Varioskan™ ALF Multimode Microplate Reader

TECHNICAL GUIDE

Catalog Numbers VA000010C

Publication Number MAN0030139

Revision B

For Research Use Only. Not for use in diagnostic procedures.

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Revision history: MAN0030139 B (English)

Revision	Date	Description
B	14 August 2024	Change of usage statement from LUN to RUO.
A.0	28 February 2024	New manual for the Varioskan™ ALF Multimode Microplate Reader.

The information in this guide is subject to change without notice.

Contents

1 Product information

Product description

The Thermo Scientific™ Varioskan™ ALF Multimode Microplate Reader is a multi-technology microplate reader. The instrument is used to measure fluorescence intensity (FI), luminescence, absorbance and turbidity from samples in appropriate microplates. The instrument also has incubating and shaking capabilities, and can be integrated into automation environments.

The instrument is used with an external computer installed with the Thermo Scientific™ SkanIt™ Software for Microplate Readers.

The instrument has detection technology capable of making the following measurements when using the appropriate microplates:

- Absorbance
- Turbidity
- Fluorescence intensity (FI)
- Luminescence

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

- The monochromator is used in absorbance and turbidity measurements.
- Filters are used in fluorescence intensity measurements.
- Most luminescence measurements do not require wavelength selection. But if required, filters can be used.

The instrument supports all common 6-well, 12-well, 24-well, 48-well, 96-well, and 384-well microplates with or without lids or seals, as well as low-volume microplates. Additionally Thermo Scientific™ µDrop™ Plate and µDrop™ Duo Plate products can be used for absorbance measurement.

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

End point and kinetic modes are supported for all detection techniques. Spectral measurements can be carried out in UV/Vis/NIR range for absorbance measurement.

Description of parts

Instrument overview

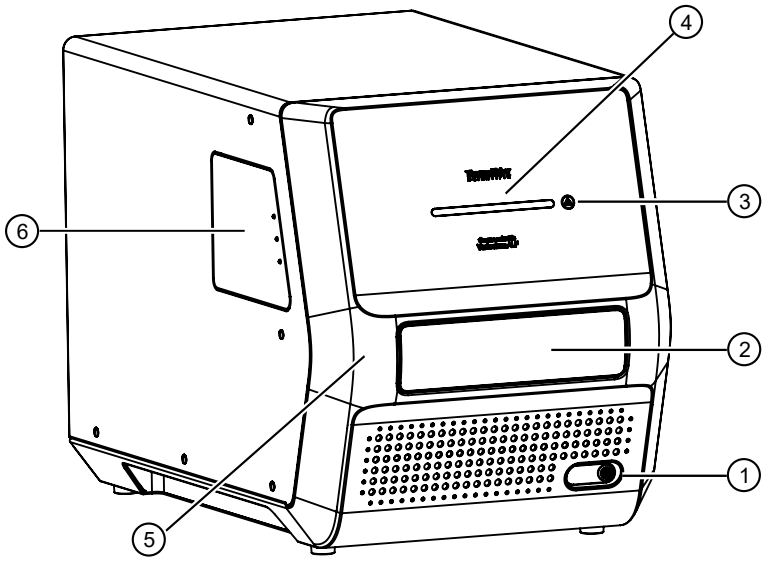


Figure 1 Front view of the Varioskan™ ALF Multimode Microplate Reader

1. Power switch
2. Measurement chamber door
3. Plate In/Out button
4. LED bar indicator (see table for explanations)
5. Front cover
6. Filter wheel chamber door

LED bar indicator	Instrument state
Blue light changing brightness slowly	Power on
Blue light steady	Standby
Blue light moving towards middle of light bar	Plate moving out
Blue light moving towards sides of light bar	Plate moving in
Blue light converges at a point in the middle	Plate out
Blue light flashing slowly [1]	Incubator on
Blue light blinking	Busy [2]
Violet light moving back and forth	Measuring absorbance or turbidity
Bright green light moving back and forth	Measuring fluorescence intensity
Dark yellow light moving back and forth	Measuring luminescence
Amber blinking	Error

[1] This indicator can be interrupted by other LED bar indicator states, but it does not mean the incubator has been turned off.
[2] Indicates non-measuring working state, such as kinetic interval and shaking.

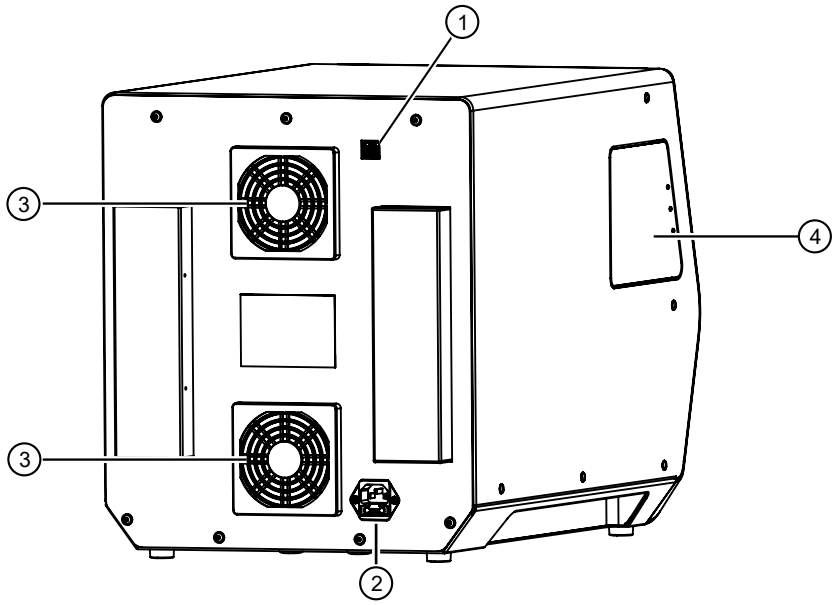


Figure 2 Rear view of the Varioskan™ ALF Multimode Microplate Reader

① USB-B connector
② Mains power supply connector
③ Cooling fan outlets
④ Filter wheel chamber door

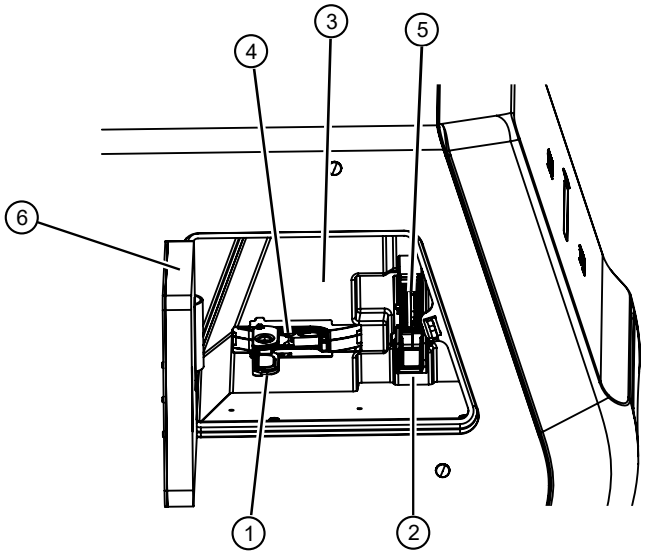
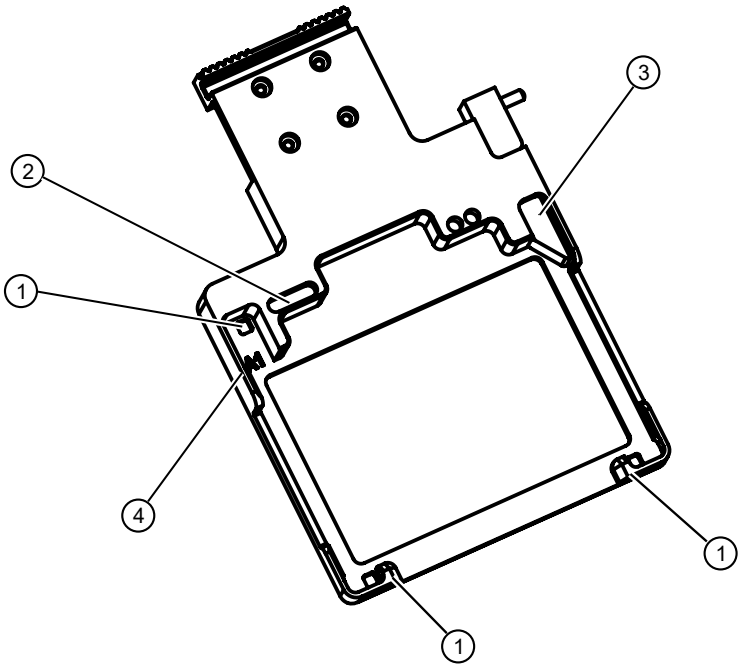


Figure 3 Internal view of the Varioskan™ ALF Multimode Microplate Reader

① Excitation filter wheel door
② Emission filter wheel door
③ Light shield
④ Excitation filter wheel
⑤ Emission filter wheel
⑥ Filter wheel chamber door

About microplates and the plate carrier

- Photometric and turbidimetric measurements support all common 6-well, 12-well, 24-well, 48-well, 96-well, and 384-well microplates with or without lids or seals, as well as low-volume microplates (preferably a high base type). The total height including the microplate and cover shall be less than 23.5 mm. Flat and C-bottom plates are recommended. U-bottom microplates are suitable but not optimal, while V-bottom microplates are not recommended. Thermo Scientific™ µDrop™ Plate and µDrop™ Duo Plate products can be used for absorbance measurement. Special UV-quality plastic or quartz plates below 380 nm are suitable for UV measurements, but the common polystyrene microplates are not compatible with UV measurements.
- Fluorometric measurement supports all common 6-well, 12-well, 24-well, 48-well, 96-well, and 384-well microplates with and without lids or seals, as well as low-volume microplates (preferably a high base type). The total height including the microplate and cover shall be less than 23.5 mm. Black plates or black plates with clear bottom are recommended.
- Luminometric measurement is designed to support all common 6-well, 12-well, 24-well, 48-well, 96-well, and 384-well microplates with and without lids or seals, as well as low-volume microplates (preferably a high base type), when total height including the microplate and cover is less than 15.5 mm. The plates between 15.5 – 23.5 mm can be also measured, but the measurement will be done without the automatic cross talk shield which will lead to the lower optical crosstalk performance. White plates or white plates with clear bottom are recommended.



① Positioning hole (used for position calibration)
② Diffuser hole (used for fluorescence signal check)
③ Plate lock (used to fix the measurement plate)
④ A1 plate position mark

About the optical system

The instrument is equipped with the following two detection modules:

- Photometry module used for absorbance and turbidity detection
- Fluorometry & Luminometry (FL) module, used for fluorescence intensity (FI) and luminescence detection

Absorbance and turbidity measurements are conducted through the well; fluorescence intensity and luminescence measurements are conducted from the top of the well.

Luminometric measurements shared the emission path of fluorometry. To minimize the crosstalk interference, an automatic shield is used. However, the automatic crosstalk shield will not be used if the height of the plate is above 15.5 mm in luminometric measurements.

The principle of the Varioskan™ ALF Multimode Microplate Reader optical measurement modules is shown in Figure 4. Each submodule is described separately in the subsequent lower-level diagrams.

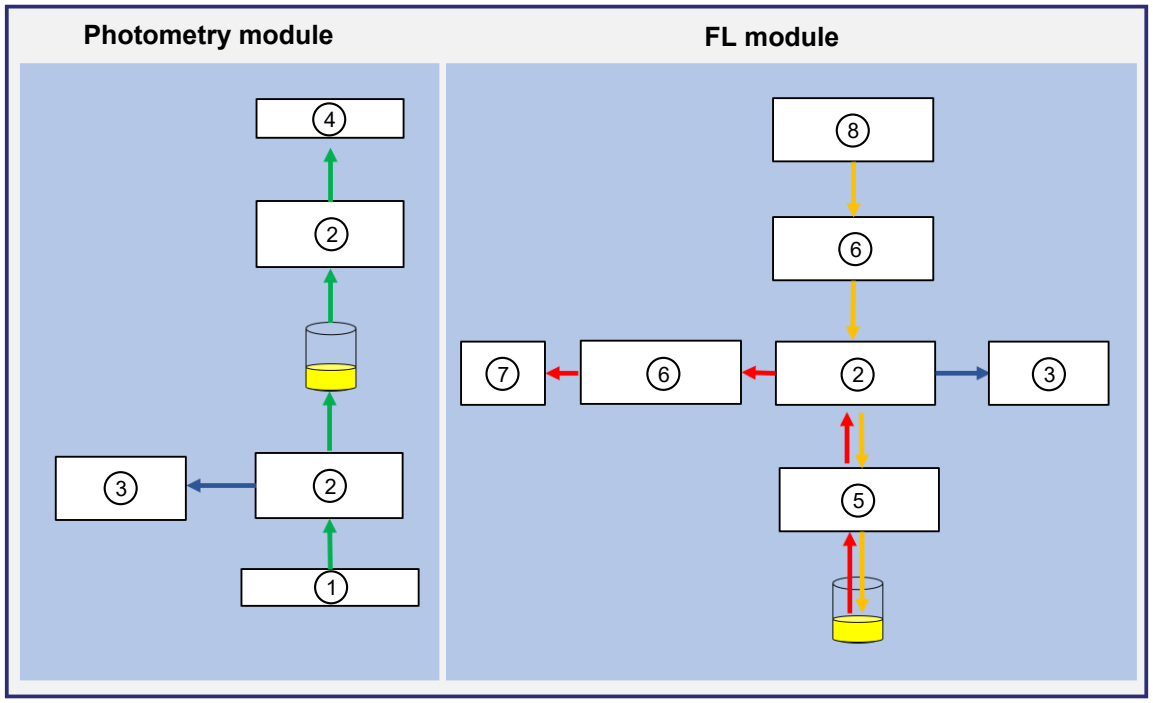


Figure 4 Principle of operation

① Monochromator
② Measurement optics
③ Reference optics
④ Photodiode
⑤ Automatic crosstalk shield
⑥ Shutter and filter selector
⑦ Photomultiplier tube (PMT)
⑧ Excitation optics

Optical system for photometric measurements

The wavelength used by the instrument is selected using a monochromator. The light is guided to the microplate optics though an optical fiber, where part of the light is guided through the sample and another part is guided to the reference detector. The light is sensed simultaneously by the reference detector and the measurement detector positioned after the sample to compensate for any intensity fluctuations of the xenon flash lamp.

