the tray . . . . .                              | 70        |
|                  | How to clean the reagent basin and dispensing area . . . . . | 70        |

|                                                                                         |            |
|-----------------------------------------------------------------------------------------|------------|
| How to clean the LAT module . . . . .                                                   | 70         |
| Routine maintenance of the dispensers . . . . .                                         | 72         |
| Daily maintenance . . . . .                                                             | 73         |
| Weekly maintenance. . . . .                                                             | 73         |
| Weak detergent or 10% bleach . . . . .                                                  | 73         |
| Weak base and acid in sequence. . . . .                                                 | 73         |
| Periodic maintenance . . . . .                                                          | 74         |
| If the plunger is stuck. . . . .                                                        | 74         |
| Replacing the aspirate tube assembly or the complete dispensing tube assembly . . . . . | 75         |
| Replacing a dispensing tip . . . . .                                                    | 75         |
| Replacing a dispenser syringe. . . . .                                                  | 76         |
| Replacing the 3-port valve . . . . .                                                    | 78         |
| Disposal information . . . . .                                                          | 79         |
| Disposal of materials . . . . .                                                         | 79         |
| Disposal of the instrument . . . . .                                                    | 79         |
| Decontamination procedure. . . . .                                                      | 80         |
| How to pack for service. . . . .                                                        | 81         |
| How to refit the transport locks . . . . .                                              | 82         |
| Tray holder transport lock . . . . .                                                    | 82         |
| <b>Chapter 6 Technical Specifications . . . . .</b>                                     | <b>85</b>  |
| General specifications . . . . .                                                        | 85         |
| Performance specifications in room temperature . . . . .                                | 86         |
| Safety specifications . . . . .                                                         | 89         |
| In conformity with the requirements. . . . .                                            | 89         |
| <b>Chapter 7 Troubleshooting . . . . .</b>                                              | <b>91</b>  |
| Error and warning codes . . . . .                                                       | 91         |
| Troubleshooting guide . . . . .                                                         | 96         |
| <b>Chapter 8 Ordering Information. . . . .</b>                                          | <b>97</b>  |
| Varioskan LUX. . . . .                                                                  | 97         |
| Gas module for Varioskan LUX . . . . .                                                  | 98         |
| Upgrade kits for Varioskan LUX . . . . .                                                | 98         |
| Accessories for Varioskan LUX. . . . .                                                  | 98         |
| Verification tools for Varioskan LUX . . . . .                                          | 99         |
| SkanIt Software. . . . .                                                                | 99         |
| Filters for Varioskan LUX . . . . .                                                     | 99         |
| <b>Appendix A Certificate of Decontamination. . . . .</b>                               | <b>101</b> |
| <b>Appendix B Preparation of Luminescence Alignment Plate . . . . .</b>                 | <b>103</b> |
| Required reagents, materials and equipment . . . . .                                    | 103        |
| Product components . . . . .                                                            | 103        |
| Reconstitution of assay components . . . . .                                            | 104        |
| Pipetting instructions. . . . .                                                         | 104        |
| Glossary . . . . .                                                                      | 105        |



# 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<sub>2</sub> & O<sub>2</sub>) 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.



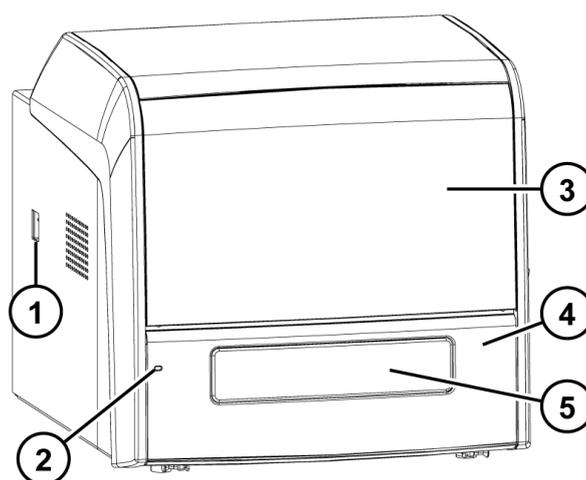
# 2

## Functional Description

### Instrument layout

#### Front view

The front view of the Varioskan LUX instrument is shown in [Figure 2–2](#).

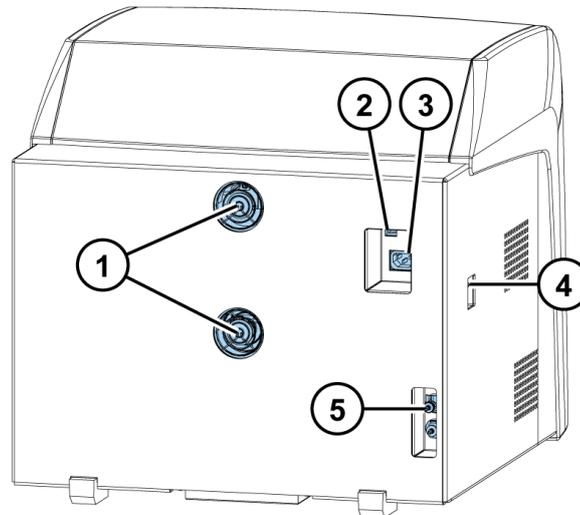


1. Power switch
2. LED indicator
3. Dispenser sliding cover
4. Front cover
5. Measurement chamber door

**Figure 2–2** Varioskan LUX front view

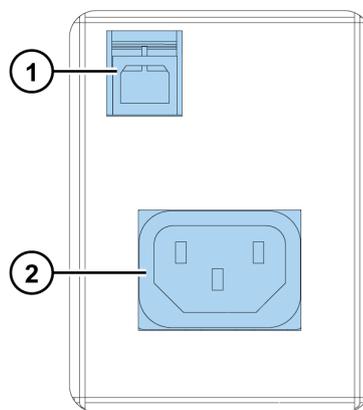
## Back view

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

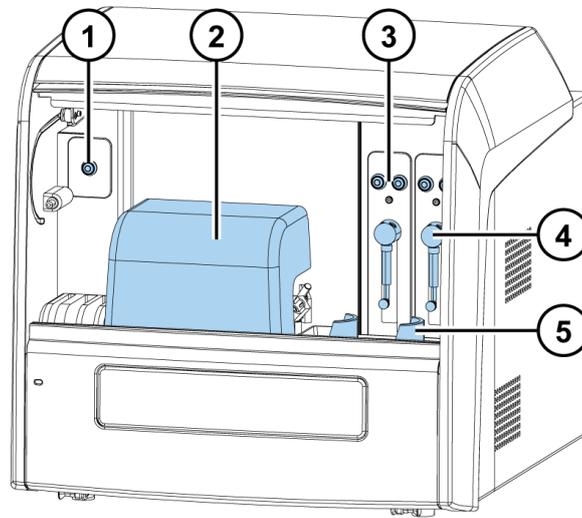


**Figure 2–4** Close-up of the computer and mains supply connectors

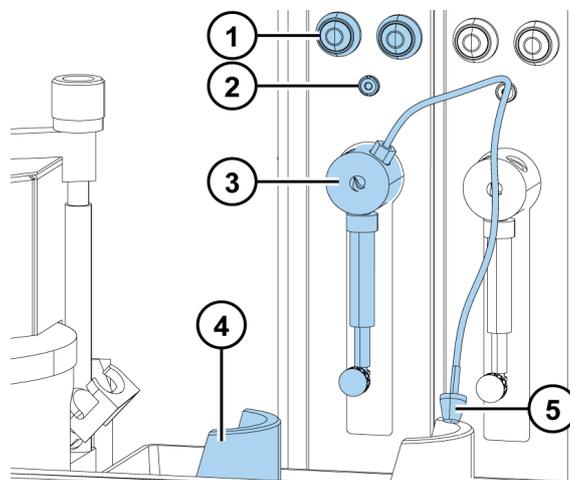
- 1) USB connector
- 2) Mains power supply connector

## 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

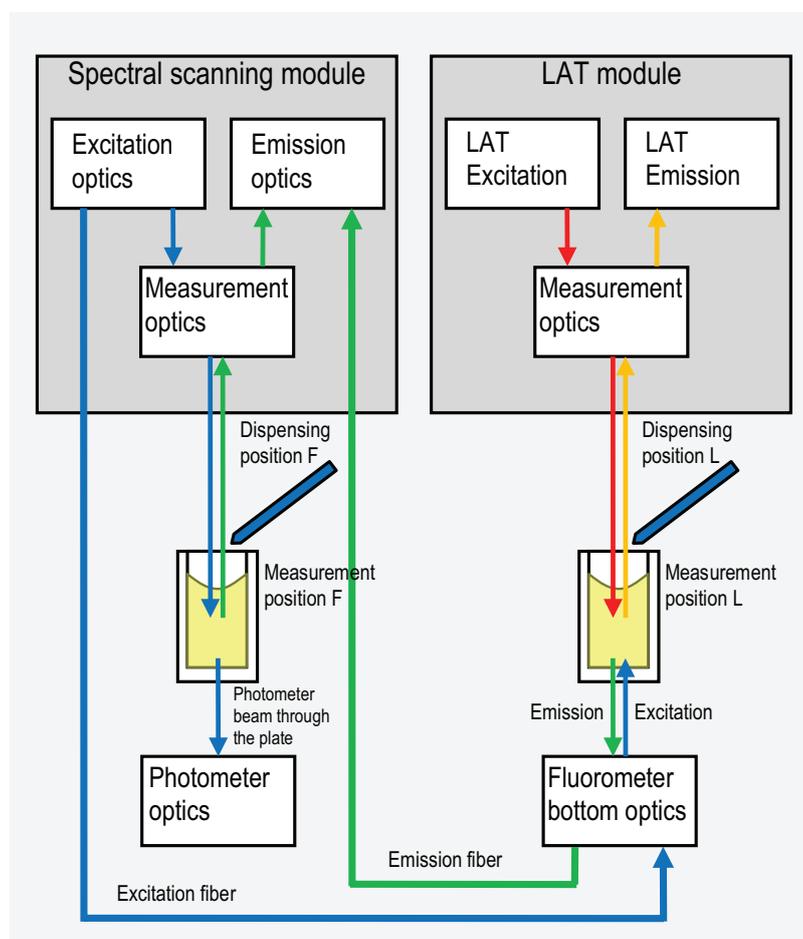
The Varioskan LUX uses:

- 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 17.
- **Measurement optics** produces a high-definition optical beam for fluorescence and absorbance measurements at measurement position F (Figure 4–44 and Table 4–4). 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 19.
- **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 19.
- 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 20.
- **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 20.
- 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 21.

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

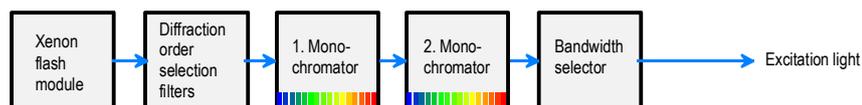
Excitation optics (Figure 2–7) consists of the light source and the wavelength selection devices.



**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.

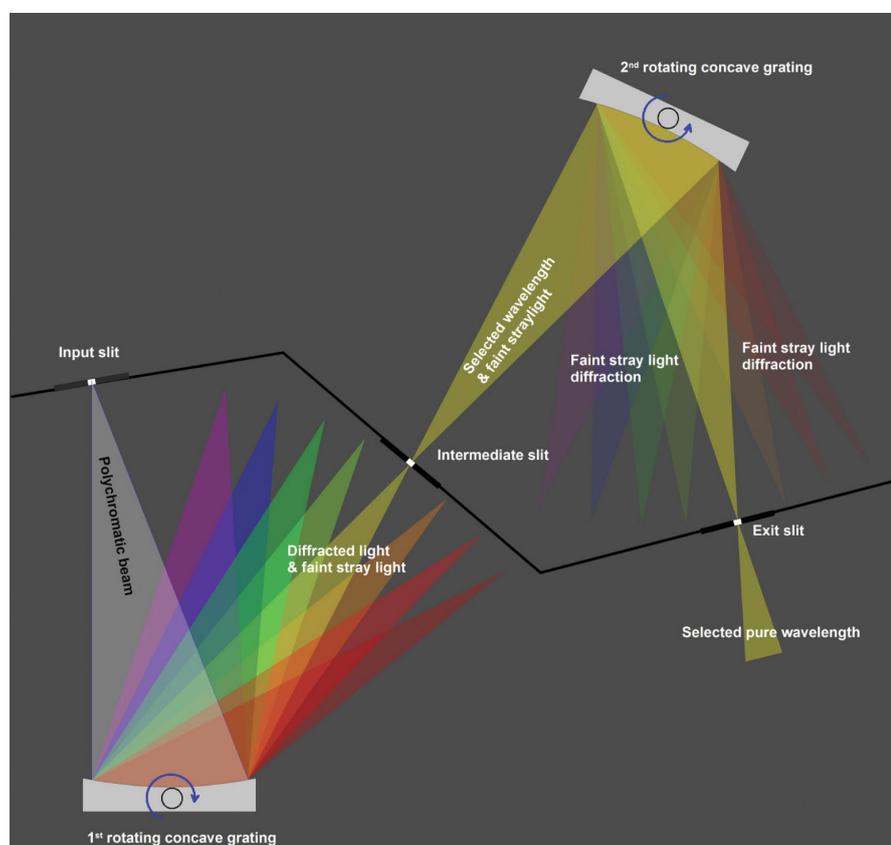


Figure 2–8 Principle of the double monochromator

### 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.

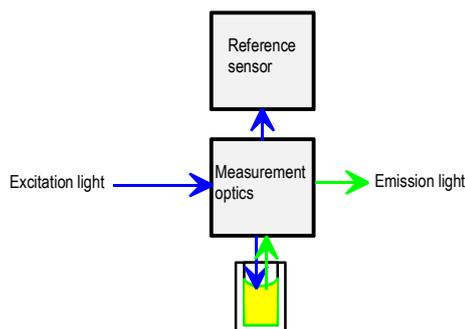


Figure 2–9 Measurement optics

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 17.