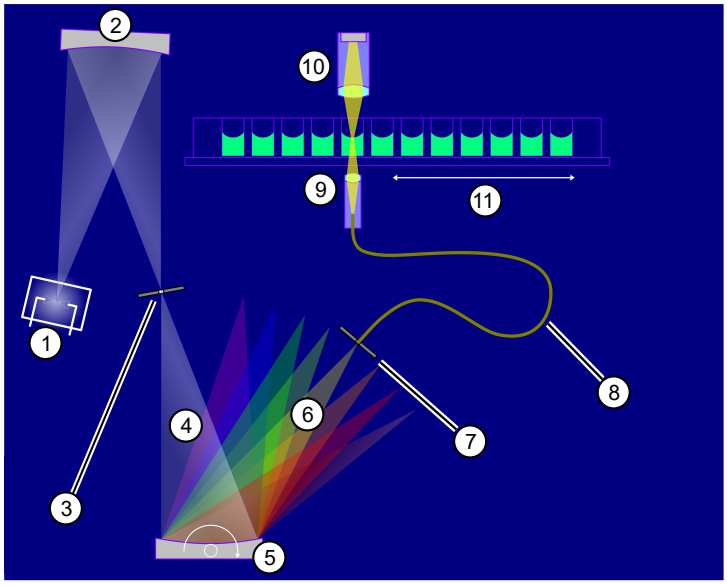


Figure 5 Operating principle of absorbance measurement

1. Xenon light source
2. Mirror optics
3. Entrance slit
4. Polychromatic beam
5. Rotating holographic grating
6. Diffracted light
7. Exit slit
8. Optical fiber
9. Lower measurement optics
10. Upper measurement optics
11. Moving plate

In microplate measurement, the track moves to select the well column and the well row. An air blank measurement is needed to calculate the absorbance values. The instrument moves the microplate aside to measure the blank automatically.

Optical system for fluorometric measurements

A xenon flash lamp is used as the source of the excitation light. The excitation light passes the excitation optical system and a filter wheel to generate a beam. Part of the beam is measured by an excitation reference detector, while another part passes through the optical system to excite the sample. The emission light is collected by the optical system and filtered by the emission filter wheel, so that the light intensity at the specified wavelength is measured by the PMT detector.

Filters for wavelength selection are held in 10-position filter wheels. The instruments can carry out top reading. The principle of fluorometric measurement is shown as below.

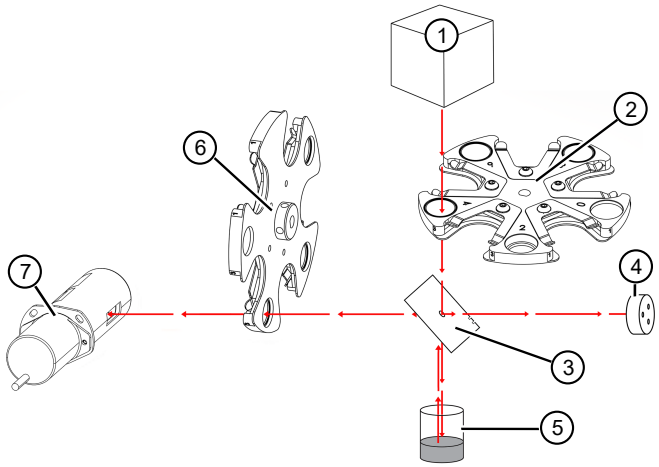


Figure 6 Operating principle of fluorometric measurement

① Xenon light source
② Excitation filter wheel (containing excitation filters)
③ Beam spllitter
④ Lamp reference detector
⑤ Sample well
⑥ Emission filter wheel (containing emission filters)
⑦ Photomultiplier tube (PMT) (to detect emission light)

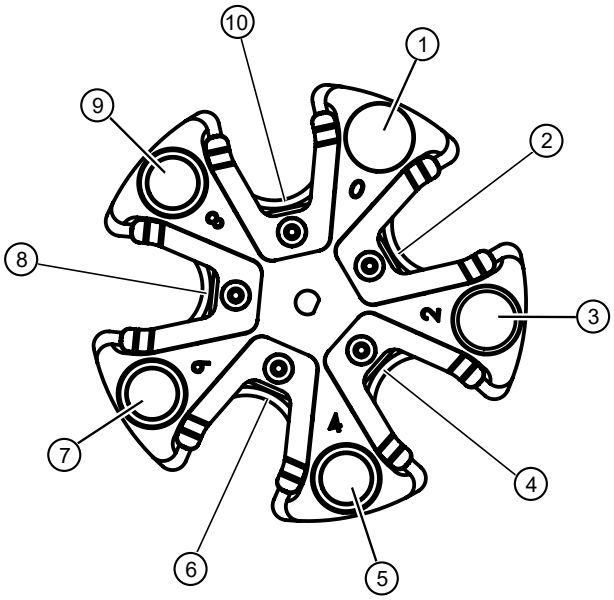


Figure 7 Excitation filter wheel

① Beam blocking filter slot
② User defined filter slot
③ Open unfiltered slot
④ User defined filter slot
⑤ Coumarin family excitation filter (center wavelength: 345 nm , bandwidth: 25 nm)
⑥ User defined filter slot
⑦ Fluorescein family excitation filter (center wavelength: 485 nm , bandwidth: 15 nm)
⑧ User defined filter slot
⑨ Resorufin family excitation filter (center wavelength: 555 nm , bandwidth: 15 nm)
⑩ User defined filter slot

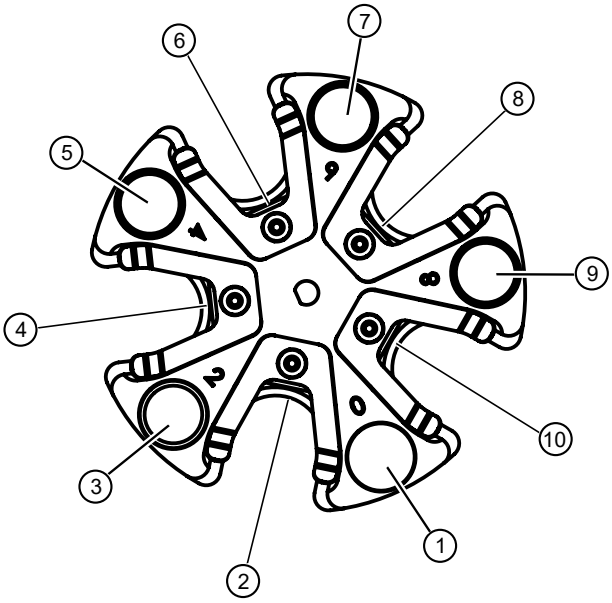


Figure 8 Emission filter wheel

① Beam blocking filter slot
② User defined filter slot
③ Open unfiltered slot
④ User defined filter slot
⑤ Coumarin family emission filter (center wavelength: 450 nm , bandwidth: 40 nm)
⑥ User defined filter slot
⑦ Fluorescein family emission filter (center wavelength: 525 nm , bandwidth: 15 nm)
⑧ User defined filter slot
⑨ Resorufin family emission filter (center wavelength: 615 nm , bandwidth: 45 nm)
⑩ User defined filter slot

Optical system for luminometric measurements

Luminometric measurements share the same emission path used for fluorometry. The emission light is collected by the optical system and measured by PMT detector. Luminometric measurements also share the emission filter wheel used for fluorometry.

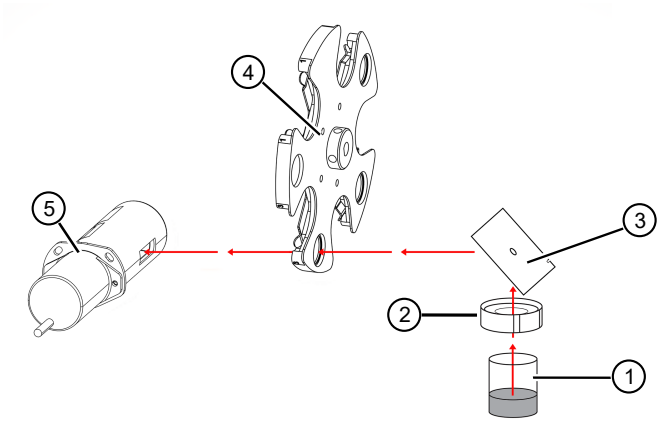


Figure 9 Operating principle of luminometric measurement

1. Sample well
2. Automatic cross talk shield (protects the luminescence light path from the measurement well to the first lens)

   IMPORTANT! The automatic cross talk shield will not be lowered into position during luminometric measurementsif the height of the plate is above 15.5 mm, which can result in deterioriation of performance due to optical crosstalk.
3. Beam splitter
4. Emission filter wheel (used for luminometric measurement)

   Note: Most luminescence measurements do not require a wavelength selection, and the light can pass through an empty filter slot. However if required, filters can be inserted into the user defined holes in the emission filter wheel.
5. Photomultiplier tube (PMT) (to detect luminescence)

About the incubator

The incubator in the measurement chamber consists of two thermal sensor-controlled incubator zones, with one at the top and one on the bottom of the measurement chamber.

The incubator design incorporates condensation control to prevent condensation from forming on the microplate lid by heating the lid to a slightly higher temperature than the microplate.

The incubation temperature range is from ambient + 2°C to 45°C.

Note: Liquid warm-up is considerably slower than incubator warm-up.

About the shaker

There are three shaker options for the Varioskan™ ALF Multimode Microplate Reader that are available through the SkanIt™ Software for Microplate Readers.

- Linear shaking
- Orbital shaking
- Dual orbital shaking

The shaker operates at different adjustable speeds, which are defined by the selected plate type.

The µDrop™ Plate and µDrop™ Duo Plate are not recommended for use with shaking.

96-well shaking parameters can be found in the following tables.

Note: Low shaking speed applies 0.2G of horizontal force, medium speed applies 0.4G of horizontal force, and high medium speed applies 0.8G of horizontal force.

Table 1 Linear shaking speeds (96-well)

Low	5 Hz, amplitude: 12 mm
Medium	10 Hz, amplitude: 2 mm
High	20 Hz, amplitude: 1 mm

Table 2 Orbital shaking speeds (96-well)

Low	60 rpm, diameter: 17 mm
Medium	300 rpm, diameter: 2 mm
High	600 rpm, diameter: 2 mm

Table 3 Dual orbital shaking speeds (96-well)

Low	100 rpm, diameter: 10 mm
Medium	600 rpm, diameter: 2 mm
High	1000 rpm, diameter: 1 mm

About the cooling fan

The cooling fan is used to maintain the instrument temperature near ambient conditions. It is automatically activated when the power is on. Cooling fans have several different working modes.

- 30% power rate in idle mode
- 50% power rate in measurement mode
- 100% power rate in shaking mode

About the SkanIt™ software

The instrument can be operated using the SkanIt™ software which controls all the instrument functions and provides data processing and reporting functions. For instructions on using the SkanIt™ software see the *SkanIt™ Software for Microplate Readers Quick Reference* and *SkanIt™ Software for Microplate Readers User Guide*.

2 Instrument installation

Upon receiving the device

- Check the enclosed packing list against order.
- Visually inspect the transport package, the instrument, and the accessories for any damage incurred during transit. 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 missing or damaged, contact your local Thermo Fisher Scientific representative.

Unpack the instrument

The following items are sent with the instrument and are immediately available when the package is opened.

- Packing list
- Quick Reference Guide to help with the installation
- USB disk box
- USB 2.0 A-B cable
- Power cord
- Performance test report
- CE and UKCA documents
- COC certificate

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

Retain the original packing materials and shipping carton for future transportation. The packaging is designed to assure safe transport and minimize transit damage. Use of alternative packaging materials may invalidate the warranty.

Retain all instrument-related documentation provided by the manufacturer for future use.

If you relocate your instrument or ship it for service, see “Ship the instrument for service” on page 46.

Unpack the instrument

1. Move the package to its site of operation.

   See “Environmental requirements and considerations” before deciding where to place the instrument.

2. To prevent condensation, leave the instrument in its protective plastic wrapping until the ambient temperature has been reached.

3. Unpack the instrument and accessories carefully with the arrows on the transport package pointing upwards.

4. Open the top of the double-layer packages and lift the instrument out of the shipping carton.

Environmental requirements and considerations

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

- Place the instrument on a sturdy laboratory bench that can take the weight of the instrument.
- Select a working area is flat, dry, clean, and vibration-proof. Ensure that additional room is available for cables.
- Ambient air should be clean and free of corrosive vapors, smoke, and dust.
- Ambient temperature range should be between +10–40°C (50–104°F).
- Humidity should be low enough that condensation does not occur (relative humidity between 10% and 80%, non-condensing).
- Ensure there is at least 10 cm of free space around the instrument for ventilation. A laptop can be placed on top of the instrument.
- Ensure there is enough space in front of the instrument so that the plate carrier stays above the table when opened.
- Avoid sites of operation with excess dust, vibrations, strong magnetic fields, direct sunlight, draft, excessive moisture, or large temperature fluctuations when installing the instrument.

The instrument does not produce operating noise at a level which could be harmful. No sound level measurements are needed after installation.

Set up the instrument

The following installation steps must be performed before the instrument can be operated.

1. Remove the transport lock.
2. Connect the mains supply cable.
3. Connect the instrument to a computer.
4. Install the SkanIt™ Software for Microplate Readers to the computer connected to the instrument.

Guidelines for instrument set up

WARNING! Only authorized technical service personnel are allowed to open the instrument. Disconnect the instrument from all voltage sources by disconnecting the power supply cable before opening it.

WARNING! Do not touch switches or electrical outlets with wet hands. Switch the instrument off before disconnecting it from the mains supply.

WARNING! The electromagnetic environment should be evaluated prior to operation of the device. Do not use this device in close proximity to sources of strong electromagnetic radiation (e.g. unshielded intentional RF sources), as these can interfere with the proper operation.

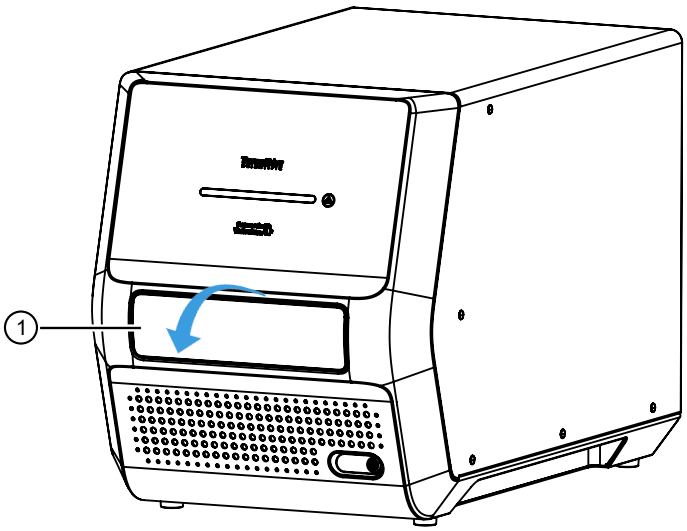
WARNING! Do not attempt to operate the instrument with the transport lock in place.

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

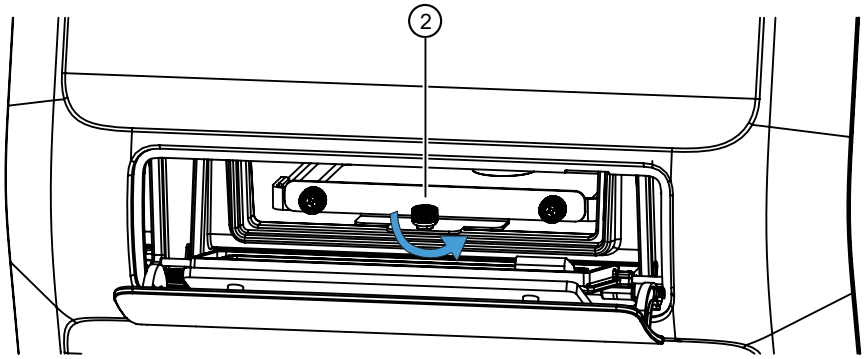
CAUTION! Leave the instrument to sit for at least three hours before installing and switching it on to prevent condensation causing a short circuit.

Remove the transport lock

1. Open the measurement chamber door ① by pulling the upper edge.

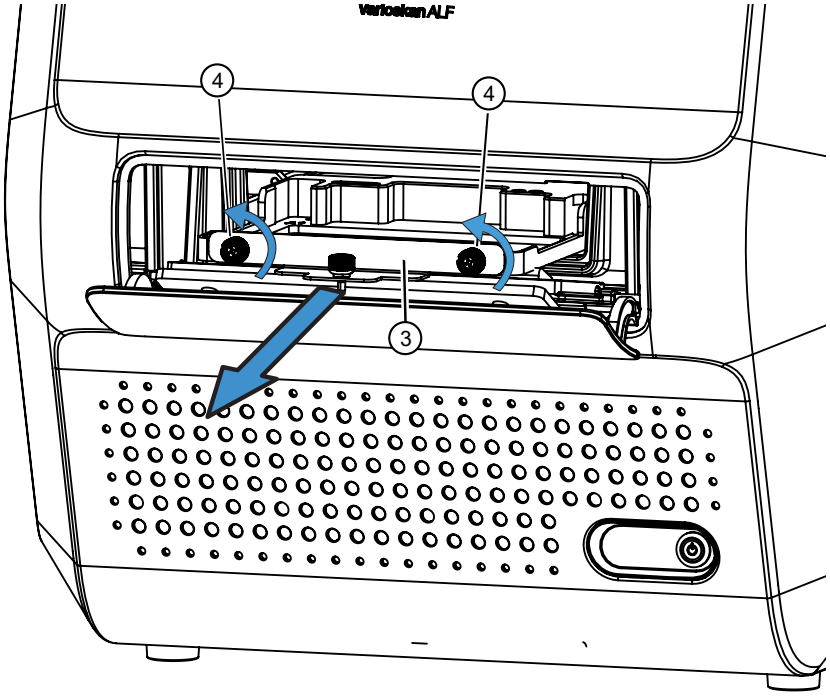


2. Unscrew the transport lock bar ② by turning it counterclockwise.



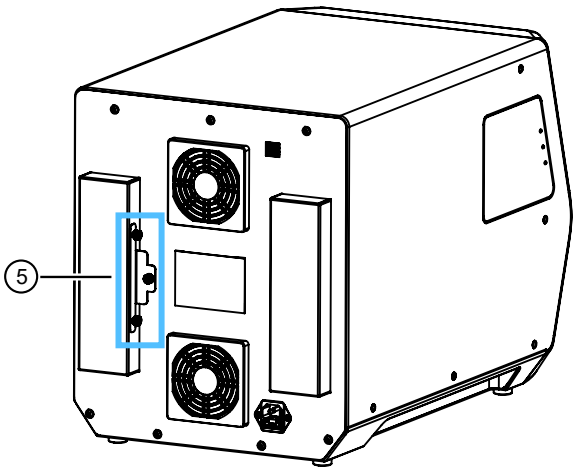
3. Pull the transport lock ③ until the plate carrier is fully out of the measurement chamber.

4. Unfasten two fixing screws ④ and remove the transport lock from the plate carrier.



5. Push the plate carrier back into the measurement chamber and make sure that the measurement chamber door closes properly.

6. Attach the transport lock ⑤ on the back of the instrument with the fixing screw and the locking piece that is on the back of the instrument.



Connect the mains supply cable

1. Connect the power supply cable to power supply connector on the back panel.

CAUTION! Do not use other power supply cables than the power supply cable delivered with the instrument. Use the power supply cable designed for your region.

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

2. Connect the power supply to a correctly installed line power outlet with a grounded conductor.

Connect the instrument to a computer

Connect the instrument to a PC using a USB cable.

Connecting the instrument to the SkanIt™ software automatically updates the instrument date and time according to the PC clock.

Install the SkanIt™ software

Install the SkanIt™ Software for Microplate Readers on the PC. For installation instructions, see the *SkanIt™ Software for Microplate Readers Quick Reference*.

For more information about the software, see the *SkanIt™ Software for Microplate Readers User Guide*.

Optical filter management

The Varioskan™ ALF Multimode Microplate Reader has three factory installed filter pairs for fluorometric measurements. Five open filter positions are available in both excitation and emission filter wheels for accessory filters. The filters in the emission filter wheel can also be used for luminometric measurements. Accessory filters should be installed according to your specific applications. Several excitation and emission filters are available for purchase (see “Accessory products” on page 61).

Table 4 Factory installed filter pair specifications

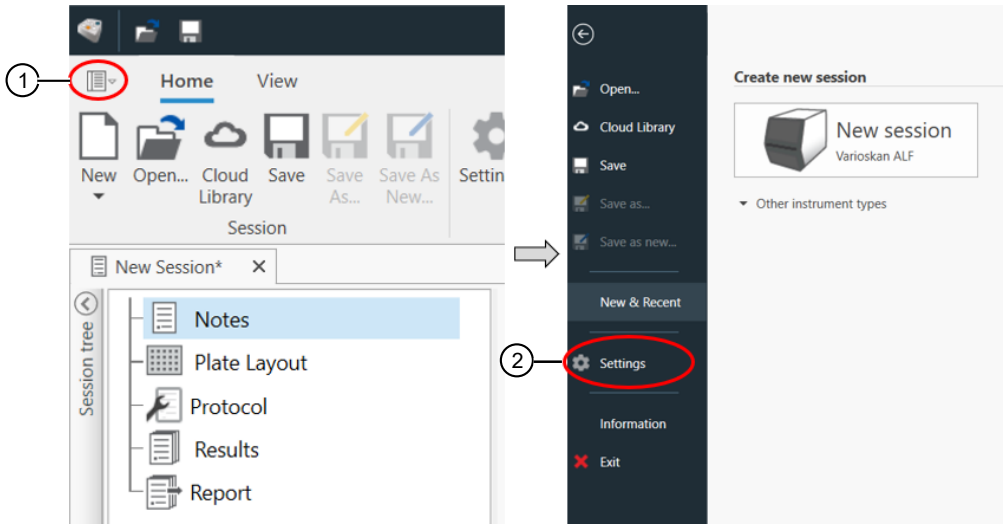
Filter pair name	Excitation wavelength	Emission wavelength	Usage
Blue fluorescence assay	345 nm	450 nm	• Most of the coumarin family dyes • Hoechst dye-based DNA assays, AMC-protease assays, aminoquinoline assays
Green fluorescence assay	485 nm	525 nm	• Most of the fluorescein family dyes • Thermo Scientific™ Quant-IT family DNA quantitation assays， GFP assays, many ROS assays
Orange fluorescence assay	555 nm	615 nm	Thermo Scientific™ PrestoBlue, alamarBlue family cell viability assays, Thermo Scientific™ Amplex Red family assays, reazurin-resorufin reaction assays

Identify instrument in SkanIt™ software

1. Turn on the instrument and open the SkanIt™ software.

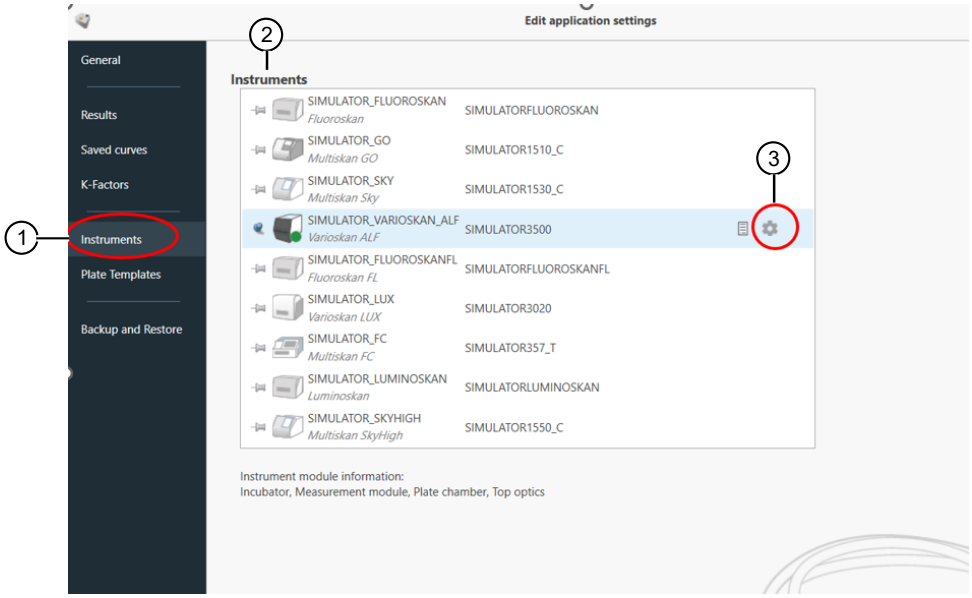
   The software automatically identifies any connected instruments.

2. Select **Menu** to open the **Application** menu, then select **Settings** to open the **Edit application settings** window.



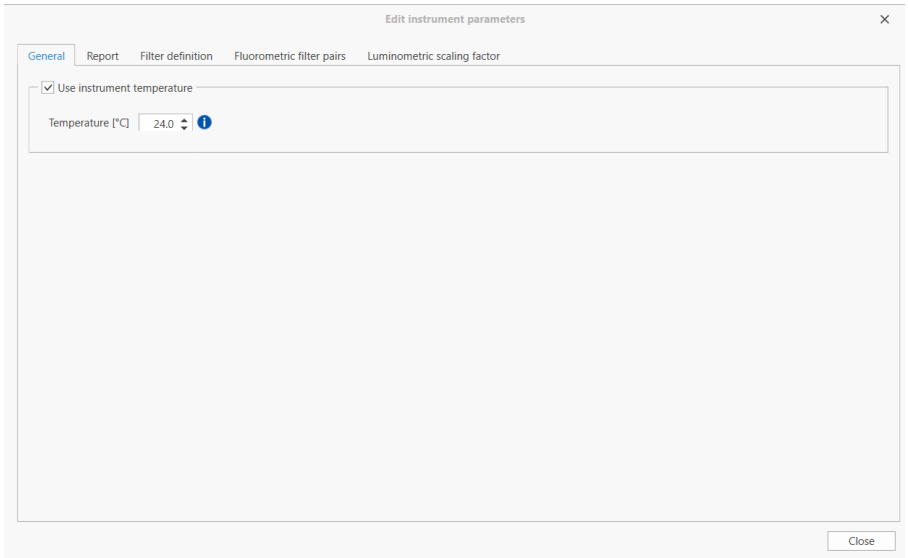
① **Menu**
② **Settings**

3. Select **Instruments** to open the **Edit instrument parameters** window.
   Currently connected instruments are shown in the **Instruments** list.