**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.

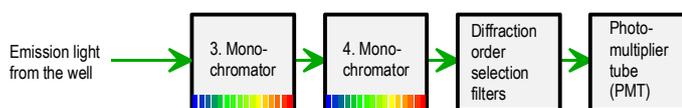


Figure 2–10 Emission optics

### 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.

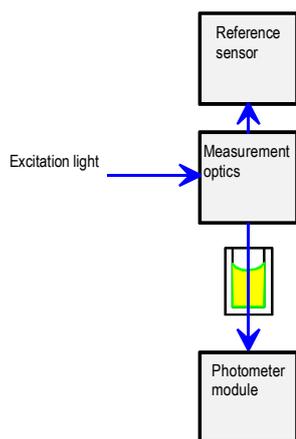


Figure 2–11 Absorbance measurement module

### 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).

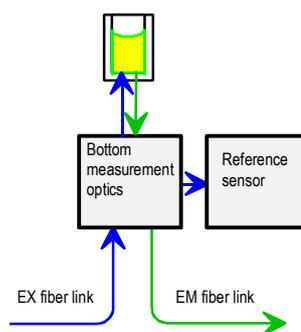


Figure 2–12 Fluorescence bottom reading optics

## 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](#).

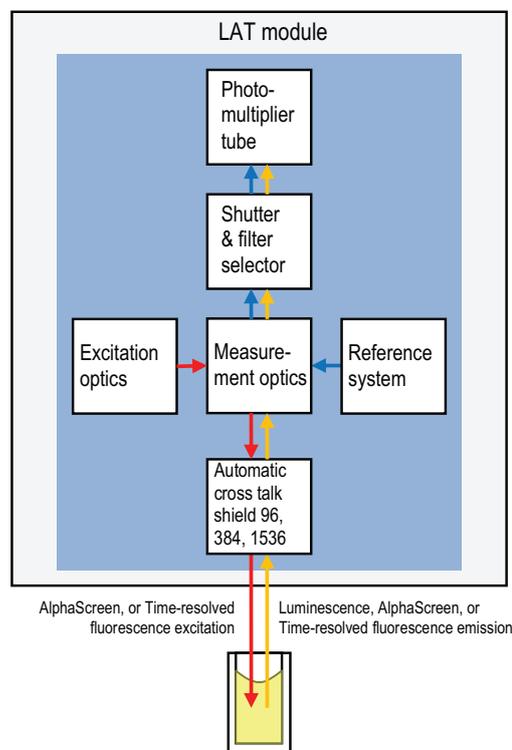


Figure 2–13 LAT measurement module

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.

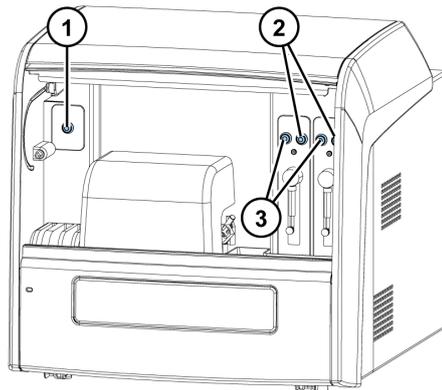


Figure 2–14 Control buttons

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*.

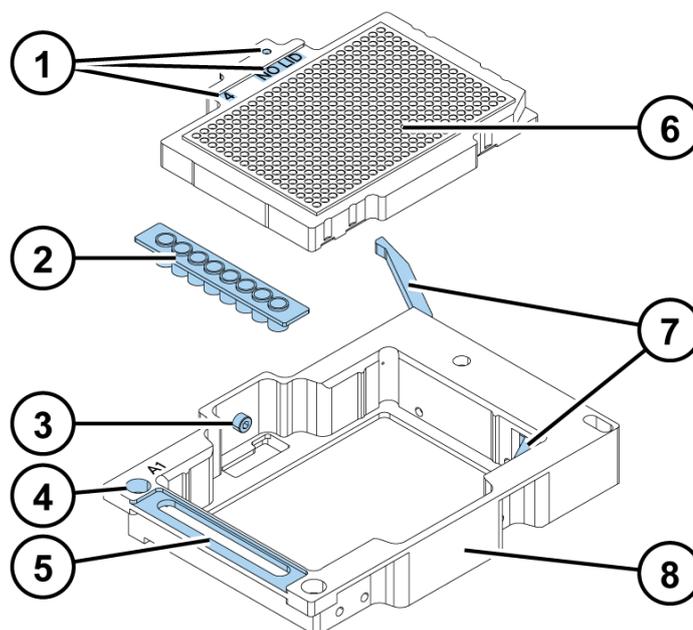
Refer to [Table 2–1](#) and [Table 2–2](#).

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 24](#).

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 25](#).

## Tray composition

The 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 33](#).

### 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.

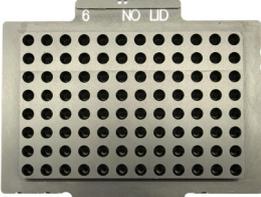
Before you run a measurement, check that the correct plate adapter is in the plate tray. Choose the adapter based on the plate format you have and whether you are using a lid or not.

**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 *Skant Software Technical Manual*.

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

| Adapter                                                                             | ID no. | Description                                                                                                                                                                                                                                                 | Dispensing         |
|-------------------------------------------------------------------------------------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
|    | #2     | <b>96-well adapter for plate without lid*)</b><br>To be used with the most common 96-well plate formats without lids.                                                                                                                                       | yes                |
|  | #3     | <b>96-well adapter for plate with lid</b><br>To be used with the most common 96-well plate formats with lids.                                                                                                                                               | no                 |
|  | #4     | <b>384-well adapter for plate without lid*)</b><br>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<br>no 1536 |
|  | #5     | <b>384-well adapter for plate with lid</b><br>To be used with the most common 384-well plate formats with lids.                                                                                                                                             | no                 |
|  | #65    | <b>1536-well adapter for plate w/o lid</b><br>To be used with the most common 10 mm high 1536-well plate formats without lids in luminescence mode.                                                                                                         | no                 |

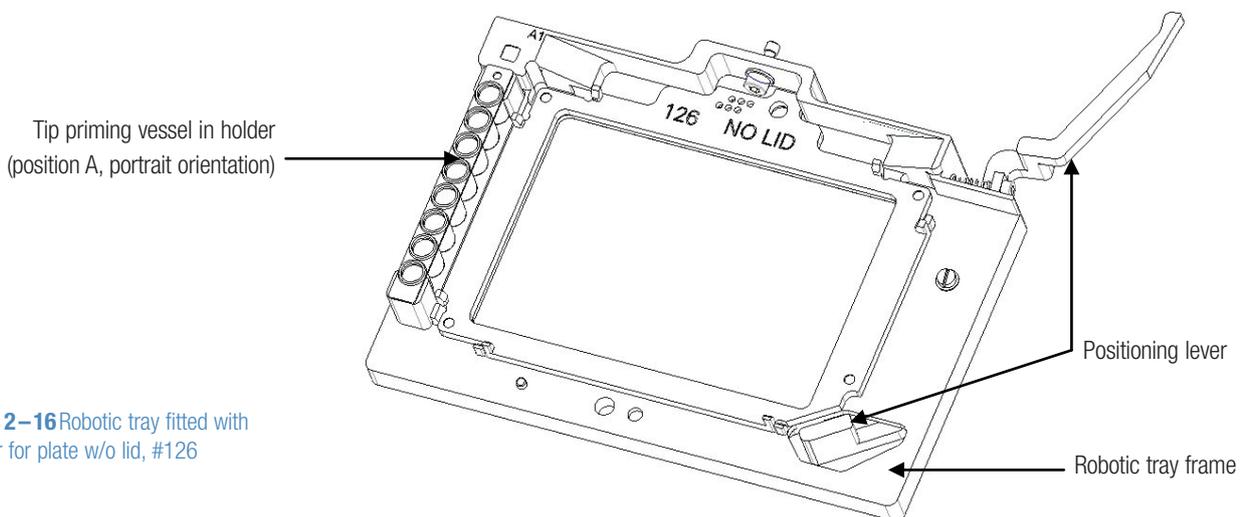
|                                                                                   |     |                                                                                                                                                                                                 |     |
|-----------------------------------------------------------------------------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|  | #80 | <p><b>6–48-well adapter for plate without lid*)</b></p> <p>To be used with the most common 6- to 48-well plate formats without lids.</p>                                                        | yes |
|  | #48 | <p><b>6–48-well adapter for plate with lid</b></p> <p>To be used with the most common 6- to 48-well plate formats with lids.</p>                                                                | no  |
|  | #6  | <p><b>96-well adapter for PCR plate without lid</b></p> <p>To be used with 96-well PCR plates with NUNC** product codes 230012, 264605 or equivalent plates from other plate manufacturers.</p> | 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 27.

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

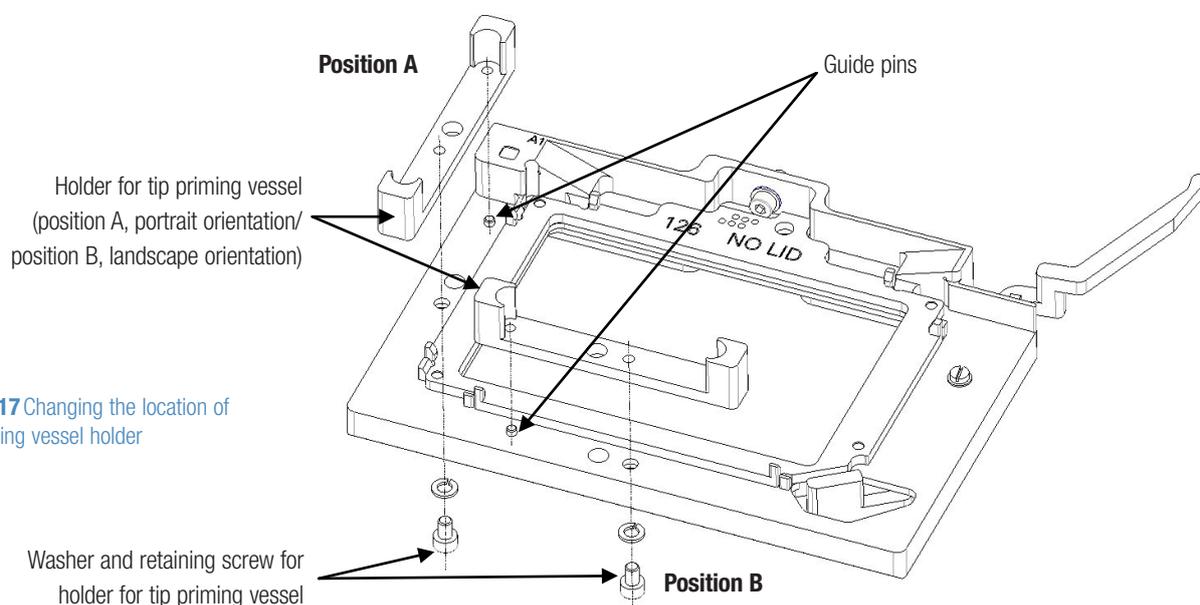
| Picture                                                                           | ID no. | Description                                                                                                                            | Dispensing              |
|-----------------------------------------------------------------------------------|--------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
|  | #126   | <b>Robotic tray with adapter for plate without lid</b><br>To be used with the most common 96- to 1536-well plate formats without lids. | yes 96 & 384<br>no 1536 |
|  | #127   | <b>Robotic tray without adapter for plate with lid</b><br>To be used with the most common 96- to 1536-well plate formats with lids.    | no                      |

### 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.

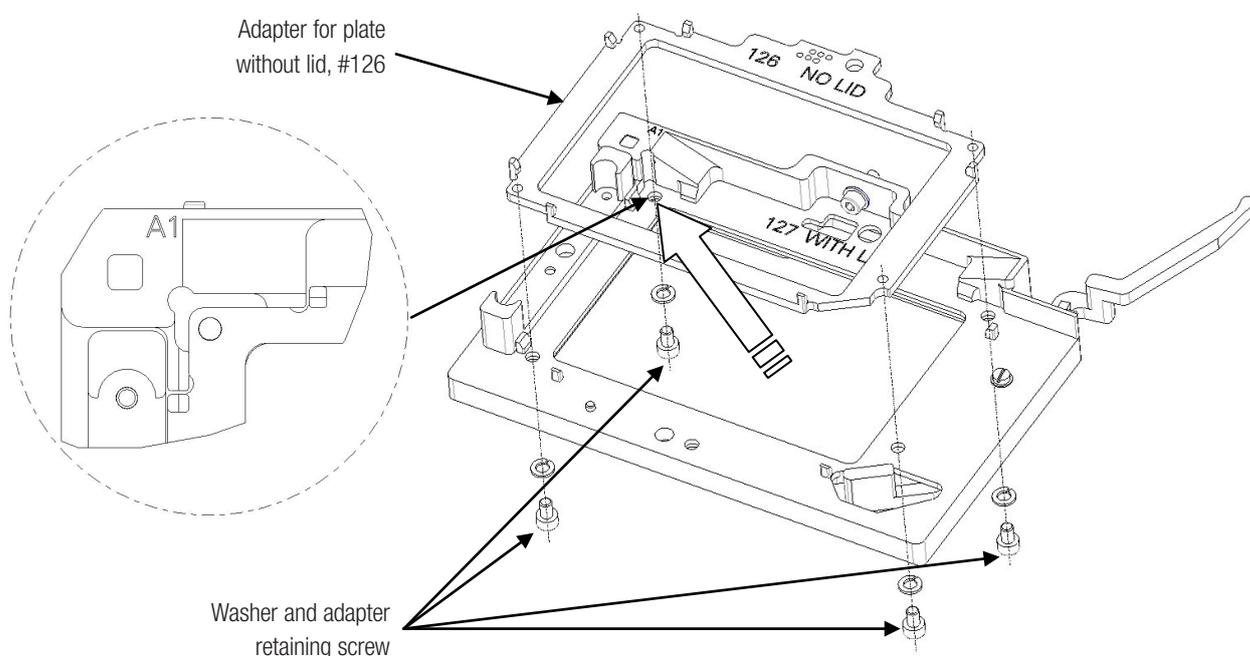
**Figure 2–17** Changing the location of the tip priming vessel holder

## 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 [“How to pack for service”](#) on [page 81](#).

## 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<sub>2</sub> and O<sub>2</sub> 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.

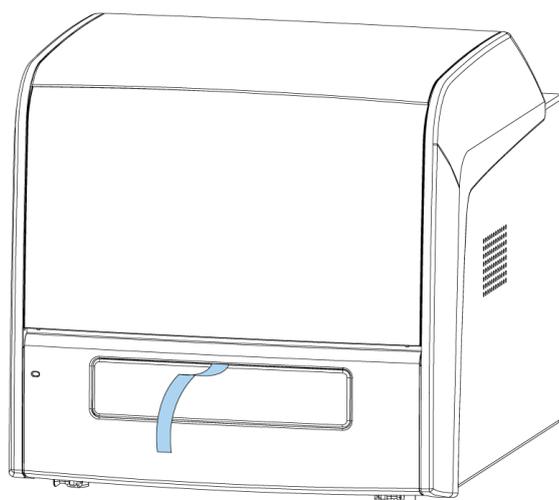
## Installation setups

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.*

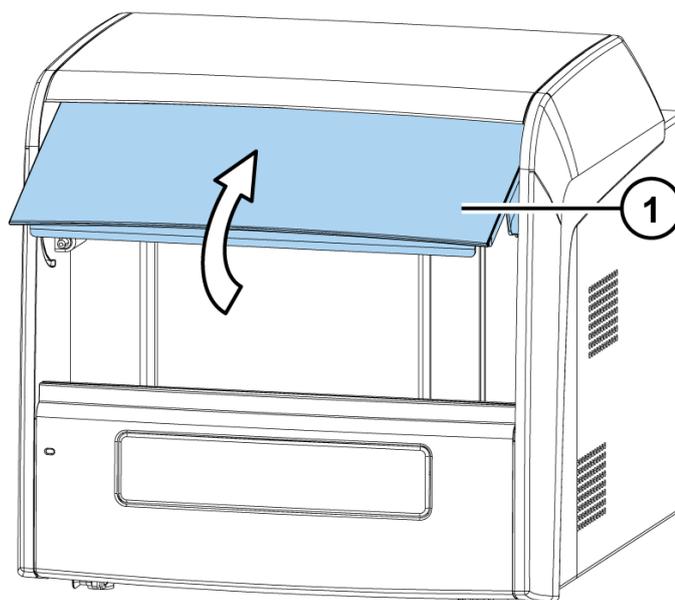


**Figure 3–19** Transport locks and transport lock tags present

### 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

- 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.

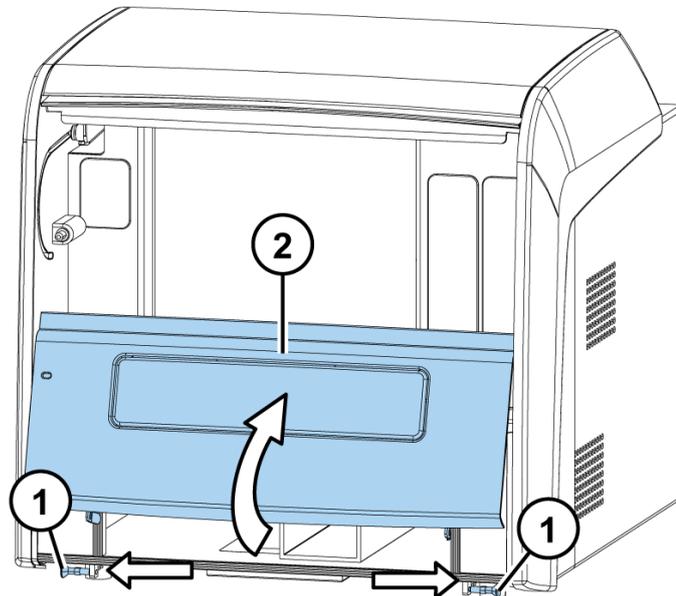


Figure 3–21 Front cover removed

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.

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

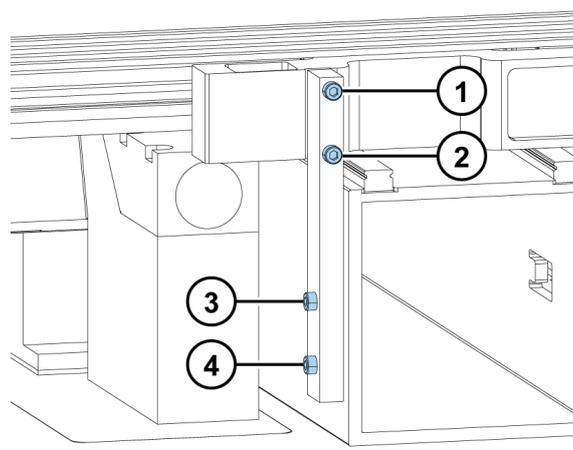
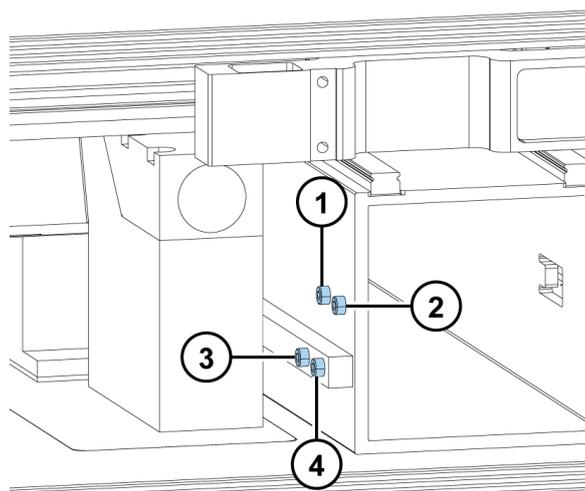


Figure 3–22 Tray holder screws (1 and 2) and track mechanism bar screws (3 and 4) on the transport lock.

- 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.

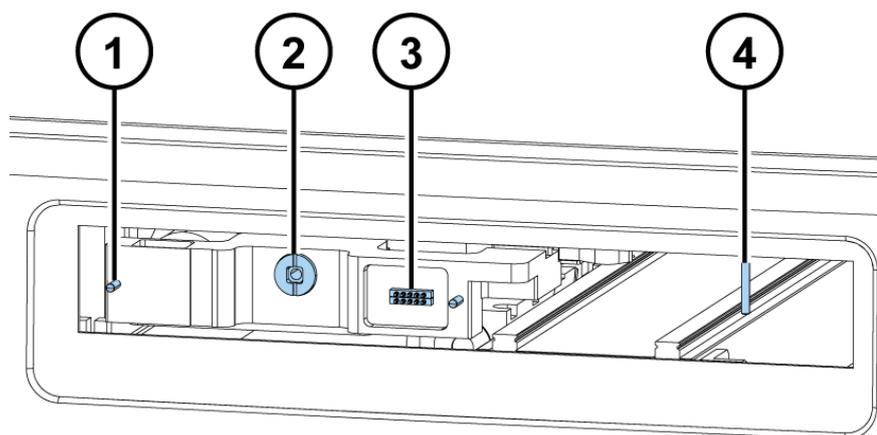
7. Tighten screw 4. Fasten screw 3 back into the same hole from which it was unfastened.
8. Fasten screws 1 and 2 onto the track mechanism bar. Keep the screws there until needed for future relocation or transportation of the instrument.

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).

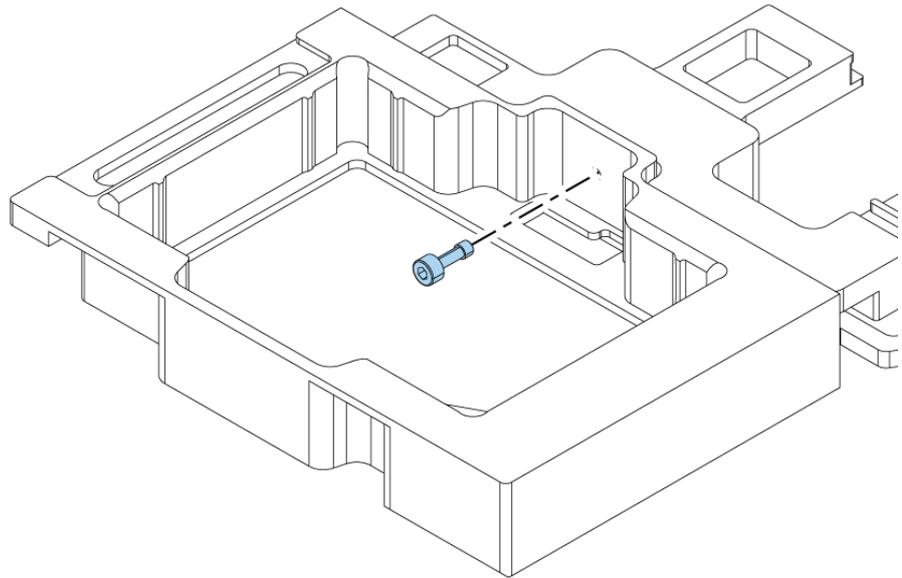


Figure 3–25 Tray and tray holder.

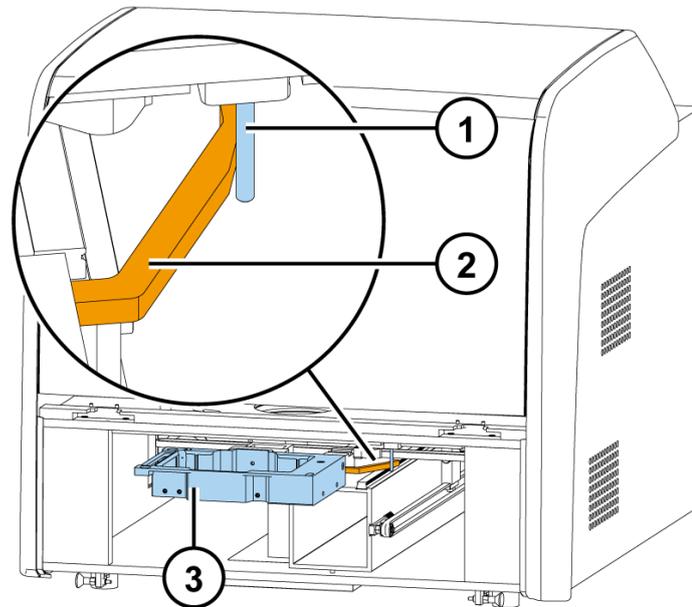
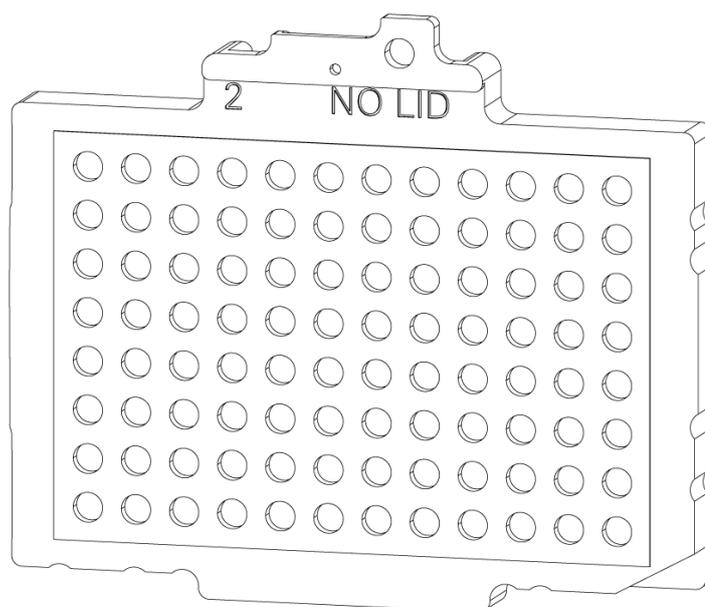


Figure 3–26 Close-up of the positioning lever when the tray is out

4. Choose the detachable adapter according to the plate type you are using. Refer to “Plate trays and adapters” on page 22.



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

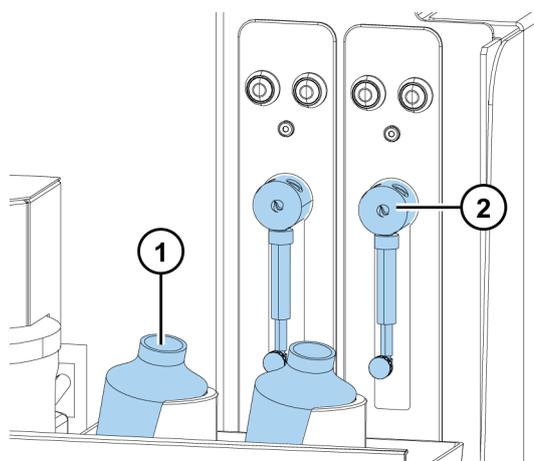
- Place the adapter at the very bottom of the tray and make sure it is level. It may be a tight fit. A click sound indicates a successful installation.