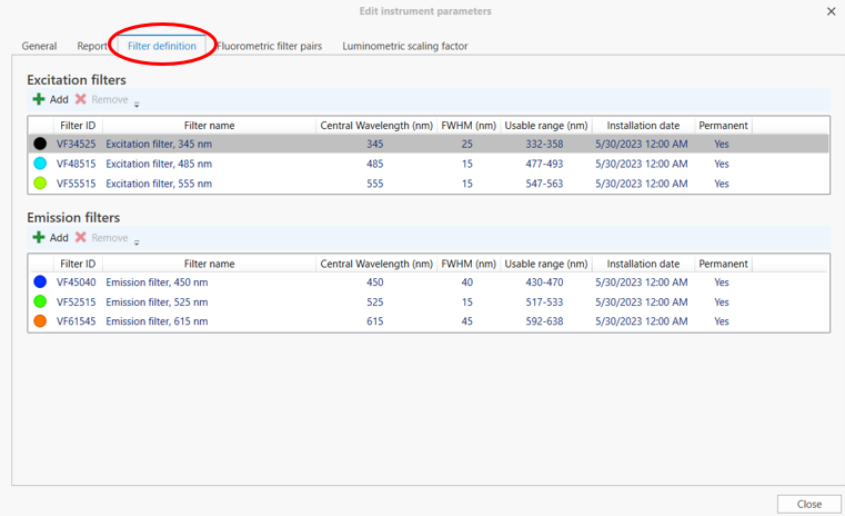


① **Instruments**
② **Instruments** list
③ **Settings**

4. Select **Settings** to open the **Edit instrument parameters** window.

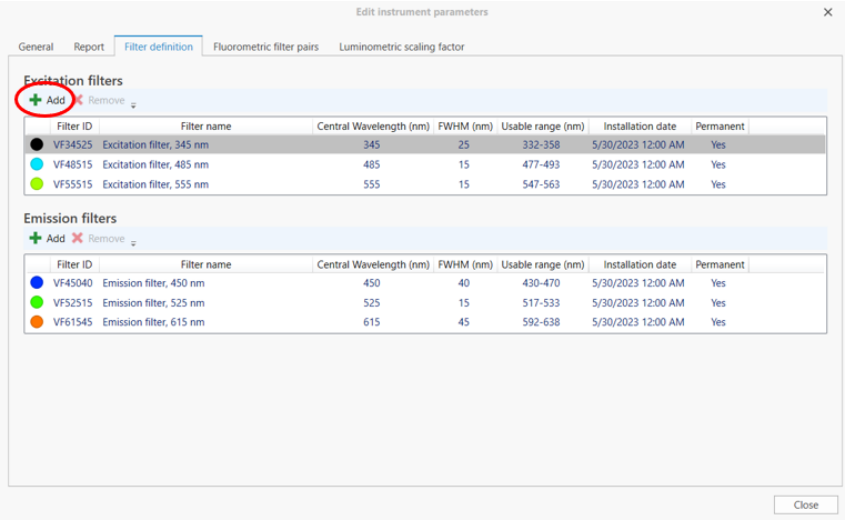


5. Select the **Filter definition** tab of **Edit instrument parameters** window to add accessory excitation (see page 26 and emission (see page 29) filters.

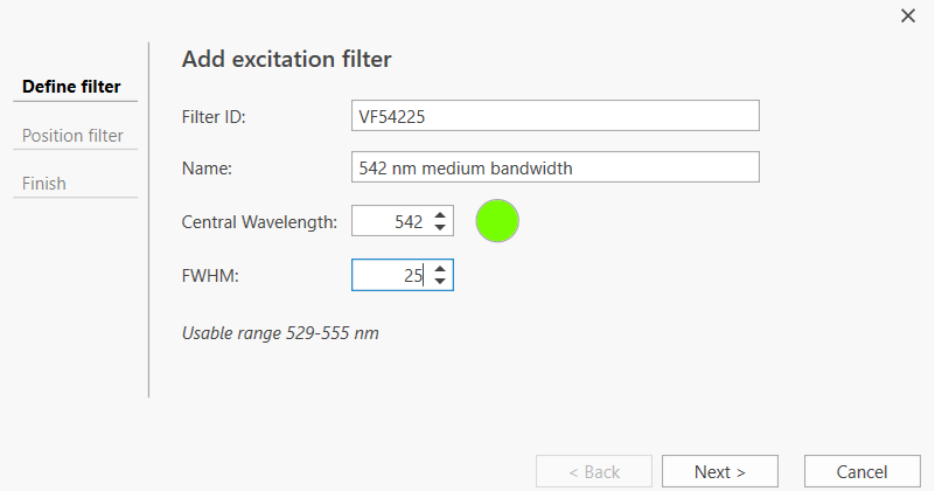


Add excitation filter

1. Select **Add** in the **Filter definition** tab to add an excitation filter.

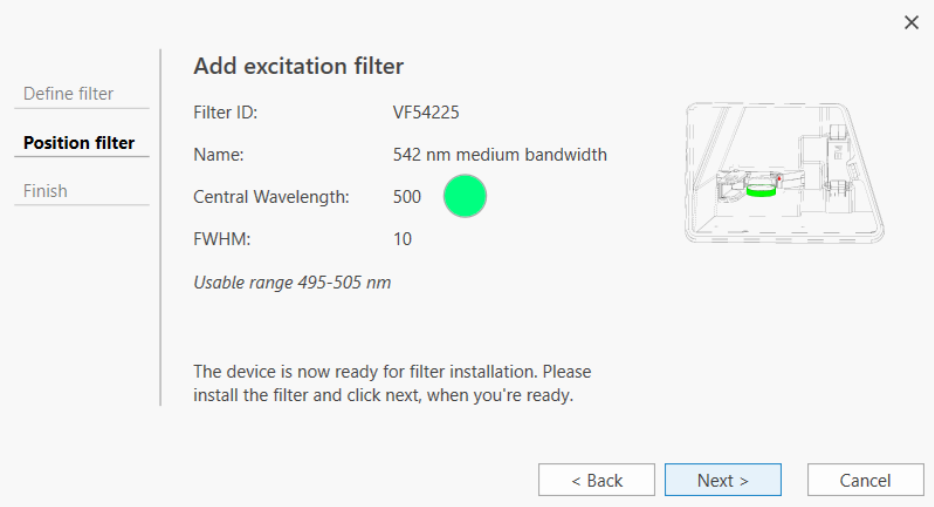


2. Input **Filter ID** (Cat. No. of filter), **Name**, **Central wavelength**, and **FWHM** (full width at half maximum) in the **Define filter** dialog box.



3. Select **Next** to view the **Position filter** dialog box.

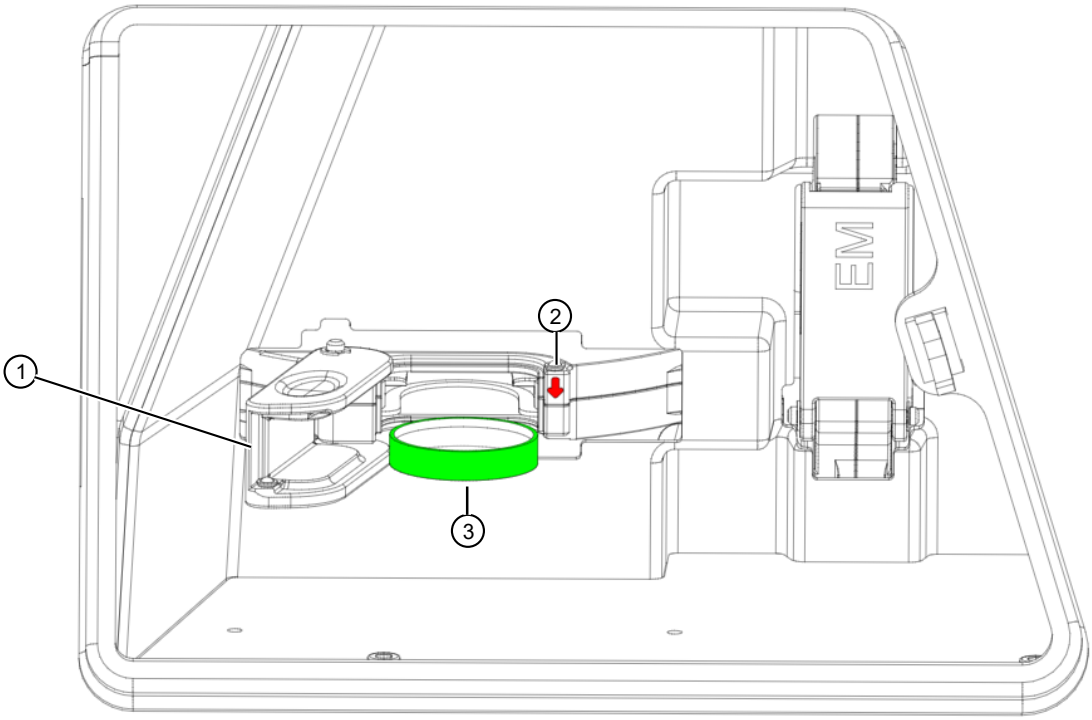
   The instrument will rotate the filter wheel so it is ready for filter installation.



4. Open the filter wheel chamber door on the left side of the instrument to access the excitation filter wheel, which is oriented in a horizontal position. Open the excitation filter wheel door (marked "EM") and insert the user defined filter.

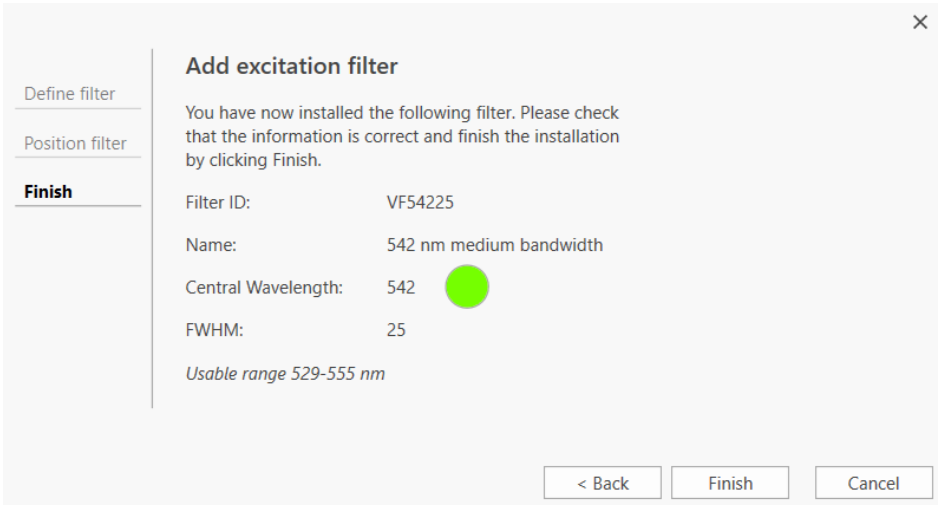
   The direction of the arrow on the filter needs to match the arrow indicating the direction of light propagation on the filter wheel.

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



① Excitation filter wheel door
② Arrow indicating direction of light propagation
③ Accessory filter

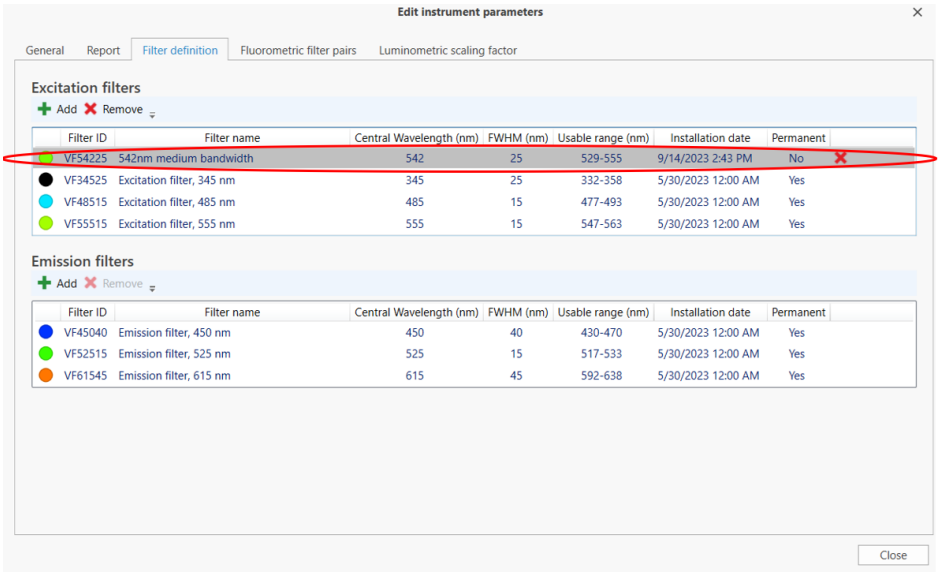
5. Close the excitation wheel door, then close the filter wheel chamber door. Select **Next** to view the **Finish** dialog box and confirm the filter parameters.



6. Select **Finish**.

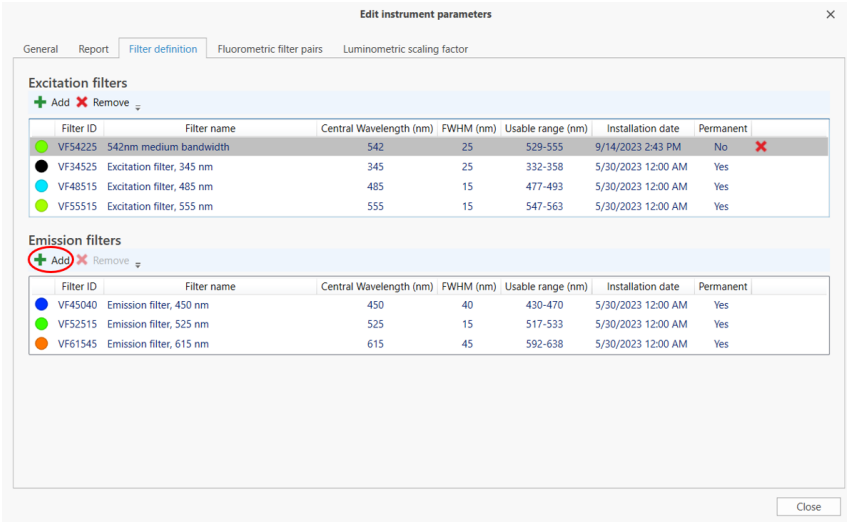
IMPORTANT! Do not forget to close the excitation filter wheel door and the filter wheel chamber door after inserting accessory filters.