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

- Push the plate tray into the instrument.
- 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.



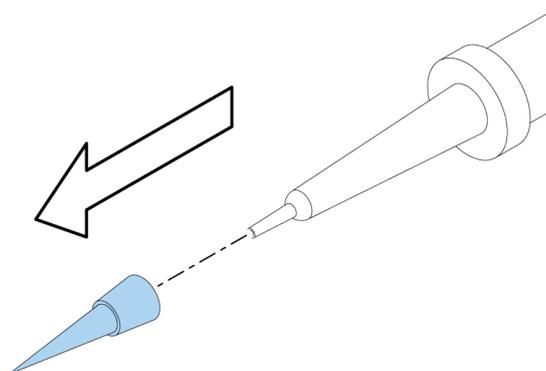
**Figure 3-28** Varioskan LUX with the dispenser sliding cover open

- Reagent bottles
- Dispensers

Note that the aspirate tubing (Figure 3–30) is factory installed into the right (Dispenser 1 and Dispenser 2) hole of the valve. Ensure that the aspirate tubing is finger tight. The aspirate tubing is used to fill the syringe with reagent.

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. 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.
3. Insert the dispensing heads into their respective dispensing head holder slots on the left-hand side (Dispenser 1 and Dispenser 2) of the dispenser.
4. 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)

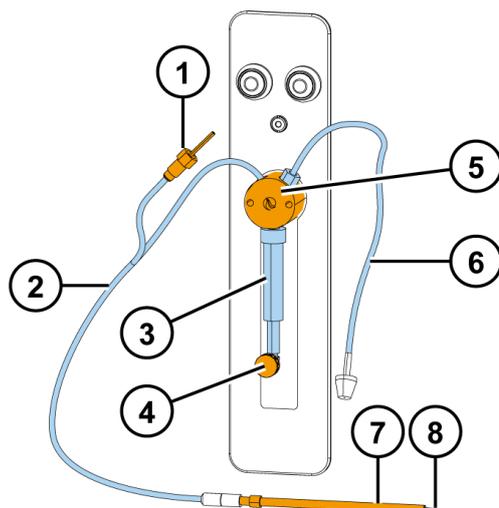


Figure 3–30 Dispenser assembly

- 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

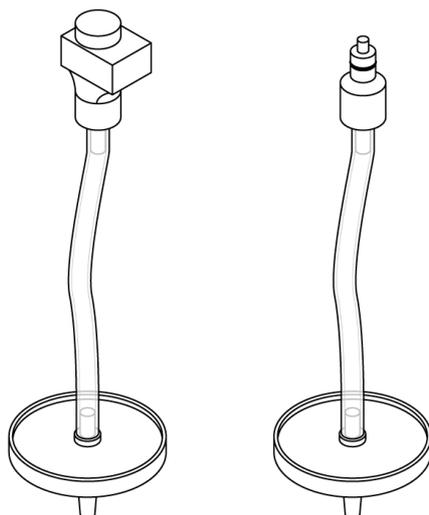
**IMPORTANT!** If the dispensers are not properly installed, leakage may occur.

## 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 ( $\text{CO}_2$  and / or  $\text{N}_2$ ) are supplied to the device from a separate gas supply system, either from gas cylinders or from a central pressurized gas container.

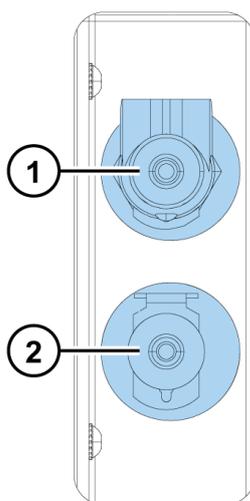
The layout of the gas supply system must ensure that the operating pressure of the gas supply lines can be set to a range between 0.8 bar (min.) to 1 bar (max.) and that the pressure cannot be changed.



**Figure 4-31** Supplied tubes for O<sub>2</sub> (left) and CO<sub>2</sub> (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<sub>2</sub> gas line to the connector 1 and N<sub>2</sub> gas line to the connector 2.



**Figure 4-32** Gas connectors

- 1) Connector for CO<sub>2</sub> gas line
- 2) Connector for N<sub>2</sub> gas line

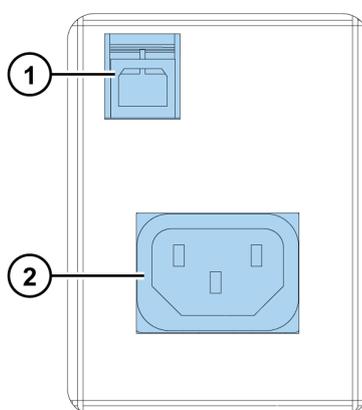
## How to connect cables

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 and the Integrated gas module.

**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. 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 *Skantl Software Technical Manual* on how to start the measurement position alignment in Skantl 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 Skantl Software.
2. Open the dispenser sliding cover and the LAT module cover.
3. Select the filter position in Skantl 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.

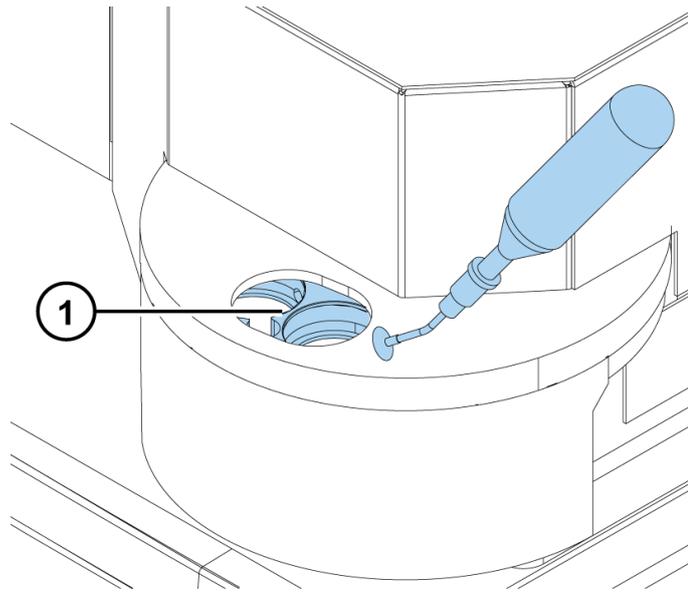


Figure 3–35 Filter nest and pick-up tool

- 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 91.

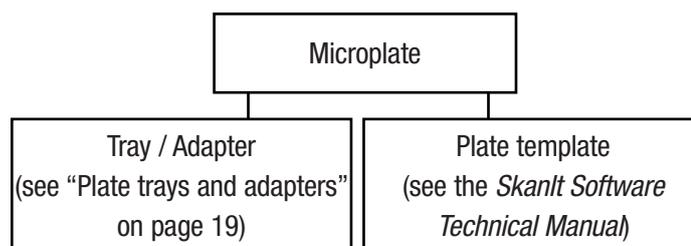
## Loading the microplate

**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.

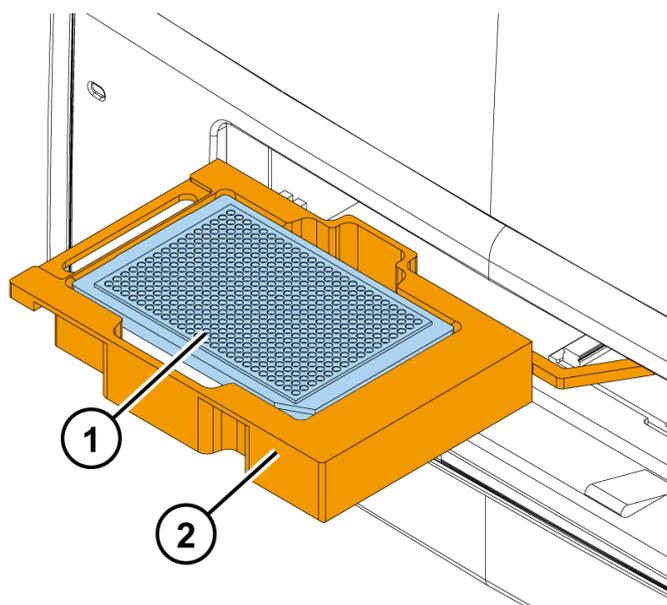
**Note!** When placing a microplate onto the tray, always make sure the correct plate type has been selected in SkanIt Software (*Plate template*) before you do anything else.

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 22 and “How to install the plate tray and adapter” on page 33.



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

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.

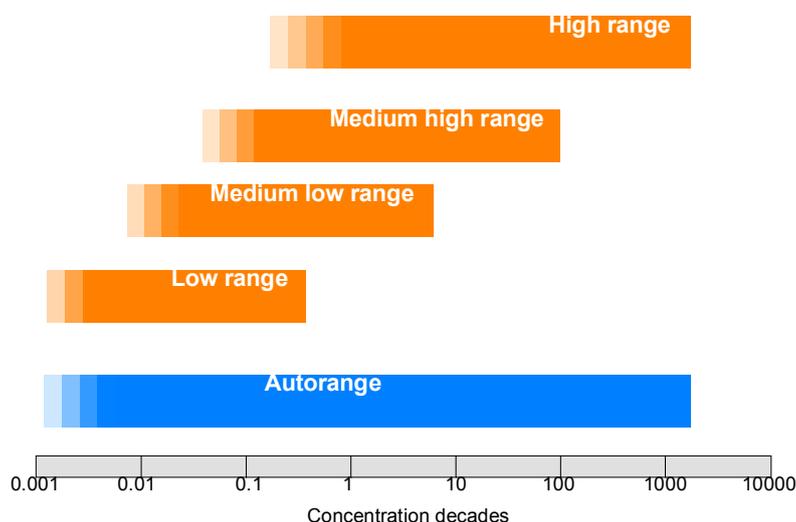


Figure 4–37 Dynamic range selection

- 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 52.

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

*High range* is intended for highest-concentration samples. It covers a wide dynamic range with somewhat lower sensitivity than with other dynamic ranges.

*Low range*, on the other hand, 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.

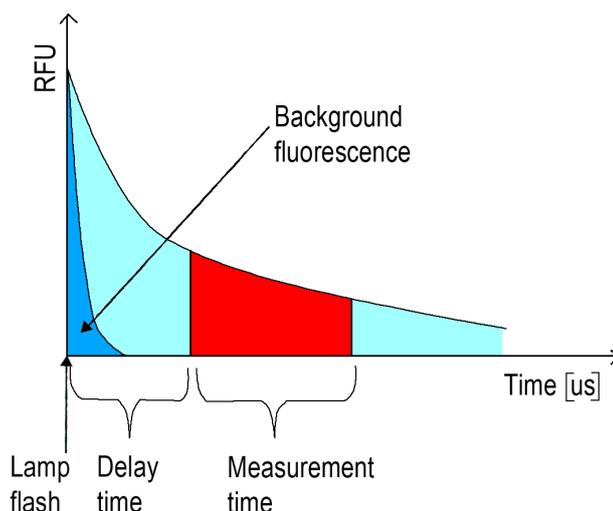
5. The wells are measured with a selected measurement time that can vary from 10 to 1000 ms in fluorescence intensity measurements and from 10 to 10 000 ms in time-resolved fluorescence (TRF) measurements. There is one xenon lamp flash for each 10 ms period of measurement time.

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 52](#).

**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 46](#).

## 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 52](#).

## 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 49](#).

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 highest-concentration samples. It covers a wide dynamic range with somewhat lower sensitivity than with other dynamic ranges.

*Low range* 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 52](#).

## 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 50](#).

## 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 4–3).

**Table 4–3** 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<sub>2</sub> or the O<sub>2</sub> 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.

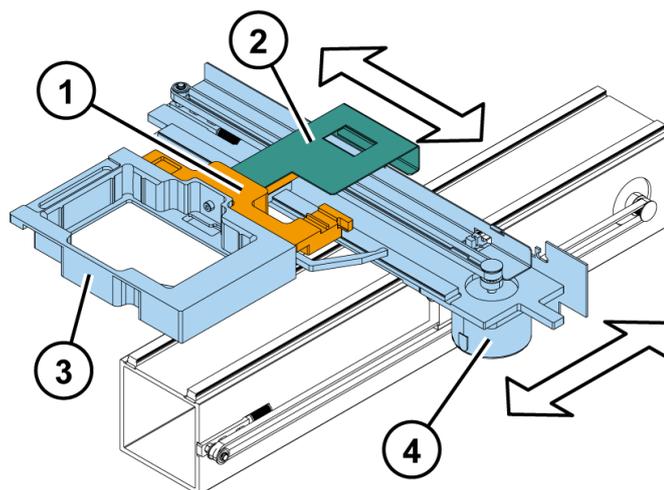
## Other functions

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.



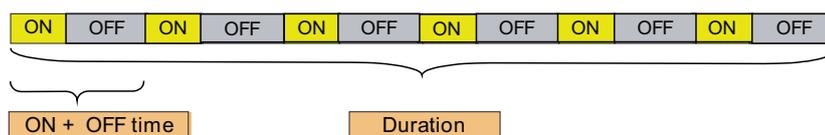
**Figure 4–39** Part of the Varioskan LUX track mechanism

- 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 *Skant 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 Skant 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 5–47).