The new filter is displayed in the **Excitation filters** list.

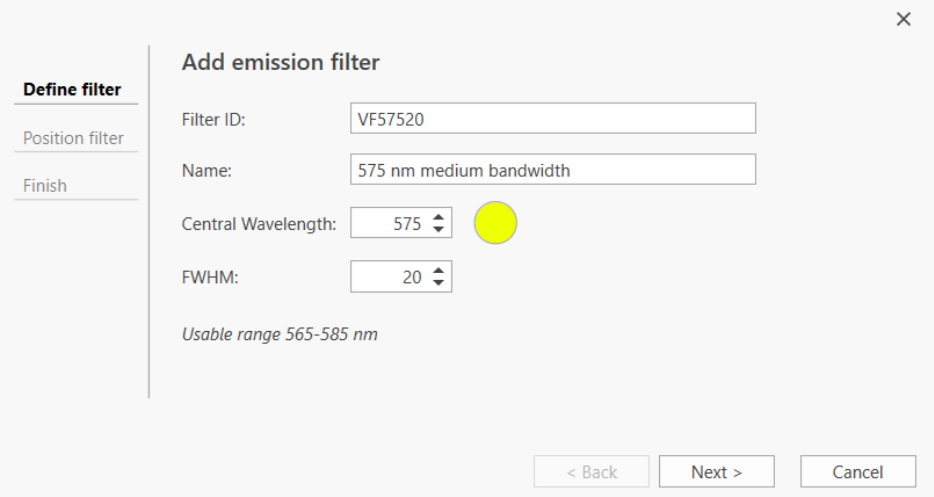


Add emission filter

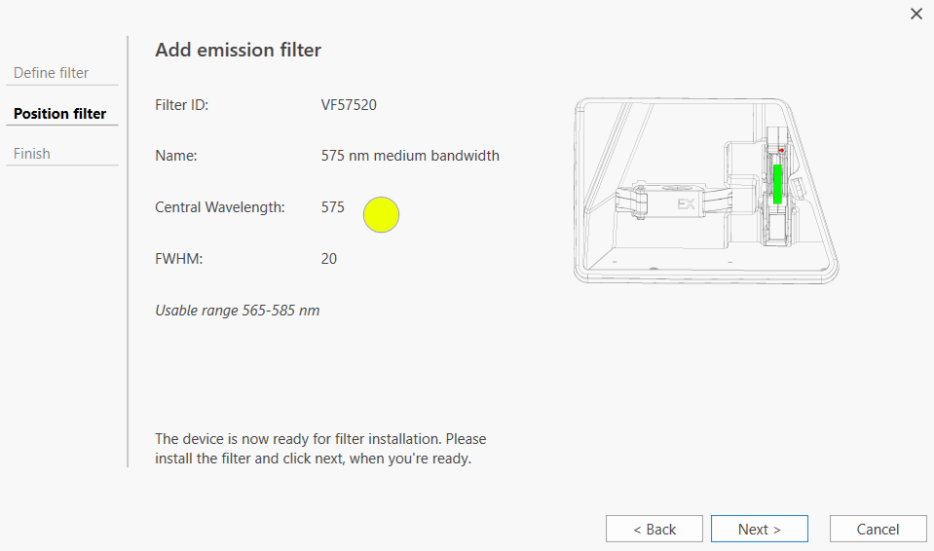
1. Select **Add** in the **Filter definition** tab to add an emission filter.



2. Input **Filter ID** (Cat. No. of filter), **Name**, **Central wavelength**, and **FWHM** (full width at half maximum) in the **Define filter** dialog box.



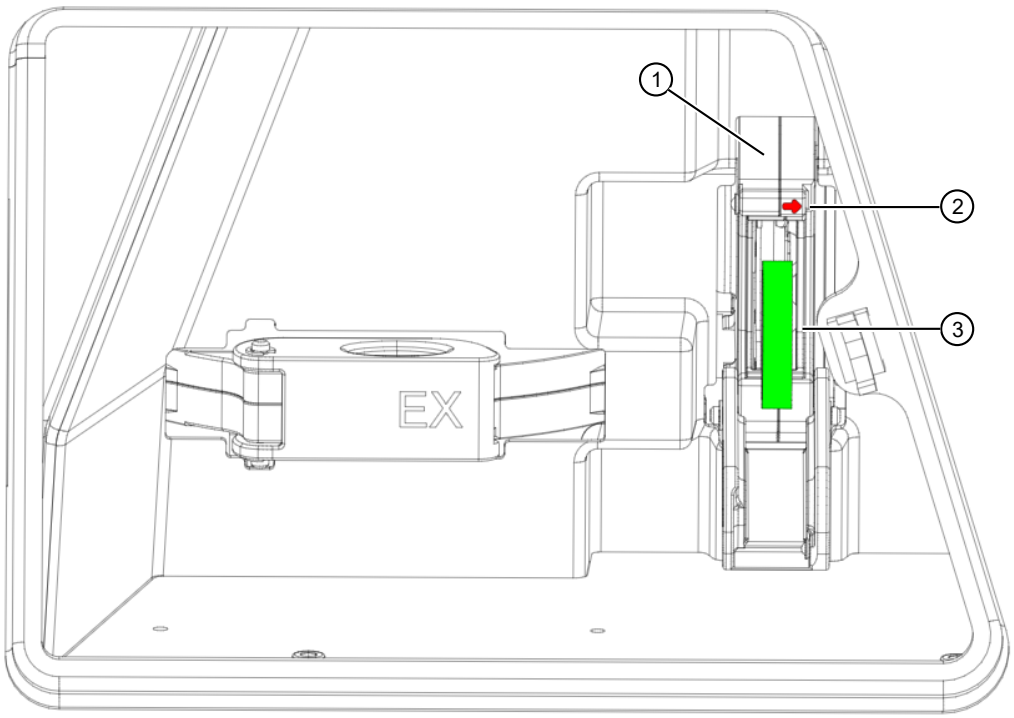
3. Select **Next** to view the **Position filter** dialog box.
The instrument will rotate the filter wheel so it is ready for filter installation.



4. Open the filter wheel chamber door on the left side of the instrument to access the emission filter wheel, which is oriented in a vertical position. Open the emission filter wheel door (marked "EX") and insert the user defined filter.

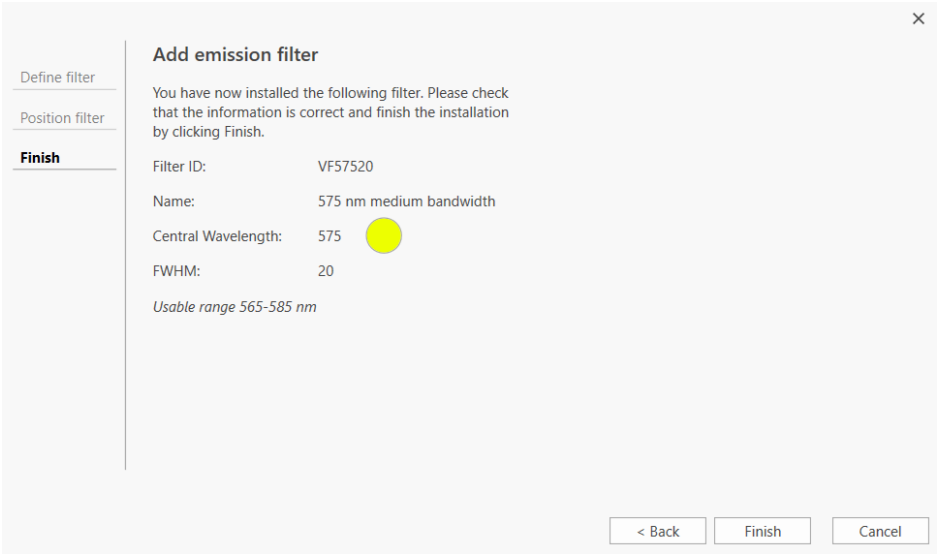
IMPORTANT! Do not expose the interior of the emission filter wheel to bright light when the filter wheel door is open.

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



① Emission filter wheel door
② Arrow indicating direction of light propagation
③ Accessory filter

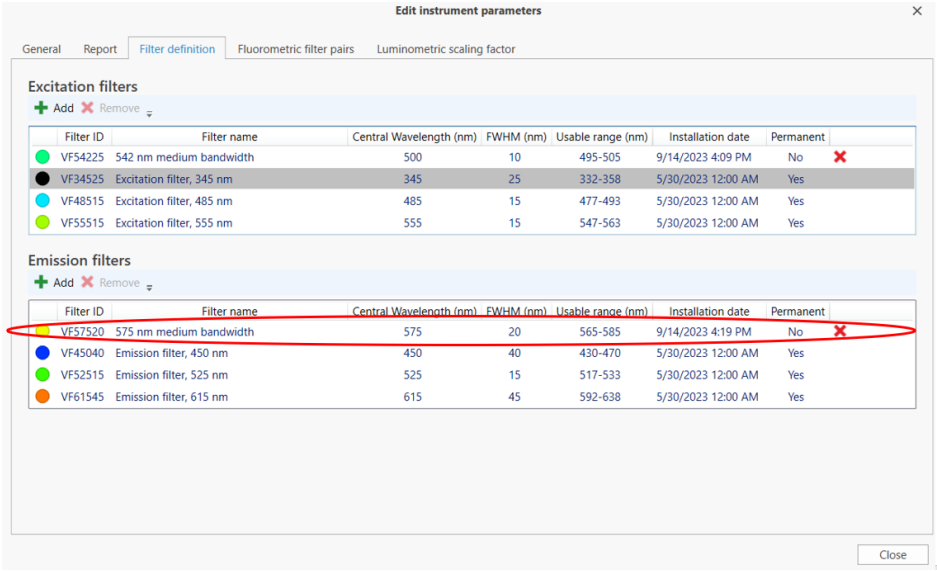
5. Close the emission wheel door, then close the filter wheel chamber door. Select **Next** to view the **Finish** dialog box and confirm the filter parameters.



6. Select **Finish**.

IMPORTANT! Do not forget to close the emission filter wheel door and the filter wheel chamber door after inserting accessory filters.

The new filter is displayed in the **Emission filters** list.



Perform an operational check

When the instrument is switched on, the instrument performs self-diagnostic tests and the LED bar indicator displays a blue light changing brightness slowly. When the plate carrier is extended out from the measurement chamber, and the LED bar indicator displays a steady blue light, the instrument is ready for use.

Note: Fluorometric filter pairs need to be defined in the SkanIt™ software, see the *SkanIt™ Software for Microplate Readers User Guide*.

3 Instrument operation

This chapter describes the instrument preparation steps you can take before you start a measurement.

After you have installed the instrument, switch it on and start the SkanIt™ software. The software finds the instrument automatically. If you have not installed the software, see “Install the SkanIt™ software” on page 22. Do not operate the instrument when it is disassembled.

Guidelines for instrument operation

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 instrument. 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! Connecting the instrument to SkanIt™ software automatically updates the instrument date and time according to the PC clock.

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

Switch on the instrument

IMPORTANT! Before you switch the instrument on, make sure that all the cables are properly fitted according to the installation instructions.

Switch the instrument on by pushing the power button on the front cover of the instrument.

Instrument startup

When the instrument is switched on, the instrument performs a series of self-diagnostics. It performs a set of initialization tests and adjustments. It also performs mechanical, electrical, and optical checks.

The LED bar indicator displays blue light changing brightness slowly during this check.

- Monochromator motor check
- Tray motors check
- Excitation motor check
- Emission motor check
- Auto crosstalk shield motor check
- Diffraction order filter motor check
- Tray position check
- Excitation and emission filters position check
- Light sources signal check
- Measurement channel dark signal check
- Measurement electronics check
- Temperature measurement electronics check
- Non-volatile memory check
- Reference detectors check

When the instrument self-diagnostics is completed, the peaking buzzer will prompt the results with beep sound.

- No error—Double short beep, the LED bar display blue light steady, the instrument is ready for use.
- Error—Triple long beep, the LED bar display amber blinking.

Although the instrument is immediately ready for operation after startup, complete stabilization of the electronics takes about one hour so for the best possible performance, the instrument should be allowed to stay on continuously for at least one hour.

If the instrument is to be left in an idle state for a long period of time, make sure that the plate carrier is kept inside the instrument.

To verify proper instrument operation, performing an empty run is recommended.

All error messages are stored in the internal memory log file. The error log file can be accessed with SkanIt™ software by selecting **Settings ▸ Instrument ▸ Edit instrument parameters ▸ Reports ▸ Instrument Error Log ▸ Run Report**. See page 52 for an explanation of error codes.

If anything fails in the initialization tests or adjustments, the LED bar turns to a blinking amber . Turn the power switch off, then on. If this does not help, contact Technical Support.

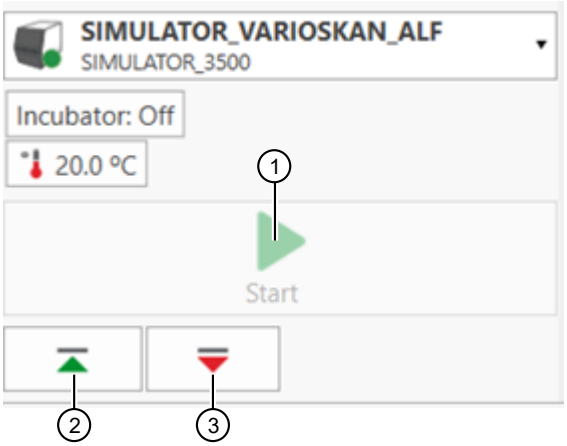
CAUTION! Do not switch the power off during startup or self-diagnostics.