## 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.

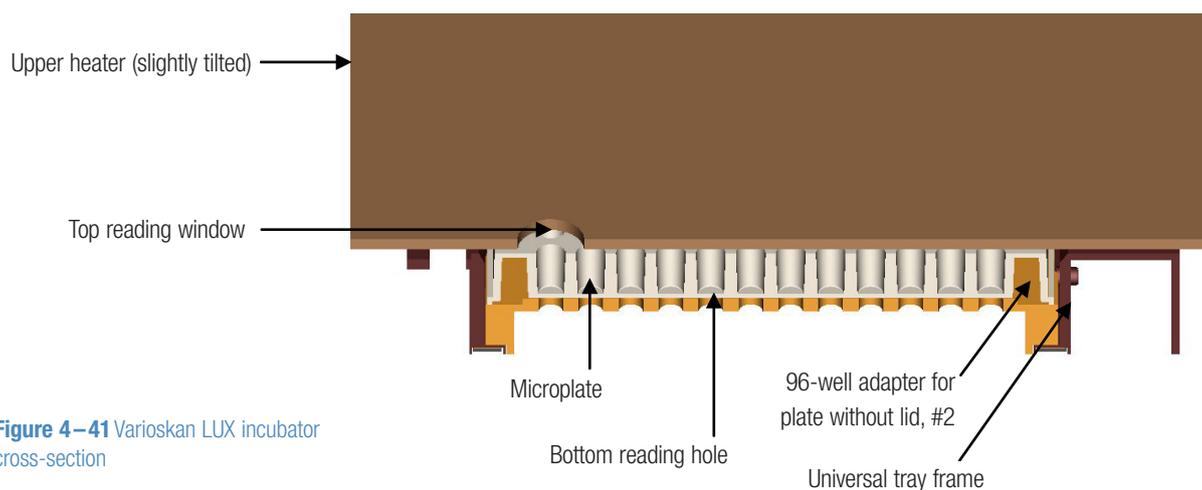
The universal tray is specially designed for precise and uniform temperature control.

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

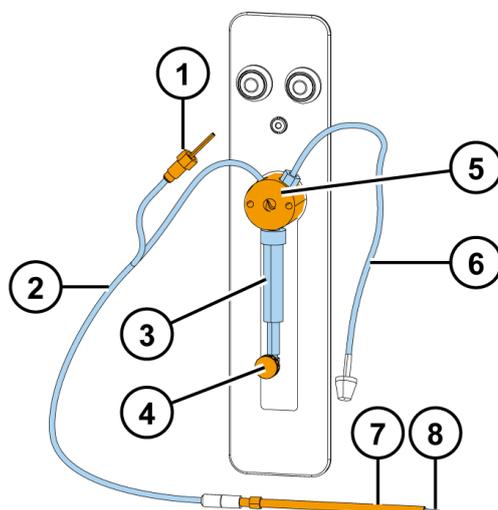
The 1 ml syringe is the *default* syringe. A 5 ml syringe is available on request.

The volume range and increment depend on the syringe size used. The volume range is from 2  $\mu$ l to 5000  $\mu$ l in 1  $\mu$ l increments with the 1 ml syringe and from 5  $\mu$ l to 25 000  $\mu$ l in 5  $\mu$ l increments with the 5 ml syringe. 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

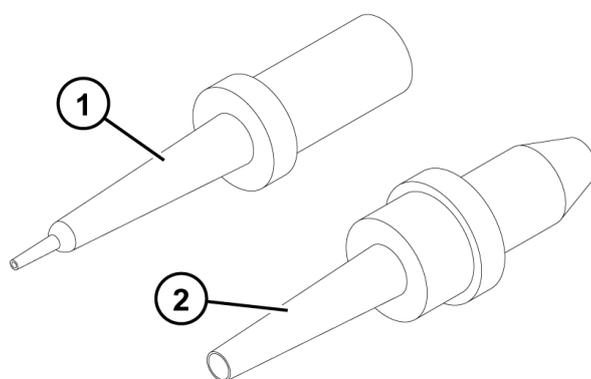
## Dispensing tip

There are two different dispensing tip options (Figure 4–43):

- The *black* dispensing tip 0.40 (Ø 0.40 mm), and
- The *transparent* dispensing tip 0.25 (Ø 0.25 mm).

Dispensing tip 0.40 (Cat. No. N03080) is the *default* tip and is recommended for volumes > 5 µl, since dispensing is then more rapid.

Dispensing tip 0.25 (Cat. No. N03081) has to be ordered separately and is intended for small volumes in the range of 2 to 20 µl.



**Figure 4–43** Dispensing tip options: 0.40 mm and 0.25 mm

Refer to “How to set up the dispensers” on page 35.

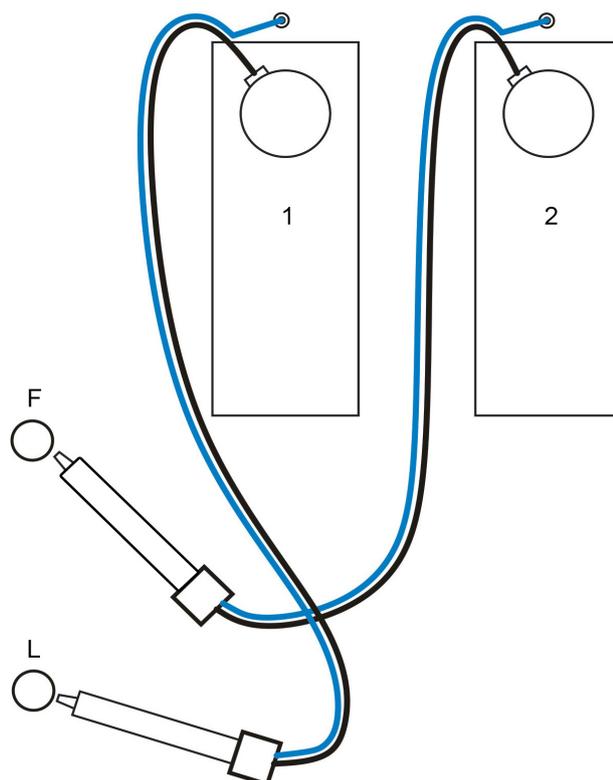
## Dispensing

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 4–44** Identification of the dispensing tip position

The two *dispensing positions* are marked F and L (Figure 4–44). 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 4–4.

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 4–4** 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 4–44 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 35.

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!

## 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 ( $\mu\text{l}$ ) feature (see the *Skantl Software Technical Manual*). This function can be selected in Skantl Software or it can be turned off.

If selected, the dispenser automatically dispenses 2 to 10  $\mu\text{l}$  reagent with the 1 ml syringe and 5 or 10  $\mu\text{l}$  reagent with the 5 ml syringe into 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  $\mu\text{l}$ .

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  $\mu\text{l}$  and after 2500 tip primings if the priming volume is 2  $\mu\text{l}$ .

## 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 Skantl Software or it can be turned off. If set, the dispenser automatically pulls back 1 to 10  $\mu\text{l}$  reagent with the 1 ml syringe and 5 or 10  $\mu\text{l}$  reagent with the 5 ml syringe into the syringe every time the instrument dispenses. It is always recommended to use the pull-back feature when using the 5 ml syringe.

## 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 4–44). To minimize the delay before the measurement, place the dispensing head into the corresponding dispensing position. Refer to Figure 4–44 and Table 4–4.

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 4–5 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 4–5** 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<sub>2</sub> and O<sub>2</sub> sensors, valves and the gas supply system. The sensors are placed in a measurement chamber. The CO<sub>2</sub> and O<sub>2</sub> 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<sub>2</sub> concentration, and
- O<sub>2</sub> concentration.

## CO<sub>2</sub> supply

To ensure the growth conditions for the cell and tissue cultures, the instrument should be supplied with CO<sub>2</sub>.

The pH of bicarbonate-buffered culture media largely depends on the CO<sub>2</sub> content of the atmosphere. The CO<sub>2</sub> content of the atmosphere can be controlled within a range of 0.1% to 15%.

The CO<sub>2</sub> supply must have either of the following quality characteristics:

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

## N<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> content and
- O<sub>2</sub>/N<sub>2</sub> content.

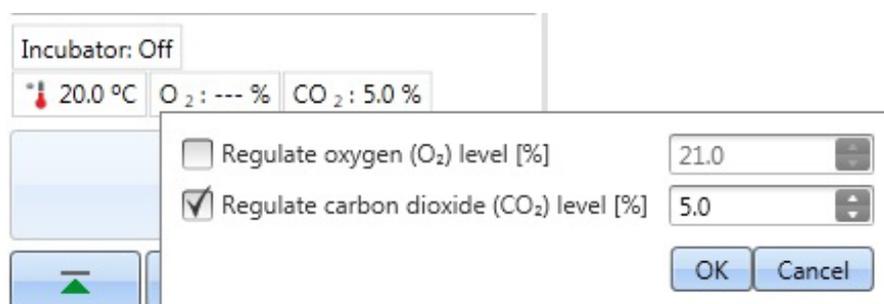
The Integrated gas module:

- 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<sub>2</sub> and O<sub>2</sub> concentrations
- CO<sub>2</sub> concentration is generally adjusted to ca. 5-6%
- O<sub>2</sub> concentration is adjusted with nitrogen (N<sub>2</sub>)

To use the Integrated gas module:

1. Turn on the instrument and open SkanIt Software.
2. Open the CO<sub>2</sub> or N<sub>2</sub> 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 5–45).
  - b. Set the O<sub>2</sub> and CO<sub>2</sub> levels as needed and click OK.
 

You can now see the current and target gas concentrations above the **Start** button.



**Figure 5–45** 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<sub>2</sub> and O<sub>2</sub> sensors must be present on the wall of the room where the Varioskan LUX with a Integrated gas module is installed.

**IMPORTANT!** The O<sub>2</sub> sensor must be changed annually. The disposable gas filters must also be changed during the same service or more frequently if necessary.

# 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 68](#) and [“Decontamination procedure”](#) on [page 80](#) for aid. If necessary, contact your local Thermo Fisher Scientific representative or the Thermo Fisher Scientific technical service department. Refer to [“How to pack for service”](#) on [page 81](#).

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 5–47), 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 5–46.

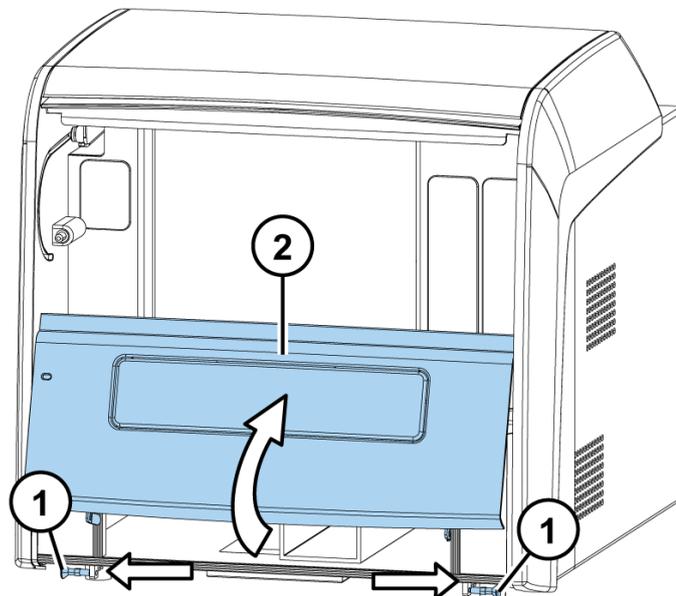
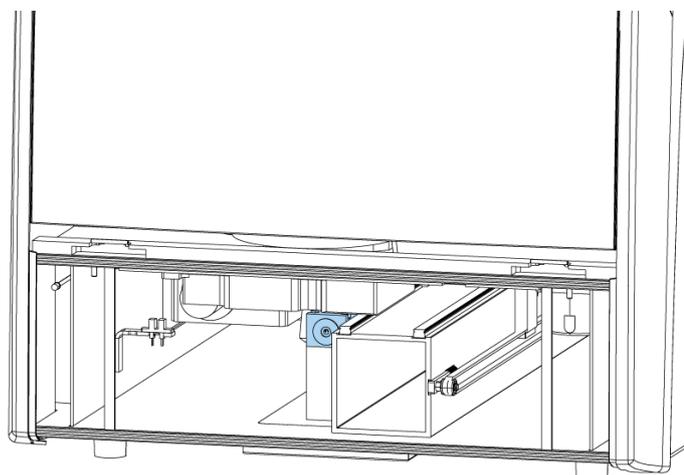


Figure 5–46 Front cover removed

- If you have spilt infectious agents into the measurement chamber (Figure 5–47), decontaminate according to “Decontamination procedure” on page 80. 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 5–47** Internal view of the measurement chamber

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

- 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 5–46). 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:

- Soak a lint free tissue in 70% ethanol.
- Wipe over the lens in a straight movement from inside to out. Do not use any circular movements when cleaning the optics.
- 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 5–47) 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 5–47). 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 “Decontamination procedure” on page 80.



**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 5–48.

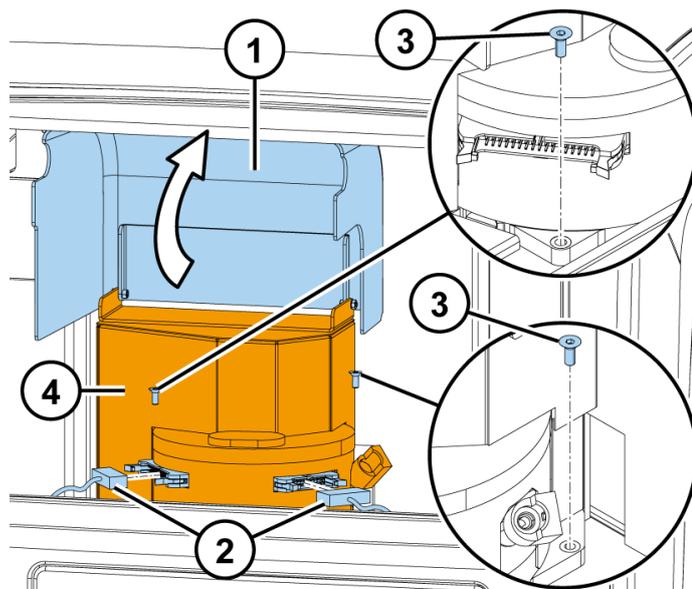


Figure 5–48 Removing the LAT module

- 1) Lift open the cover.
- 2) Detach the two connectors.
- 3) Unfasten the two bottom screws.
- 4) Lift the module off upwards.

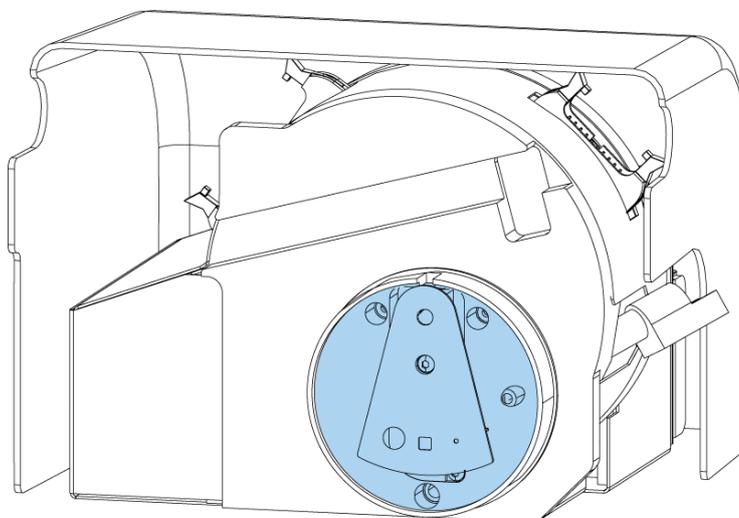
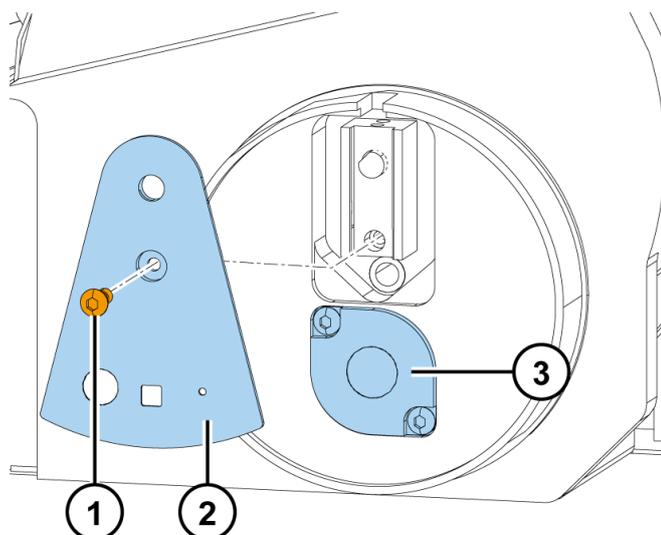


Figure 5–49 Crosstalk shield

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!** Try to avoid loosening the crosstalk shield, but if necessary, be careful to remount it into the original position without using extensive force. Do not wash any electronic parts.

6. Remove the crosstalk shield according to [Figure 5–50](#).



**Figure 5–50** 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 40](#).

## 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 61](#). For use of the Wash functionality, refer to the *Skant 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 5–47). 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 5–53) – and/or the dispensing tip (Figure 5–51), (2) syringe (Figure 5–53), and (3) valve (Figure 5–53).

### 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 76) 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

The dispensing tip replacement procedure is carried out in two stages:

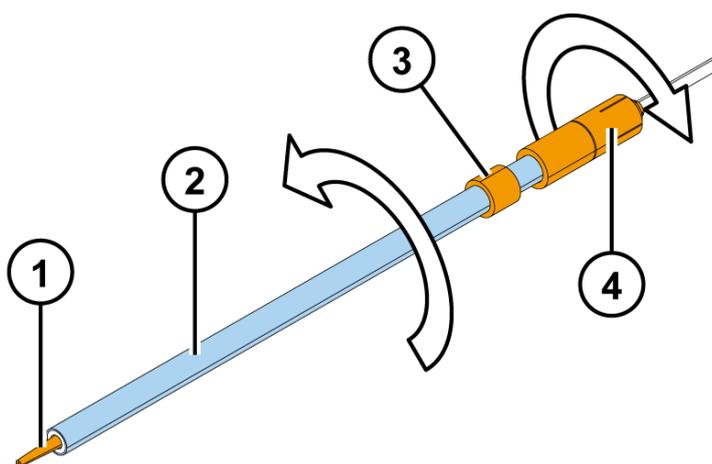
- Manual replacement of the dispensing tip
- Defining the dispensing tip data using SkanIt Software if you have changed the tip size

If the instrument has the wrong information about the dispensing tip size used, it will affect the dispensing jet speed.

Refer to the *SkanIt Software Technical Manual*.

To replace a dispensing tip (Figure 5–51):

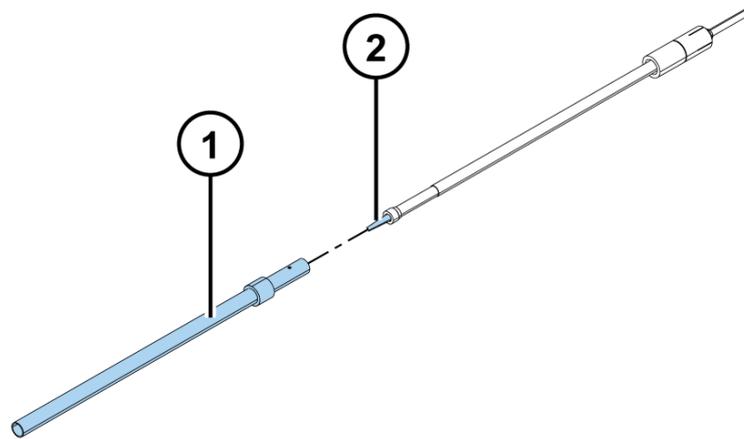
1. Remove the dispensing head tube (Figure 5–51) from the brass tube holder (Figure 5–51) by turning the dispensing head tube counterclockwise and the brass part closest to it clockwise.



**Figure 5–51** Replacing the dispensing tip (A)

- 1) Dispensing tip (0.40 mm default)
- 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 5–52). 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 5–52** Replacing the dispensing tip (B)

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

3. Replace the dispensing head tube (Figure 5–52). Fasten the parts by turning in the opposite directions than shown in Figure 5–51.
4. Change the tip size setting in SkanIt Software if you have changed the tip size.

## Replacing a dispenser syringe

The dispenser syringe replacement procedure is carried out in two stages:

- Manual replacement of the dispenser syringe
- Defining the dispenser syringe data using SkanIt Software only if you have changed the syringe size

If the instrument has the wrong information about the syringe used, it will dispense incorrect volumes.

Refer to the *SkanIt Software Technical Manual*.

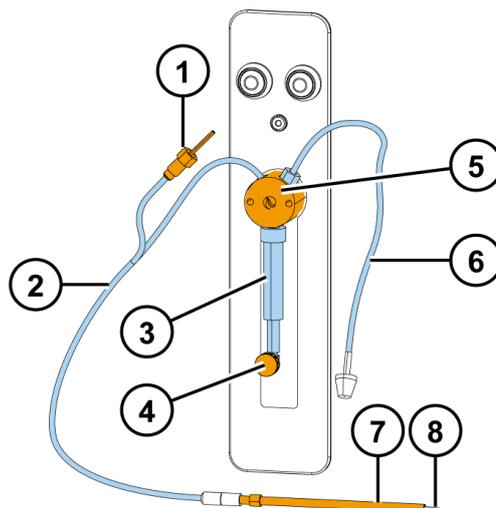
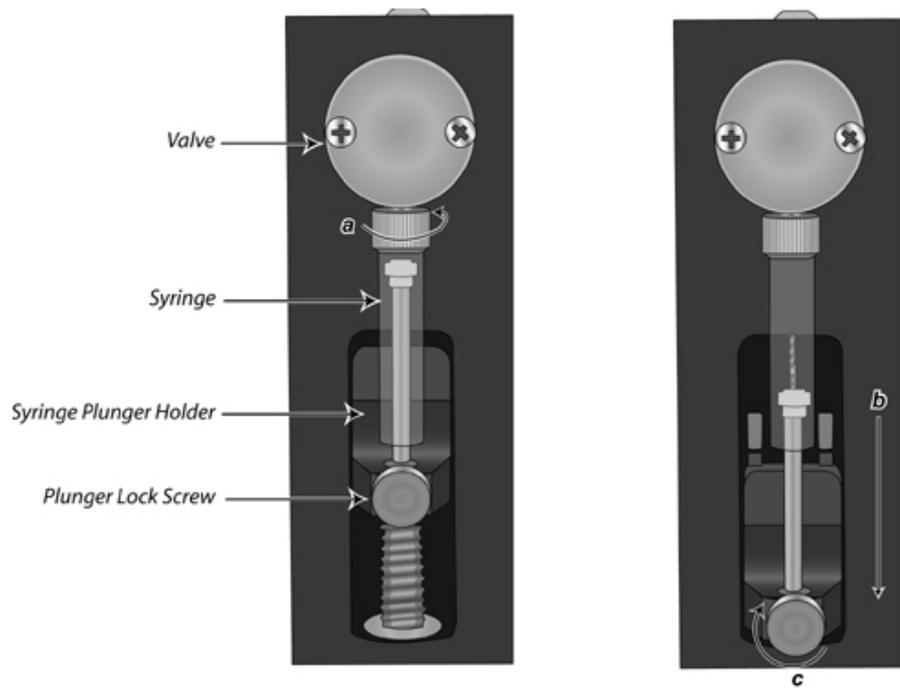


Figure 5–53 Dispenser assembly

- 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

To replace a dispenser syringe of 1 ml (Figure 5–54) or 5 ml:

1. Remove the liquid from the dispenser syringe (Figure 5–53) 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 5–53) approximately three full turns clockwise (Figure 5–54, item c).
4. Pull the plunger holder arm (Figure 5–53) firmly down (Figure 5–54, item b).
5. Unscrew the syringe from the valve (Figure 5–54, 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 5–54).



**Figure 5–54** 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 5–53 and Figure 5–55), 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  $1/4$  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.

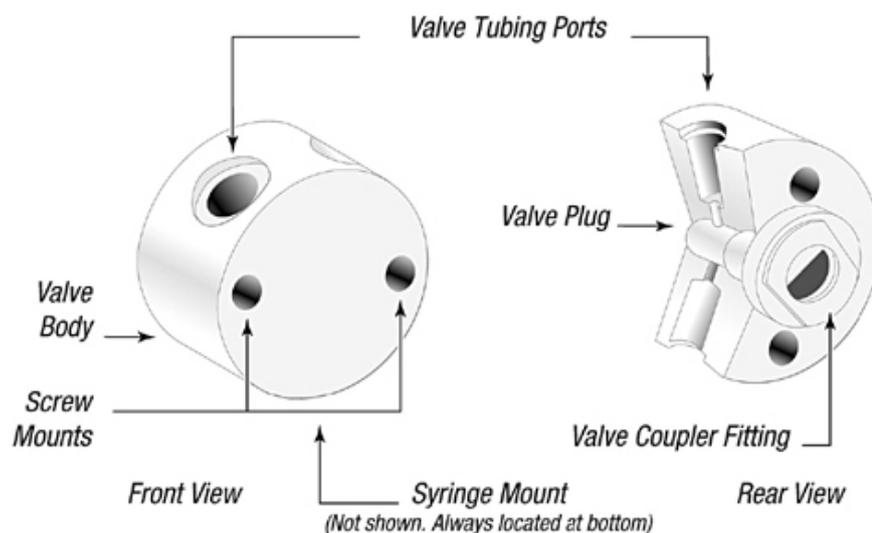


Figure 5–55 3-port valve replacement

## 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 “[Decontamination procedure](#)” on [page 80](#) 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 89)

*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.

## Decontamination procedure

If you have spilled infectious agents, carry out the decontamination procedure.



**CAUTION!** The decontamination procedure should be performed by authorized trained personnel in a well-ventilated room wearing disposable gloves, protective glasses and clothing.

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

It is strongly recommended to perform the complete decontamination procedure before relocating the instrument from one laboratory to another.

Example of decontaminants:

- Ethanol 70%
- Virkon™ solution 1–3%
- Glutaraldehyde solution 4%
- Chloramine T
- Microcide SQ™ 1:64
- Decon™ 90 min. 4%

**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.

To decontaminate the instrument:

1. Prepare the decontaminant: 200 ml 4% glutaraldehyde solution (or another agent recommended by your safety officer).
2. Empty the tray (Figure 2–15 and Figure 2–16). Ensure that you are wearing disposable gloves.
3. Switch off the power (Figure 2–2) and disconnect the mains supply cable (Figure 3–33).
4. Disinfect the outside of the instrument using a cloth dampened with 70% ethanol.
5. Place the instrument in a large plastic bag. Ensure that the dispenser sliding cover and front cover (Figure 3–21) are open and the tray is out (Figure 4–36).
6. Place a cloth soaked in the prepared solution into the bag. Ensure that the cloth does not come into contact with the instrument.
7. Close the bag firmly and leave the instrument in the bag for at least 24 hours.
8. Remove the instrument from the bag.
9. Clean the instrument using a mild detergent.
10. Remove any stains using 70% ethanol.
11. After performing this decontamination procedure, enclose a signed and dated Certificate of Decontamination both inside the transport package and attached to the outside of the package.