Open or close the measurement chamber

Move the plate carrier in or out of the measurement chamber using the SkanIt™ software or directly from the instrument.

Move the plate carrier using the SkanIt™ software

Click the **Run plate in** or **Run plate out** icon below the **Start** button.



① **Start**
② **Run plate in**
③ **Run plate out**

Move the plate carrier using the instrument controls

Press the **Plate in/out** button on the right side of the instrument to move the plate carrier in or out of the measurement chamber.

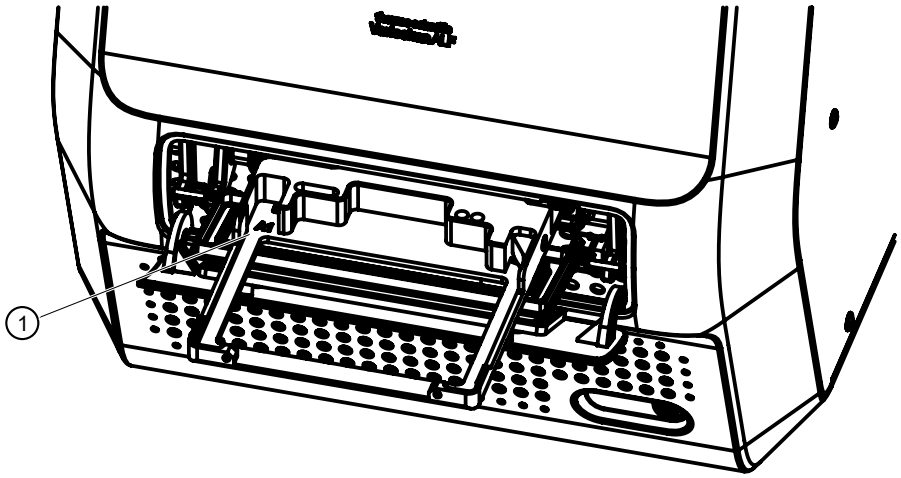
Load and measure a microplate

1. Load the microplate.
   a. If the plate carrier is inside the instrument, press the **Plate in/out** button to move the plate carrier out of the measurement chamber.
   b. Insert the microplate so that the A1 corner is positioned in the top left corner ① of the plate carrier.

IMPORTANT! Ensure that the plate type being loaded matches the plate template indicated in the SkanIt™ software.

An unsuitable microplate can become jammed in the instrument.

Note: When working in the UV range, use quartz or other UV-compatible microplates.



2. Select the desired measurement parameters to read the microplate.

   Note: If the desired measurement is already saved in the SkanIt™ software, you can open the measurement protocol.

3. Start the measurement protocol using the SkanIt™ software. See the *SkanIt™ Software for Microplate Readers User Guide* for more information.

Automatic runtime calibration

Runtime calibration is always automatically performed at the beginning of protocol execution. The instrument also performs calibrations during protocol execution if it does not interfere with 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.

Absorbance

The blank value for each selected wavelength is calibrated automatically. The typical calibration time is about one second when less than five wavelengths are used, but the calibration for a spectrum scan from 200 to 1000 nm with a 1 nm increment takes over 1.5 minutes. Recalibration is performed 30 minutes after the previous calibration depending on the measurement procedure.

Fluorescence

Recalibration is performed 7 minutes after the previous calibration depending on the measurement procedure. In fluorescence calibration a dark level measurement is also performed to compensate for possible electronic component and photomultiplier signal level drift.

Luminescence

Recalibration is performed 7 minutes after the previous calibration depending on the measurement procedure. In luminescence calibration a dark level measurement is also performed to compensate for possible electronic component and photomultiplier signal level drift.

Measurements

CAUTION! Do not open the measurement chamber door during measurement because this causes stray light to enter and aborts the measurement.

Absorbance and turbidity measurement

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

1. The plate carrier is retracted.
2. The measurement wavelength is selected by rotating the grating.
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 30 minutes.
4. The wells can be measured with fast mode and precision mode. One xenon lamp flash is taken for fast mode measurement and sixteen flashes for precision mode measurement. The precision result is the average of the sixteen measurements.

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.

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

Fluorescence measurement

In fluorescence intensity (FI) measurement, the following actions are carried out by the instrument:

1. The plate carrier is retracted.
2. In fluorescence intensity measurements, excitation and emission wavelengths are selected by rotating the excitation filter wheel and emission filter wheel.
3. In the signal level calibration procedure the instrument reads the internal reference signal in the blocked mode and 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 7 minutes.
4. The instrument uses the dynamic range setting the user has selected in the SkanIt™ software measurement session (see “Dynamic range selection” on page 39 for details).
   - Automatic range
   - Manual range

   The measured values are comparable regardless of the dynamic range selection, Automatic range, or any of the fixed manual ranges.
5. The wells are measured with a selected measurement time that can vary from 10 to 1000 ms in fluorescence intensity 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 number of flashes can be set to 1 to 100 flashes per measurement (10–1000ms) for fluorescence intensity measurements. It is recommended to measure using 100 ms measurement time in fluorescence intensity 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 10ms readings during the total measurement time.

Luminescence measurement

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

1. The plate carrier is retracted.
2. The emission filter wheel is rotated to the blocked position for PMT dark signal measurement.
3. In the signal level calibration procedure the instrument reads the internal 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 kinetic measurement procedures, calibration is performed in a suitable phase without disturbing the measurement timing. The default calibration interval is 7 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 emission filter wheel without placing any filters in the light way.
   The filter mode can use all the filters in emission filter wheel.

5. The instrument uses the dynamic range setting the user has selected in the SkanIt™ software measurement session (see “Dynamic range selection” on page 39 for details).
   - Automatic range
   - Manual range

   The measured values are comparable regardless of the dynamic range selection, Automatic range 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 10ms readings during the total measurement time.

Dynamic range selection

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

Automatic dynamic range selection

Automatic range (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.

Manual dynamic range selection

Select manual dynamic range according to the following principles:

- High range is intended for samples that are expected to produce high intensity signal when measured. It covers a wide dynamic range with somewhat lower sensitivity than with other dynamic ranges.
- Medium high range provides sensitivity and dynamics below High range.
- Medium range provides sensitivity and dynamics in between the Low and High ranges.
- Medium low range provides sensitivity and dynamics above Low range.
- Low range produces the highest sensitivity with a limited dynamic range.

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.

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.

- Use detergent in the well, if possible.
- Set on the settle delay in SkanIt™ software. The used settle delay time is automatically selected according to the plate format.

Table 5 Settle delay times by plate format

Speed name	Time [1]
6-well plates	600 ms
12-well plates	600 ms
24-well plates	400 ms
48-well plates	200 ms
96-well plates	100 ms
384-well plates	50 ms

[1] The settle delay is the amount of time allowed for the liquid surface to settle before the reading is carried out.

Instrument temperature

Instrument temperature is set using the SkanIt™ software (up to a maxiumum of 45°C).

The software shows both the current and target temperatures until the target temperature is reached.

When the incubator is on, the LED bar display flash very slowly. This state can be interrupted by other LED bar indicator states. But that doesn't mean the incubator has been turned off.

Note: The instrument has no cooling system.

Switch off the instrument

Switch the instrument off after daily operation.

1. Move the plate carrier into the measurement chamber using the SkanIt™ software, or the **Plate in/out** button on the instrument.
2. Use the **on/off** switch on the front panel of the instrument to switch the instrument off.

4 Maintenance

Regular and preventive maintenance

Follow normal laboratory safety procedures with regard to biohazardous, infectious, radiologic or toxic materials when maintaining the instrument.

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

Guidelines for maintaining the instrument

- Decontaminate the instrument before removing from the laboratory and before servicing.
- Follow the preventative maintenance instructions to keep the instrument in the best condition, see “Maintenance checklist” on page 41.
- Do not use the instrument if it does not function properly.
- Do not spill fluids in or on the equipment.
- Take the chemical resistance of the microplates into account.
- Make sure the microplate is not too full.
- Keep the underside of the microplates dry to avoid contamination.

Maintenance checklist

Maintenance	Daily	Weekly	Yearly	If required
Ensure proper shutdown. [1]	–	–	–	✓
Keep the instrument free of dust.	✓	–	–	–
Wipe away spilled saline solutions, solvents, acids or alkaline solutions from outer surfaces immediately to prevent damage, and wipe with deionized distilled water.	✓	–	–	–
If any surfaces have been contaminated with biohazardous material, disinfect with a mild sterilizing solution. [2]	✓	–	–	–
Clean the case of the instrument.	–	✓	–	–
Clean the plate carrier.	–	✓	–	–
Perform verification with Themo Scientific Multifunctional Verification plate or Thermo Scientific Lumiwell plate.	–	–	✓	–

(continued)

Maintenance	Daily	Weekly	Yearly	If required
Decontaminate the instrument when relocating the instrument or sending it for service. [2]	–	–	–	✓
Service the instrument regularly.	–	–	✓	–

[1] To save energy, it is recommended to shut down the instrument for the weekends.

[2] For detailed decontamination instructions, see "Decontamination procedure" on page 45.

Firmware updates

Use the firmware loader in the SkanIt™ software to update the firmware of the instrument. For instructions, see the *SkanIt™ Software for Microplate Readers User Guide*.

Instrument care

WARNING! If any surfaces have been contaminated with biohazardous material, use a mild sterilizing solution.

CAUTION! Do not use acetone as it damages the covers.

CAUTION! Do not autoclave any part of this instrument.

Ensure that the electricity supply in the laboratory conforms to that specified on the type label of the instrument.

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

- Prevent any liquid from entering the instrument.
- Keep the instrument free of dust and other foreign matter.
- Clean the touch screen display with a mild laboratory detergent.
- Clean the plastic covers and surfaces with a mild laboratory detergent or alcohol.

Abrasive cleaning agents are not recommended, because they are likely to damage the paint finish. It is recommended that you clean the case of the instrument periodically to maintain its good appearance. For more information, see "Clean the instrument" on page 43.

In the event of any damage, contact your local Thermo Fisher Scientific representative for service.

Guidelines for cleaning the instrument

CAUTION! Wear disposable gloves when cleaning this instrument.

CAUTION! Immediately wipe away spilled saline solutions, solvents, acids or alkaline solutions from outer surfaces to prevent damage and wipe with deionized distilled water.

CAUTION! Painted surfaces can be cleaned with most laboratory detergents. Dilute the cleaning agent as recommended by the manufacture.

CAUTION! Do not use any solutions containing oxidative chemicals, such as hypochlorite and peroxides or strong bases, on any of the anodized aluminum surfaces (plate carrier), as this can cause permanent damage to the finish.

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

CAUTION! Keep the instrument plate carrier clean to avoid dust and dirt from entering the measurement chamber. Clean the plate carrier surface 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 or strong alkaline.

Clean the instrument

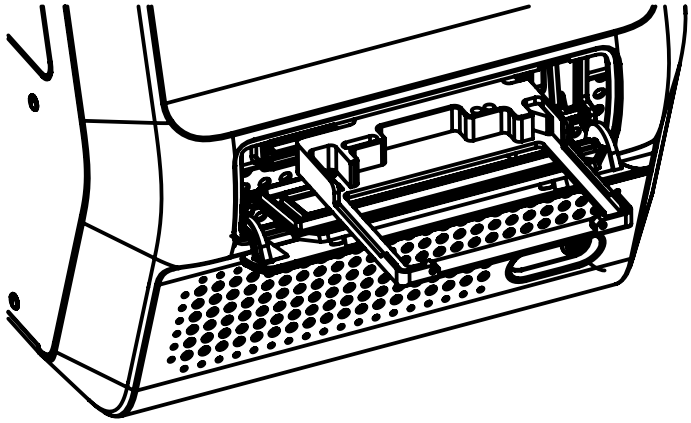
The following procedure describes the process for regular cleaning of the instrument exterior. If infectious agents have been spilled on the instrument, decontaminate the instrument (see “Decontamination procedure” on page 45).

1. Switch the instrument off.
2. Unplug the instrument.
3. Clean the outside of the instrument with a soft cloth dampened with water or mild detergent.

Clean the plate carrier

If infectious agents have been spilled on the instrument, decontaminate the instrument (see “Decontamination procedure” on page 45).

1. Move the plate carrier out of the measurement chamber using the **Run plate out** icon from the SkanIt™ software, or press the **Plate in/out** button on the instrument.
2. Switch the instrument off.
3. Unplug the instrument.
4. Open the measurement chamber door by pushing it from the bottom edge and pulling it from the top edge.
5. Pull the plate carrier fully out of the instrument.



Note: When switching the instrument off with the plate carrier extended, the instrument will automatically pull in the plate carrier to the position next to the chamber door. This is proper operation for plate carrier cleaning and transportation lock installation. When switching the instrument off while the carrier is inside the chamber, the plate carrier may not be manually accessible.

6. Clean the plate carrier with a soft cloth dampened with water or mild detergent.

Disposal information

If the instrument 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.

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

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

Guidelines for instrument disposal

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

- Decontaminate the instrument.
- 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 “Operating conditions” on page 65).
  - Method of disposal: Electronic waste, contaminated waste, (infectious waste)
- Recycle the original packaging and packing materials with the appropriate facilities.

Guidelines for instrument disposal

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

WARNING! The samples can be infectious. Dispose of all used disposable plastic microplates and disposable gloves, and so on as biohazardous waste. Be cautious and always use gloves.

Decontamination procedure

WARNING! Only authorized and trained personnel should perform the decontamination procedure in a well-ventilated room wearing disposable gloves, protective glasses, and protective clothing.

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

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

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

The decontamination procedure is required prior to shipping the instrument to Thermo Fisher Scientific, for example, for repair.

If the instrument is shipped back to Thermo Fisher Scientific, it must be accompanied by two dated and signed Certificates of Decontamination (see page 70).

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

It is strongly recommend that the complete decontamination procedure is performed before relocating the instrument from one laboratory to another.

Examples of disinfectants that can be used include:

- Formaldehyde solution 10%
- Pure ethanol 70% (in distilled water)
- Virkon solution 1–3%
- Activated glutaraldehyde solution 4%

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

Decontaminate the instrument

1. Prepare the decontaminant: 200 mL 10% formaldehyde solution or 200 mL 4% activated glutaraldehyde solution (or other acceptable decontamination agent).
2. Empty the plate carrier.
3. Switch the instrument off and disconnect the mains power supply cable.
4. Disinfect the outside of the instrument using a cloth dampened with 70% pure ethanol in distilled water.
5. Place the instrument in a large plastic bag. Ensure the measurement chamber door is open and the plate carrier is out.
6. Place a cloth soaked in the prepared solution into the bag.
7. Ensure that the cloth does not touch the instrument.
8. Close the bag firmly and leave the instrument in the bag for at least 24 hours.
9. After at least 24 hours, remove the instrument from the bag.
10. Clean the instrument using a mild detergent.
11. Enclose a signed and dated Certificate of Decontamination both inside the transport package and attached to the outside of the package.

Ship the instrument for service

Before shipping the instrument for service, the transport lock must refitted and the instrument appropriately packed.

These instructions also apply if the instrument needs to be relocated.

Prepare the instrument for transport

1. Remove any microplates from the instrument.
2. Remove the mains supply power cable.

3. Decontaminate the instrument.
4. Refit the transport lock. For instructions, see “Refit the transport lock” on page 49.
5. Pack the instrument, see “Pack the instrument” on page 47.

   Use the original packaging to ensure that no damage will occur to the instrument during shipping. Any damage incurs additional labor charges.

   If the original packaging is not available:

   - Place the instrument in a plastic bag (if possible) to prevent loose packing material entering the instrument.
   - Make sure that the instrument is completely suspended in packing material so that there is 100 mm between the box wall and the instrument.
   - Wrap any loose parts and place them in the spare space around the instrument.
6. Inform about the use of hazardous materials.
7. Enclose a dated and signed Certificate of Decontamination (see page 70) both inside and attached to the outside of the box in which you return your instrument or other items.

   If the decontamination form is missing or not completed, Thermo Fisher Scientific holds the process of treating your instrument until full information is provided.
8. Indicate the fault after you have been in touch with your local Thermo Fisher Scientific representative or the Thermo Fisher Scientific technical service department.
9. Enclose the returned goods authorization number (RGA) given by the Thermo Fisher Scientific representative.

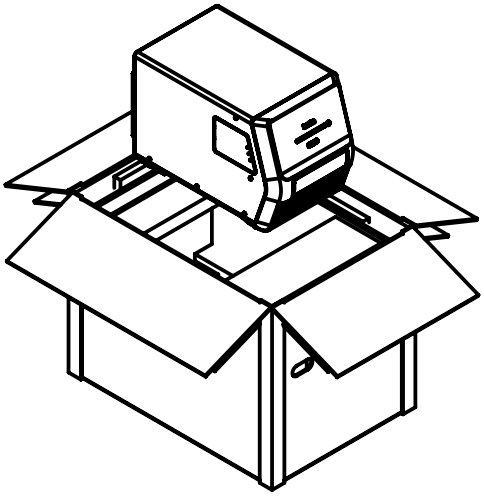
   Keep a note of the RGA number and quote it in any further correspondence with Thermo Fisher Scientific.
10. Seal the box and ship it to the address on the label, and notify the depot of the shipping date, carrier and any tracking number so that Thermo Fisher Scientific can trace your instrument.

    For details on storage and transportation temperatures, see “Instrument specifications” on page 57.

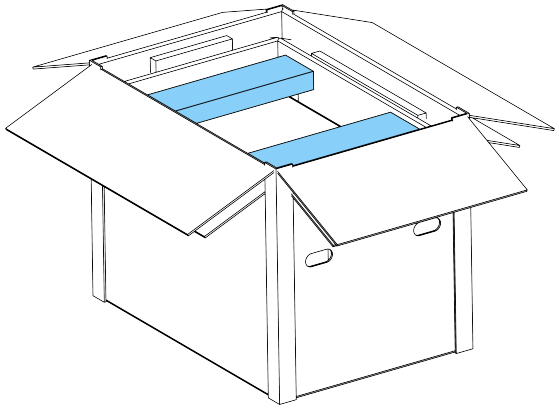
Pack the instrument

1. Place the instrument in a plastic bag to prevent loose packing material entering the instrument.
2. Open the carton and put foam pieces at the bottom of the carton.

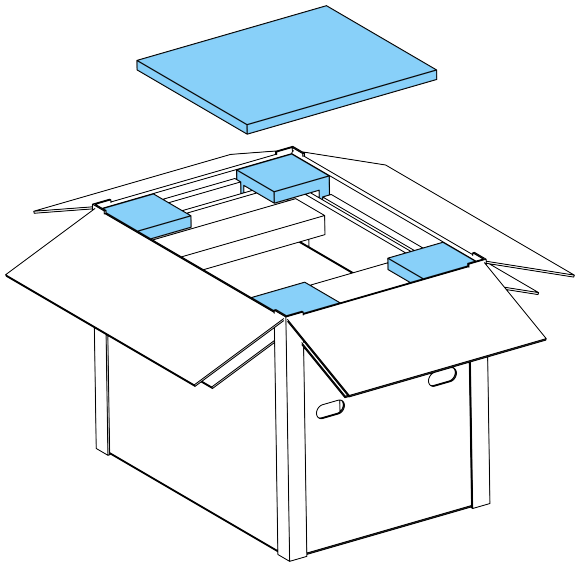
3. Put the instrument into the carton.



4. Put foam pieces around the instrument.



5. Put foam pieces at the corners of the carton, then cover the top with foam piece.

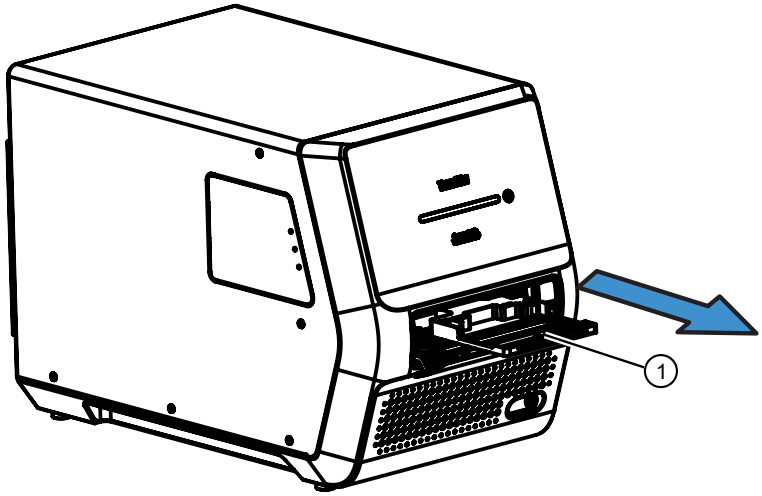


6. Close the carton.

Refit the transport lock

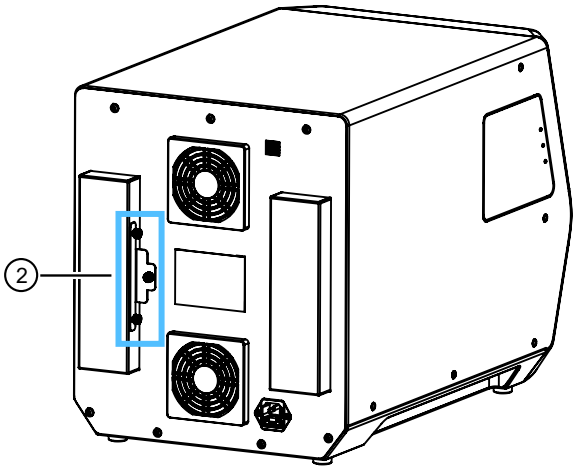
1. Move the plate carrier out of the measurement chamber using the **Run plate out** icon from the SkanIt™ software, or press the **Plate in/out** button on the instrument.
2. Switch the instrument off using the power button.
3. Unplug the instrument.
4. Disconnect the USB communication cable and any other connected devices.
5. Open the measurement chamber door by pushing it from the bottom edge and pulling it from the top edge.

6. Pull the plate carrier ① fully out of the instrument.

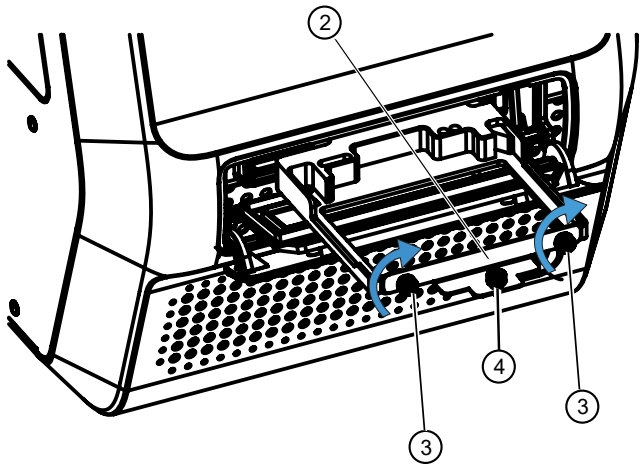


Note: When switching the instrument off with the plate carrier extended, the instrument will automatically pull in the plate carrier to the position next to the chamber door. This is proper operation for plate carrier cleaning and transportation lock installation. When switching the instrument off while the carrier is inside the chamber, the plate carrier may not be manually accessible.

7. Take the transport lock ② from the back of the instrument.

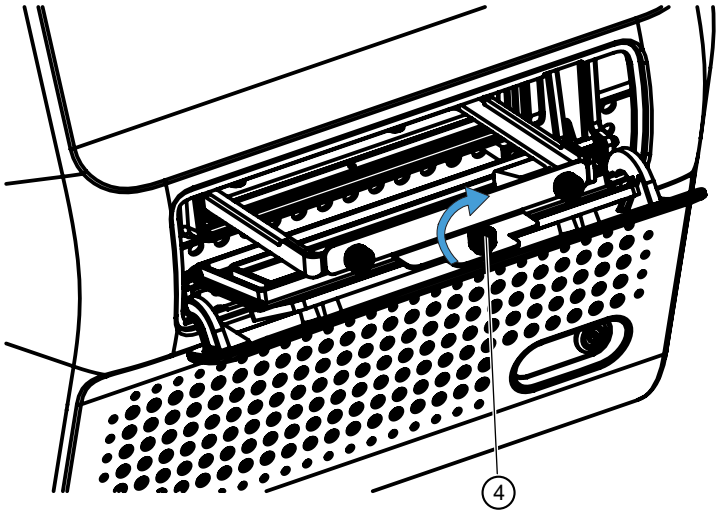


8. Put the transport lock ② into the slot on the plate carrier. Fasten the two fixing screws ③ and put the transport lock bar ④ on the transport lock.



9. Push the plate carrier to locked position.

10. Tighten the transport lock bar ④ clockwise into locked position.



11. Close the measurement chamber door and make sure that the end of the transport lock bar enters the corresponding recess in the door, and that the warning tag hangs out of the instrument.

A Troubleshooting

Abnormal situations

CAUTION! Do not use the instrument if it appears to malfunction.

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

- Switch off the instrument by pushing the power button.
- Unplug the instrument immediately from the power supply.
- Carry out the appropriate corrective measures.

  Note: Do not disassemble the instrument.

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

Error 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 and warning codes that may appear in SkanIt™ software are presented below.

Code	Explanation	Action
0	—	—
1	Internal firmware error.	Contact service.
2	The instrument did not recognize the command it received.	Contact the PC software vendor.
3	The arguments of the received command are not valid.	Contact the PC software vendor.
4	The XY table X position is incorrect.	Contact service.
5	The XY table Y position is incorrect.	Contact service.
6	Grating position is incorrect.	Contact service.
7	Absorbance measurement detector signal error.	Contact service.
8	Absorbance reference detector signal error.	Contact service.
9	Absorbance optics signal error.	Contact service.

(continued)

Code	Explanation	Action
10	Diffraction order filter position is incorrect.	Contact service.
11	Excitation filter motor position is incorrect.	Contact service.
12	Emission filter motor position is incorrect.	Contact service.
13	PMT signal error.	Contact service.
14	Fluorometric reference detector error.	Contact service.
15	Fluorometric optics signal error.	Contact service.
16	Grating motor position is incorrect.	Contact service.
17	The distance between measure points is too short for plate scanning measurement.	Use normal measurement instead of scan. Do not try to measure all the points with a single scan, but use interleaving scans.
18	The sampling time for a single result is too long for plate scanning measurement.	Use normal measurement instead of scan. Use shorter sampling time.
19	The requested plate position is outside the limits of the XY table.	Contact service.
20	The offset voltage of the temperature measurement electronics is too high.	Contact service.
22	The background noise of the AD converter is too high.	Contact service.
23	AD converter communication error.	Contact service.
24	Plate position error.	Contact service.
25	Analog signal outside measuring range.	Contact service.
27	The serial number has already been set.	Do not try to set the serial number.
28	Filter pair setting error.	Contact service.
30	Nonvolatile parameters lost.	Contact service.
31	Incomplete factory calibration.	Contact service.
32	The requested measure method is not available.	Do not try to use measure methods not supported by the instrument.
41	LED calibration failed.	Contact service.
42	Flash lamp calibration failed.	Contact service.
43	PMT drift compensation calibration failed.	Contact service.
44	PMT gain calibration failed.	Contact service.
45	XY table position calibration failed.	Contact service.