## How to pack for service

To pack for service, follow the instructions presented below.



**CAUTION!** It is important that the instrument is thoroughly decontaminated before it is removed from the laboratory or any servicing is performed on it.

When you ship the instrument for service, remember to:

- Inform about the use of hazardous materials.
- Decontaminate the instrument. Empty the dispensers and remove any loose items from the tray, for example, plates and priming vessels before decontamination.
- Remove the tray (Figure 2–15 and Figure 2–16) and the complete dispensing tube assemblies (Figure 5–53) after decontamination.
- Install the transport lock of the tray holder. Then 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 5–46).
- Pack the instrument according to the enclosed packing instructions.
- Use the original packaging to ensure that no damage will occur to the instrument during shipping. Any damage will incur additional labor charges.
- Enclose a dated and signed “Certificate of Decontamination” (see Appendix A) both inside and attached to the outside of the package in which you return your instrument (or other items).

- Enclose the return authorization number (RGA) given by your local Thermo Fisher Scientific representative.
- Indicate the fault after you have been in touch with your local Thermo Fisher Scientific representative or the Thermo Fisher Scientific technical service department.

Refer to “[General specifications](#)” on [page 85](#) for details on storage and transportation temperatures.

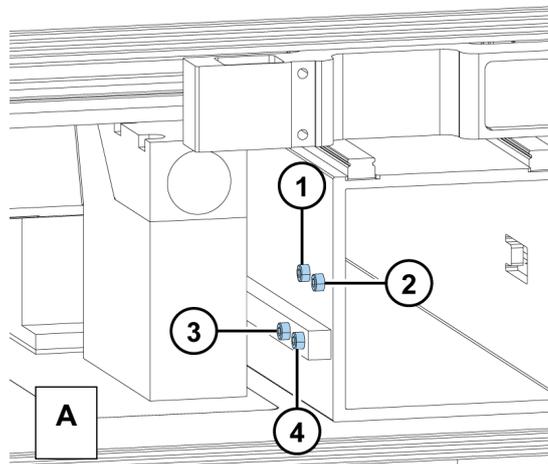
## How to refit the transport locks

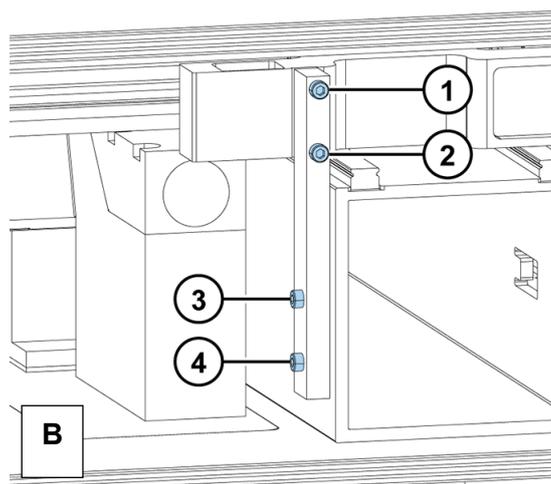
When you relocate the instrument or ship it for service, make sure you refit the transport lock of the tray holder.

### 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 31](#) (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 5–56](#).





**Figure 5-56** 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 5-56 A).
6. Remove the screw marked number 3 (Figure 5-56 A).
7. Loosen the screw marked number 4 of the transport lock slightly by using the hexagonal screwdriver supplied (Figure 5-56 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 5-56 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 5-56 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 5-56 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 5-46). 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 6–6 through Table 6–15).

**Table 6–6** 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:<br>Universal tray: 127.8 mm (W) x 85.8 mm (D) x 23.5 mm (H)<br>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 6–7** Fluorometry

| Performance specifications    | Fluorometry                                                                                                                                                                                   |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Light source                  | Xenon flash lamp                                                                                                                                                                              |
| Wavelength selection          | Double excitation and double emission monochromators                                                                                                                                          |
| Excitation wavelength range   | 200–1000 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 $\pm 2$ nm, emission $\pm 3$ nm                                                                                                                                                    |
| 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:<br>< 0.4 fmol fluorescein/well (black 384-well plate), > 6 decades<br>Bottom reading:<br>< 4 fmol fluorescein/well, (clear bottom black 384 square well plate),<br>> 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)<br>6 – 384-well plates (bottom reading)                                                                                                                    |

**Table 6–8** 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           | $\pm 2$ nm                                                                                                    |
| Linear measurement range      | 0 – 4 Abs (96-well plate) at 450 nm, $\pm 2\%$<br>0 – 3 Abs (384-well plate) at 450 nm, $\pm 2\%$             |
| Absorbance resolution         | 0.001 Abs                                                                                                     |
| Accuracy                      | 0.003 Abs or $\pm 2\%$ , at 200 – 399 nm (0 – 2 Abs)<br>0.003 Abs or $\pm 1\%$ , 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 6–9** 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<br>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 6–10** Alpha

| Performance specifications                  | Alpha                                                  |
|---------------------------------------------|--------------------------------------------------------|
| Light source                                | LED                                                    |
| 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 6–11** TRF

| Performance specifications        | TRF                                                                        |
|-----------------------------------|----------------------------------------------------------------------------|
| Light source                      | Xenon flash lamp                                                           |
| TRF excitation wavelength         | 334 nm                                                                     |
| Emission wavelength selection     | Filter wheel with up to 8 optional filter positions                        |
| TRF emission wavelength range     | 400 – 670 nm                                                               |
| Eu sensitivity for 384 well plate | < 1 amol/well (white low volume 384 well plate), dynamic range > 6 decades |

**Table 6–12** Integrated Gas Module

| Performance specifications                                 | Integrated Gas Module              |
|------------------------------------------------------------|------------------------------------|
| Measurement chamber O <sub>2</sub> concentration accuracy  | ±1.0% (37°C, 1% O <sub>2</sub> )   |
| Measurement chamber CO <sub>2</sub> concentration accuracy | ±1.0%. (37°C, 5% CO <sub>2</sub> ) |
| Measurement chamber O <sub>2</sub> concentration           | 1-21%                              |
| Measurement chamber CO <sub>2</sub> concentration          | 0.1-15%                            |
| Gas concentration recovery time                            | 10 minutes                         |

Table 6–13 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 6–14 Shaker

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

Table 6–15 Dispensers

| Performance specifications                | Dispensers                                                                                                                                                    |
|-------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Syringe size                              | 1 ml (standard)<br>5 ml (on request)                                                                                                                          |
| Dispensing tip sizes                      | 0.40 mm (standard)<br>0.25 mm (on request)                                                                                                                    |
| Dispensing volume                         | 1 ml syringe: 2 – 5 000 µl with 1 µl increments<br>5 ml syringe: 5 – 25 000 µl with 5 µl increments<br>Automatic safety control based on maximum well volume. |
| 1 ml syringe<br>0.40 mm tip size, default | Accuracy: < 1 µl with 50 µl<br>Precision: < 1 µl with 50 µl                                                                                                   |
| 1 ml syringe<br>0.25 mm tip size          | Accuracy: < 0.2 µl with 5 µl<br>Precision: < 0.25 µl with 5 µl                                                                                                |
| Dispensing speed                          | 96-well plate: 30 s<br>384-well plate: 80 s<br>(5 µl/well, 1 ml syringe, 0.40 mm tip)                                                                         |
| 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                          |
| Voltage                                     | 100–240 Vac, 50/60 Hz, 200 VA |
| CE marking                                  |                               |
| cTUVus                                      |                               |

| 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 7–16) and warning codes (Table 7–17) that may appear in SkanIt Software are presented below.

Table 7–16 Error codes reported

| Code | Explanation                                                                                                                                              | Suggested action                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 0    | The command was executed successfully.                                                                                                                   |                                                                                                                              |
| 1    | Internal firmware error. When this error occurs, the internal software halts. This error can only be seen in the error log returned for the LOG command. | 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 1 <sup>st</sup> excitation grating position is incorrect.                                                                                            | Contact service.                                                                                                             |
| 7    | The 2 <sup>nd</sup> excitation grating position is incorrect.                                                                                            | Contact service.                                                                                                             |
| 8    | The 1 <sup>st</sup> emission grating position is incorrect.                                                                                              | Contact service.                                                                                                             |
| 9    | The 2 <sup>nd</sup> 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   | Luminescence filter position is incorrect.                                                                                                               | Contact service.                                                                                                             |
| 15   | Excitation bandwidth selector position is incorrect.                                                                                                     | Contact service.                                                                                                             |
| 16   | Beam diameter selector position is incorrect.                                                                                                            | Contact service.                                                                                                             |
| 17   | The distance between measurement points is too short for scan measurement. The plate cannot be moved as slowly as the distance requires.                 | Use normal measurement instead of scan. Do not try to measure all the points with a single scan, but use interleaving scans. |

Continued

Cont.

| Code | Explanation                                                                                                                                | Suggested action                                                                                                                                                                                                                                          |
|------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18   | The sampling time for a single result is too long for scan measurement. The plate cannot be moved as slowly as the sampling time requires. | Use normal measurement instead of scan. Use a shorter sampling time.                                                                                                                                                                                      |
| 19   | The requested plate position is outside the mechanical limits of the XY table.                                                             | Check the plate definition (PLA command). Remember that the actual plate position depends on the measurement method and dispensers used. Note that plate scanning (SCA command) requires some extra space in the scanning direction for start/stop ramps. |
| 20   | The offset voltage of the temperature measurement electronics is too high.                                                                 | Contact service.                                                                                                                                                                                                                                          |
| 21   | An offset voltage on the QUAD analog board is too high.                                                                                    | Contact service.                                                                                                                                                                                                                                          |
| 22   | A background noise on the QUAD analog board is too high.                                                                                   | Contact service. Commands REP 21 and REP 38 may be used to diagnose the source of this error.                                                                                                                                                             |
| 23   | Error when checking the QUAD analog board reference voltage.                                                                               | Contact service.                                                                                                                                                                                                                                          |
| 24   | Calibration of the QUAD analog board gain steps failed.                                                                                    | Contact service.                                                                                                                                                                                                                                          |
| 25   | Analog signal outside measuring range. This situation is an error during start-up and the execution of the CAL command.                    | Contact service.                                                                                                                                                                                                                                          |
| 26   | Flash lamp failure.                                                                                                                        | Contact service.                                                                                                                                                                                                                                          |
| 27   | Attempt to set the instrument serial number when it already has been set.                                                                  | Do not try to set the serial number.                                                                                                                                                                                                                      |
| 29   | A dispenser is not responding.                                                                                                             | Contact service.                                                                                                                                                                                                                                          |
| 30   | Non-volatile parameters lost.                                                                                                              | Contact service.                                                                                                                                                                                                                                          |
| 31   | The digital to analog converters check of the QUAD analog board failed.                                                                    | Contact service.                                                                                                                                                                                                                                          |
| 32   | The requested measurement method is not available.                                                                                         | Do not try to use measurement methods not supported by the instrument.                                                                                                                                                                                    |
| 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. This is only reported in response to the FCA command.                                 | Contact service.                                                                                                                                                                                                                                          |
| 36   | Excitation grating 1 335 nm calibration failed. This is only reported in response to the FCA command.                                      | Contact service.                                                                                                                                                                                                                                          |
| 37   | Excitation grating 1 823 nm calibration failed. This is only reported in response to the FCA command.                                      | Contact service.                                                                                                                                                                                                                                          |
| 38   | Excitation grating 20 nm calibration failed. This is only reported in response to the FCA command.                                         | Contact service.                                                                                                                                                                                                                                          |
| 39   | Excitation grating 2 823 nm calibration failed. This is only reported in response to the FCA command.                                      | Contact service.                                                                                                                                                                                                                                          |
| 40   | Emission gratings 405 nm calibration failed. This is only reported in response to the FCA command.                                         | Contact service.                                                                                                                                                                                                                                          |
| 41   | Emission gratings 695 nm calibration failed. This is only reported in response to the FCA command.                                         | Contact service.                                                                                                                                                                                                                                          |
| 42   | Flash lamp calibration failed. This is only reported in response to the FCA command.                                                       | Contact service.                                                                                                                                                                                                                                          |

Continued

Cont.

| Code | Explanation                                                                                                  | Suggested action                                                                                                                              |
|------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 43   | PMT relative spectral sensitivity calibration failed. This is only reported in response to the FCA command.  | Contact service.                                                                                                                              |
| 44   | PMT gain calibration failed. This is only reported in response to the FCA command.                           | Contact service.                                                                                                                              |
| 45   | XY table position calibration failed. This may be reported after start-up or in response to the FCA command. | Contact service.                                                                                                                              |
| 46   | No factory calibration for the current measurement method.                                                   | After adding hardware for a new measurement method, the method cannot be used until the instrument is recalibrated by giving the FCA command. |
| 47   | Plate tray alignment error. This is only reported in response to the FCA command.                            | Check that the plate tray is properly inserted. Contact service.                                                                              |
| 48   | LAT module calibration failed. This is only reported in response to the FCA command.                         | 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. The background level is checked during execution of the CAL command.              | 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.           |
| 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.                                                                                  | Do not try to use nonexistent dispensers.                                                                                                     |
| 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. This error may be reported in response to a PUT command. | Using the PUT command, delete some unused user parameters to make room for new parameters.                                                    |
| 72   | The drop shield position is incorrect.                                                                       | 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 QUAD board input channels is too high.                                  | Contact service.                                                                                                                              |
| 78   | PMT linearity calibration failed.                                                                            | Contact service.                                                                                                                              |
| 79   | Bandwidth factors calibration failed.                                                                        | Contact service.                                                                                                                              |

Continued

Cont.

| Code | Explanation                                                                                                                                                                               | Suggested action                                                                                                                                                                                                                  |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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. <sup>1</sup>                                                                                                         | 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. | Make sure that the number of filter pairs in a FIL command and the number of delay/integration time pairs in a SET 8 command are equal.                                                                                           |
| 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. DME and DIS commands only work with plate types having up to 384 wells.                                                                                                                                |
| 87   | A dispenser has run out of liquid.                                                                                                                                                        | Add liquid and prime the dispenser.                                                                                                                                                                                               |
| 88   | LAT module base is installed but the LAT module itself is not.                                                                                                                            | Install the LAT module or replace the base with a dual dispensing base or a dummy.                                                                                                                                                |
| 89   | LAT module position calibration failed.                                                                                                                                                   |                                                                                                                                                                                                                                   |
| 90   | LAT module position calibration failed.                                                                                                                                                   |                                                                                                                                                                                                                                   |
| 91   | TRF lamp fail.                                                                                                                                                                            | LAT module flash lamp failure.                                                                                                                                                                                                    |
| 92   | Varioskan LUX LED fail.                                                                                                                                                                   | LAT module Varioskan LUX LED failure.                                                                                                                                                                                             |
| 93   | Integrated gas module is not installed.                                                                                                                                                   | Gas control feature not available.                                                                                                                                                                                                |
| 94   | Integrated gas module communication error.                                                                                                                                                | Errors detected in communication with the Integrated gas module.                                                                                                                                                                  |
| 95   | Gas concentrations too high.                                                                                                                                                              |                                                                                                                                                                                                                                   |
| 96   | Integrated gas module memory error.                                                                                                                                                       | Integrated gas module memory access failed or data was corrupted.                                                                                                                                                                 |
| 97   | CO <sub>2</sub> concentration above target.                                                                                                                                               | Target CO <sub>2</sub> concentration above target.                                                                                                                                                                                |
| 98   | CO <sub>2</sub> concentration below target.                                                                                                                                               | Target CO <sub>2</sub> concentration below target.                                                                                                                                                                                |
| 99   | CO <sub>2</sub> sensor failure.                                                                                                                                                           | CO <sub>2</sub> sensor failure.                                                                                                                                                                                                   |

Table 7–17 Warning codes reported

| Code | Explanation                                                                                                                                    | Suggested action                                                                                                                                                                                                                                                                                                                                                                            |
|------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 100  | Unable to comply with the defined lag time.                                                                                                    | <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                |
| 101  | Unable to comply with the defined well interval.                                                                                               | <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                |
| 102  | Unable to comply with the defined wavelength interval.                                                                                         | <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                |
| 103  | Unable to comply with the defined kinetic interval.                                                                                            | <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                |
| 104  | Unable to comply with the defined group interval.                                                                                              | <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                |
| 105  | The timer referenced in the WAI timer command is not (anymore) running. Your timing requirement is not met.                                    | Make sure you started the timer with a long enough wait time.                                                                                                                                                                                                                                                                                                                               |
| 106  | The lamp lifetime has reached its end.                                                                                                         | Arrange for the replacement of the lamp as soon as convenient.                                                                                                                                                                                                                                                                                                                              |
| 107  | Calibration validity has expired.                                                                                                              | The accuracy of the measurement results may have suffered. The action depends on the calibration options your PC offers and the type of assay you were running. If there is no waiting time in the assay, then you have to accept the possible accuracy reduction. If there is waiting time, you could switch on the automatic calibration feature if that is an option in the PC software. |
| 108  | Command has no effect.                                                                                                                         | This just informs that a command has been used which has no effect in the current measurement method. Commands BWS, PAR 4, PAR 5, PAR 8, PMT and SET 9 are no operation commands for some measurement methods.                                                                                                                                                                              |
| 109  | The interval time defined with a SYN command for the next two measurements was too short. The second measurement started later than requested. | <sup>2</sup>                                                                                                                                                                                                                                                                                                                                                                                |
| 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.                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                             |
| 112  | Gas concentration out of the set value.                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                             |

<sup>1</sup> 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.

<sup>2</sup> 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 7–18). If problems occur or reoccur, contact authorized technical service immediately.

**Table 7–18** Troubleshooting guide

| Symptom                                              | Cause                                                                                                                                           | Suggested action                                                                                                                    |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Connection to the instrument fails.                  | The instrument is switched off.<br>The instrument is not completely initialized.<br>The USB cable is not connected.<br>The USB cable is broken. | Switch on the instrument.<br>Wait for the initialization tests to be performed.<br>Connect the USB cable.<br>Replace the USB cable. |
| Too low signal or no signal at all.                  | The plate is missing.<br>An empty well or an incorrect layout vs. actual layout.<br>Measurement at wrong wavelength.                            | Insert the plate.<br>Check that the plate vs. layout matches.<br>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 <sub>2</sub> concentration below target.          | The CO <sub>2</sub> gas cylinder closed.                                                                                                        | Open the CO <sub>2</sub> gas cylinder.<br>Check that all the gas lines are properly connected.                                      |

## Ordering Information

Contact your local Thermo Fisher Scientific representative for ordering and service information (Table 8–19 through Table 8–25).

### Varioskan LUX

Table 8–19 Instrument catalog numbers

| Cat.no.   | Instrument / System                                                                                        |
|-----------|------------------------------------------------------------------------------------------------------------|
| VL0000D0  | Varioskan LUX with fluorescence (top) and absorbance                                                       |
| VLOL00D0  | Varioskan LUX with fluorescence (top), absorbance and luminescence                                         |
| VLOLOT0D0 | Varioskan LUX with fluorescence (top), absorbance, luminescence and TRF                                    |
| VLOLA0D0  | Varioskan LUX with fluorescence (top), absorbance, luminescence and AlphaScreen                            |
| VLOLAT0D0 | Varioskan LUX with fluorescence (top), absorbance, luminescence, AlphaScreen and TRF                       |
| VLB000D0  | Varioskan LUX with fluorescence (top & bottom) and absorbance                                              |
| VLBL00D0  | Varioskan LUX with fluorescence (top & bottom), absorbance and luminescence                                |
| VLBL0TD0  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and TRF                           |
| VLBLA0D0  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and AlphaScreen                   |
| VLBLATD0  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen and TRF              |
|           |                                                                                                            |
| VL0000D1  | Varioskan LUX with fluorescence (top) and absorbance, 1 dispenser                                          |
| VLOL00D1  | Varioskan LUX with fluorescence (top), absorbance and luminescence, 1 dispenser                            |
| VLOLOTD1  | Varioskan LUX with fluorescence (top), absorbance, luminescence and TRF, 1 dispenser                       |
| VLOLA0D1  | Varioskan LUX with fluorescence (top), absorbance, luminescence and AlphaScreen, 1 dispenser               |
| VLOLATD1  | Varioskan LUX with fluorescence (top), absorbance, luminescence, AlphaScreen and TRF, 1 dispenser          |
| VLB000D1  | Varioskan LUX with fluorescence (top & bottom) and absorbance, 1 dispenser                                 |
| VLBL00D1  | Varioskan LUX with fluorescence (top & bottom), absorbance and luminescence, 1 dispenser                   |
| VLBL0TD1  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and TRF, 1 dispenser              |
| VLBLA0D1  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and AlphaScreen, 1 dispenser      |
| VLBLATD1  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen and TRF, 1 dispenser |

Continued

Cont.

|          |                                                                                                             |
|----------|-------------------------------------------------------------------------------------------------------------|
| VL000D2  | Varioskan LUX with fluorescence (top) and absorbance, 2 dispensers                                          |
| VLO00D2  | Varioskan LUX with fluorescence (top), absorbance and luminescence, 2 dispensers                            |
| VLO0TD2  | Varioskan LUX with fluorescence (top), absorbance, luminescence and TRF, 2 dispensers                       |
| VLOA0D2  | Varioskan LUX with fluorescence (top), absorbance, luminescence and AlphaScreen, 1 dispenser                |
| VLOATD2  | Varioskan LUX with fluorescence (top), absorbance, luminescence, AlphaScreen and TRF, 2 dispensers          |
| VLB00D2  | Varioskan LUX with fluorescence (top & bottom) and absorbance, 2 dispensers                                 |
| VLB00D2  | Varioskan LUX with fluorescence (top & bottom), absorbance and luminescence, 2 dispensers                   |
| VLB0TD2  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and TRF, 2 dispensers              |
| VLBA0D2  | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence and AlphaScreen, 2 dispensers      |
| VLBLATD2 | Varioskan LUX with fluorescence (top & bottom), absorbance, luminescence, AlphaScreen and TRF, 2 dispensers |

## Gas module for Varioskan LUX

**Table 8–20** Catalog number for Integrated gas module

| Cat.no.  | Instrument / System                                              |
|----------|------------------------------------------------------------------|
| VLGAS001 | Integrated gas module (factory installed at instrument purchase) |

## Upgrade kits for Varioskan LUX

**Table 8–21** Catalog numbers for upgrade kits

| Cat.no.   | Instrument / System                                             |
|-----------|-----------------------------------------------------------------|
| VLUPL0002 | Luminometric upgrade kit (L module) (service upgradable)        |
| VLUPA003  | AlphaScreen upgrade kit (service upgradable), requires L module |
| VLUPT004  | TRF upgrade kit (service upgradable), requires L module         |
| VLUPD005  | Dispenser upgrade kit (service upgradable)                      |
| VLUPG006  | Integrated gas module upgrade kit (service upgradable)          |

## Accessories for Varioskan LUX

**Table 8–22** Catalog numbers for accessories

| Cat.no. | Instrument / System                                  |
|---------|------------------------------------------------------|
| N12391  | µDrop Plate                                          |
| N03079  | Robotic Tray including adapter for plate without lid |
| 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 plate without lid              |
| N03395  | 96-well adapter for PCR plate without lid            |
| N02339  | Adapter for plate without lid                        |

Continued

Cont.

|          |                                      |
|----------|--------------------------------------|
| N16443   | Adapter holder                       |
| N16484   | Filter pick-up tool                  |
| 2805690  | Aspirate tube assembly for dispenser |
| SP-00094 | Dispensing tube assembly             |
| SP-00096 | Dispenser syringe 1 ml               |
| SP-00093 | Dispenser syringe 5 ml               |
| N164263  | Varioskan LUX Demo instrument box    |

## 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           |

## Skant Software

**Table 8–24** Catalog numbers for Skant Software

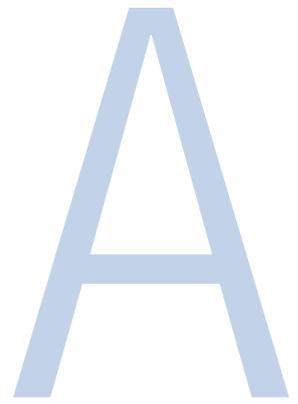
| Cat.no. | Instrument / System                                     |
|---------|---------------------------------------------------------|
| 5187139 | Skant SW for Microplate Readers, Research Edition       |
| 5187149 | Skant SW for Microplate Readers, Drug Discovery Edition |

## Filters for Varioskan LUX

**Table 8–25** Filters

Contact your local Varioskan LUX sales representative for the latest list of available TRF, AlphaScreen/AlphaLISA and luminometric filters.





## Certificate of Decontamination

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
Tel./Fax: \_\_\_\_\_  
Instrument: \_\_\_\_\_ Serial No. \_\_\_\_\_

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

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

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

Specific information about contaminants:

\_\_\_\_\_  
\_\_\_\_\_

Decontamination procedure<sup>1</sup>:

\_\_\_\_\_  
\_\_\_\_\_

Date and place: \_\_\_\_\_

Signature: \_\_\_\_\_

Name (block capitals): \_\_\_\_\_

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

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

Date and place: \_\_\_\_\_

Signature: \_\_\_\_\_

Name (block letters): \_\_\_\_\_

<sup>1</sup> Please include decontaminating solution used.





## 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™ Finnpipe™ for 10–100 µl (with 15 µl volume)
  - Thermo Scientific™ Finnpipe™ 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  $\mu$ l 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  $\mu$ l 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  $\mu$ l of ATP Standard solution and 15  $\mu$ l 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.

### **DELFIATM**

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  $\mu$ s 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)**

$\log (1/\text{transmittance}) = \log (I/I_0)$  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.







[www.thermoscientific.com](http://www.thermoscientific.com)

© 2015 Thermo Fisher Scientific Inc. All rights reserved. Decon 90 is a trademark of Cole-Palmer, Microcide SQ is a trademark of Global Biotechnologies, Inc., Microsoft and Windows are trademarks of Microsoft Corporation, Virkon is a trademark of E.I. du Pont de Nemours and Company or its affiliates. All (other) trademarks are the property of Thermo Fisher Scientific Inc. and its subsidiaries.

**Africa-Other** +27 11 570 1840  
**Australia** +61 2 8844 9500  
**Austria** +43 1 333 50 34 0  
**Belgium** +32 53 73 42 41  
**Canada** +1 800 530 8447  
**China** +86 10 8419 3588  
**Denmark** +45 70 23 62 60  
**Europe-Other** +43 1 333 50 34 0

**Finland /Norway/Sweden**  
+46 8 556 468 00  
**France** +33 1 60 92 48 00  
**Germany** +49 6103 408 1014  
**India** +91 22 6742 9434  
**Italy** +39 02 950 591  
**Japan** +81 45 453 9100  
**Latin America** +1 608 276 5659

**Middle East** +43 1 333 50 34 0  
**Netherlands** +31 76 579 55 55  
**South Africa** +27 11 570 1840  
**Spain** +34 914 845 965  
**Switzerland** +41 61 716 77 00  
**UK** +44 1442 233555  
**USA** +1 800 532 4752

**Thermo**  
SCIENTIFIC

A Thermo Fisher Scientific Brand