(continued)

Code	Explanation	Action
46	No factory calibration for the current measure method.	Contact service.
50	PMT background level too high during autocalibration.	Clean off any possible liquid spills inside the measuring compartment. Contact service if the error persists.
51	Diffraction filter home tolerance error.	Contact service.
52	FCA command did not find the 0 nm spectrum peak.	Contact service.
53	FCA command did not find the 882 nm spectrum peak.	Contact service.
54	The grating constant calculated by FCA command is too far from the nominal value.	Contact service.
55	Grating home sensor is too far from grating 0 nm position.	Contact service.
56	Measurement electronics error.	Contact service.
57	FCA command did not find the 261 nm spectrum peak.	Contact service.
58	The grating calibration file is lost.	Contact service.
59	The PMT calibration file is lost.	Contact service.
60	The plate calibration file is lost.	Contact service.
61	The power calibration file is lost.	Contact service.
62	The emission factor calibration file is lost.	Contact service.
63	The PGA calibration file is lost.	Contact service.
64	The excitation and emission calibration file is lost.	Contact service.
65	The signal calibration file is lost.	Contact service.
68	The PMT drift compensation factor is too far from the nominal value.	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 of the AD converter is too high.	Contact service.
78	PMT linearity calibration failed.	Contact service.

(continued)

Code	Explanation	Action
81	Instrument self-diagnostics error prevents execution of the protocol.	The measure chamber door must be closed during startup. If the door is closed and error persists, contact service.
83	Automatic crosstalk shield error.	Contact service.
86	The command cannot be executed for the current plate type.	Use a suitable plate type.
103	Unable to comply with the defined kinetic interval.	Lengthen kinetic interval.
105	The timer referenced in the WAI timer command is not running (anymore). Your timing requirement is not met.	Make sure you started the timer with long enough wait time.
106	The lamp lifespan has reached expiration.	Arrange for the replacement of the lamp as soon as possible.
107	Calibration validity has expired.	The accuracy of the measure results may have suffered. The action depends on the calibration options your PC software 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 informs that a command has been used which has no effect for the current measure method.
110	Dark level interpolation for luminometric 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 1536 results are measured between the dark level measure points.
111	Excitation filter position is incorrect.	Contact service.
112	Emission filter position is incorrect.	Contact service.
113	Excitation filter background signal is incorrect.	Contact service.
114	Emission filter background signal is incorrect.	Contact service.
115	Incubator temperature sensor error.	Temperature sensor is not connected or broken.

(continued)

Code	Explanation	Action
116	Incubator cannot reach the requested temperature.	This warning is generated if the temperature cannot reach the target temperature, or if the environment temperature is too low.
117	Incubator heating element error.	Contact service.

B

Specifications

Instrument specifications

Parameter	Description
Overall dimensions	343 mm (width) × 610 mm (depth) × 402mm (height)
Weight	24.5 kg
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
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	Maximum 305 W; Typical operation (without heating) <85 W
User interface	The instrument is operated through PC software control
Connection	USB type A for PC USB type B for instrument Speed: 12/Mbps (USB 2.0 with full speed)
Measurement type	Absorbance, fluorometry, luminometry, turbidimetry
Incubator	Incubator included (heating)
Shaker	Linear, orbital, double orbital
Plate type	6-well, 12-well, 24-well, 48-well, 96-well, and 384-well microplates µDrop™ and µDrop™ Duo plates
Plate size [1]	Photometry and fluorometry: 128.5 mm (width) × 86.0 mm (depth) × 23.5 mm (height) Luminometry: 128.5 mm (width) × 86.0 mm (depth) × 15.5 mm (height)

[1] Maximum dimension including lid height

Performance specifications

Table 6 Performance specifications

Performance specifications	
Photometry	
Light source	Xenon flash lamp
Wavelength selection	Monochromator
Wavelength range	200–1000 nm
Bandwidth	2.5 nm
Wavelength setting resolution	1 nm
Wavelength accuracy	±2 nm
Stray light at 230 nm	<0.05%
Linearity (absorbance) at 450 nm	±2.0% (0–2.5 Abs), 96-welll plate
Accuracy (absorbance) at 450 nm	±(1.0% + 0.003 Abs) (0–2 Abs), 96-welll plate ±2.0% (2.0–2.5 Abs), 96-welll plate
Precision (absorbance) at 450 nm	SD <0.003 Abs or CV <1.0% (whichever is greater)
DNA sensitivity at 260 nm (50 µL) [1]	<1 ng/µL, 96-half area plate
Turbidimetric sensitivity [1]	<5 FTU (formazine turbidimetric units), 96-welll plate
Measurement speed [2]	96-well microplates • Fast mode: ≤10 seconds • Precision mode: ≤26 seconds
Spectral scanning speed	• Fast mode: ≤16 seconds (from 200–1000 nm in 1 nm steps) • Precision mode: ≤200 seconds (from 200–1000 nm in 1 nm steps)
Fluorometry	
Dynamic range	≥6 decades
Sensitivity [1]	0.35 fmol/well fluorescein, black 384-well plate
Wavelength	Excitation wavelength: 200–710 nm Emission wavelength: 210–720 nm
Wavelength selection	Filter wheel with three factory filter pairs and five optional filter positions

Table 6 Performance specifications *(continued)*

Performance specifications	
Factory filter pairs	Coumarin family filter pair • Ex 345 nm/25 nm • Em 450 nm/40 nm
	Fluorescein family filter pair • Ex 485 nm/15 nm • Em 525 nm/15 nm
	Resorufin family filter pair • Ex 555 nm/15 nm • Em 615 nm/45 nm
Dual label measurements speed	<1 second
Measurement speed (fixed dynamic range) [2]	≤20 seconds, 96-well microplate
Measurement time	10–1000 ms
Luminometry	
Wavelength selection	Filter wheel with no filter and five optional filter positions
Wavelength range	200–720 nm
Dynamic range	>6 decades
Sensitivity [1]	<275 amol/well ATP, white 96-well plate
Crosstalk	≤0.1%, white 96-well plate
Measurement speed (fixed dynamic range) [2]	≤20 seconds, 96-well microplate
Measurement time	10 ms to 10 seconds
Incubator	
Temperature range	From ambient +2°C to 45°C (room temperature 25°C)
Liquid warm-up time	<60 minutes from 25°C to 37°C, 96-well microplate, 200 µL water/well
Mean temperature of wells at 37°C	±0.5°C
Plate temperature uniformity at 37°C	<1.0°C
Shaker	
Shaking modes	Linear, orbital, dual orbital

Table 6 Performance specifications *(continued)*

Performance specifications	
Shaking speed	Low, medium, high
Shaking type	Continuous or pulsed

[1] Sensitivity specification values represent the median of observed factory tested values.

[2] Minimum kinetic interval time from A1 back to A1.

C

Ordering information

Accessory products

Product	Cat. No.
Verification plates	
Multifunctional Verification Plate	N03394M2
Lumiwell Verification Plate	2806460
Software	
SkanIt™ Software for Microplate Readers, Drug Discovery Edition	5187149
Filters	
Go to **thermofisher.com** to check for availability of accessory filters.	

D

Safety

WARNING! GENERAL SAFETY. Using this product in a manner not specified in the user documentation may result in personal injury or damage to the instrument or device. Ensure that anyone using this product has received instructions in general safety practices for laboratories and the safety information provided in this document.

- Before using an instrument or device, read and understand the safety information provided in the user documentation provided by the manufacturer of the instrument or device.
- Before handling chemicals, read and understand all applicable Safety Data Sheets (SDSs) and use appropriate personal protective equipment (gloves, gowns, eye protection, and so on). To obtain SDSs, visit **thermofisher.com/support**.

Symbols on the instrument

Symbols may be found on the instrument to warn against potential hazards or convey important safety information. In this document, the hazard symbol is used along with one of the following user attention words:

- **CAUTION!** – Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
- **WARNING!** – Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.
- **DANGER!** – Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

Symbol	English
	Refer to User Guide for details.
	Environmental protection symbol of the China RoHS directive. The "e" in the symbol indicates the product does not have any hazardous substances in excess of the concentration limits.
	The CE mark symbolizes that the product conforms to all applicable European Community provisions for which this marking is required. Operation of the instrument is subject to the conditions described in this manual. The protection provided by the device may be impaired if the instrument is used in a manner not specified by the manufacturer.

(continued)

Symbol	English
UK CA	The UKCA mark symbolizes that the product conforms to all applicable provisions in Great Briitain (England, Wales, and Scotland) for which this marking is required. Operation of the instrument is subject to the conditions described in this manual. The protection provided by the device may be impaired if the instrument is used in a manner not specified by the manufacturer.
	Regulatory Compliance Mark indicates conformity with Australian standards for electromagnetic compatibility.
TÜV SÜD C US	This product conforms to UL 61010-1, CAN/CSA C22.2 No.61010-1 “Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part I: General Requirements.” Instruments bearing the TUV symbol are certified by TUV Product Services to be in conformance with the applicable safety standard for the US and Canada.
	Caution, risk of danger Consult the manual for further safety information.
	WARNING Risk of electric shock.
	WARNING Biohazard risk.
	Protective conductor terminal (main ground)
	Do not dispose of this product in unsorted municipal waste **CAUTION!** To minimize negative environmental impact from disposal of electronic waste, do not dispose of electronic waste in unsorted municipal waste. Follow local municipal waste ordinances for proper disposal provision and contact customer service for information about responsible disposal options.

Instrument safety

General instrument safety

- The instrument is for laboratory research use only.
- Observe proper laboratory safety precautions; wear protective clothing and follow approved laboratory safety procedures.
- Follow Good Laboratory Practice (GLP) to guarantee reliable analyses.
- Follow the preventative maintenance instructions to keep the instrument in the best condition, see “Maintenance checklist” on page 41.
- Observe all safety symbols and markings on the instrument.
- Do not open any covers except the filter wheel chamber door or measurement chamber door when the instrument is plugged in a power source.
- Do not open the measurement chamber door manually when the instrument is in operation.
- Do not push the plate carrier in manually unless the instrument is switched off.
- Do not force a microplate into the instrument.

WARNING! Only authorized technical service personnel are allowed to open the instrument. Disconnect the instrument from all voltage sources by disconnecting the power supply cable before opening it.

WARNING! Do not touch switches or electrical outlets with wet hands. Switch the instrument off before disconnecting it from the mains supply.

WARNING! The electromagnetic environment should be evaluated prior to operation of the device. Do not use this device in close proximity to sources of strong electromagnetic radiation (e.g. unshielded intentional RF sources), as these can interfere with the proper operation.

WARNING! Do not attempt to operate the instrument with the transport lock in place.

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

CAUTION! Leave the instrument to sit for at least three hours before installing and switching it on to prevent condensation causing a short circuit.

Operating conditions

The safety specifications are also met under the following environmental conditions in addition to or in excess of those stated in the operating conditions:

Parameter	Description
Altitude	Up to 2,000 m
Humidity	Maximum relative humidity 80% for temperatures up to 31°C decreasing linearly to 50% relative humidity at 40°C
Temperature	+5°C to +40°C
Mains supply fluctuations	±10% from nominal
Installation category (Overvoltage category)	II (IEC 60664-1) [1]
Pollution degree	2 (IEC 60664-1) [2]

[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.

[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.

Electrical safety

WARNING! Ensure appropriate electrical supply. For safe operation of the instrument:

- Plug the system into a properly grounded receptacle with adequate current capacity.
- Ensure the electrical supply is of suitable voltage.
- Never operate the instrument with the ground disconnected. Grounding continuity is required for safe operation of the instrument.

WARNING! Power Supply Line Cords. Use properly configured and approved line cords for the power supply in your facility. If the line cord is damaged, contact Technical Support.

WARNING! Disconnecting Power. To fully disconnect power either detach or unplug the power cord, positioning the instrument such that the power cord is accessible.

Cleaning and decontamination

CAUTION! Cleaning and Decontamination. Use only the cleaning and decontamination methods that are specified in the manufacturer user documentation. It is the responsibility of the operator (or other responsible person) to ensure that the following requirements are met:

- No decontamination or cleaning agents are used that can react with parts of the equipment or with material that is contained in the equipment. Use of such agents could cause a HAZARD condition.
- The instrument is properly decontaminated a) if hazardous material is spilled onto or into the equipment, and/or b) before the instrument is serviced at your facility or is sent for repair, maintenance, trade-in, disposal, or termination of a loan. Request decontamination forms from customer service.
- Before using any cleaning or decontamination methods (except methods that are recommended by the manufacturer), confirm with the manufacturer that the proposed method will not damage the equipment.

Safety and electromagnetic compatibility (EMC) standards

The instrument design and manufacture complies with the following standards and requirements for safety and electromagnetic compatibility.

Safety

Reference	Description
CE-LVD (2014/35/EU)	European Union “Low Voltage Directive”
IEC 61010-1 GB 4793.1 EN 61010-1	*Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*
IEC 61010-2-010 GB 4793.6 EN 61010-2-010	*Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-010: Particular requirements for laboratory equipment for the heating of materials*
IEC 61010-2-081 GB 4793.9 EN 61010-2-081	*Safety requirements for electrical equipment for measurement, control and laboratory use – Part 2-081: Particular requirements for automatic and semi-automatic laboratory equipment for analysis and other purposes*

EMC

Reference	Description
CE-EMC (2014/30/EU)	European Union “EMC Directive”
EN 61326-1 GB 18268.1	*Electrical Equipment for Measurement, Control and Laboratory Use – EMC Requirements – Part 1: General Requirements*

Environmental design standards

Reference	Description
Directive 2012/19/EU	European Union “WEEE Directive”—Waste electrical and electronic equipment
Directive 2011/65/EU and (EU) 2015/863	European Union “RoHS Directive”—Restriction of hazardous substances in electrical and electronic equipment
SJ/T 11364-2014	“China RoHS” Standard—Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products

Chemical safety

WARNING! GENERAL CHEMICAL HANDLING. To minimize hazards, ensure laboratory personnel read and practice the general safety guidelines for chemical usage, storage, and waste provided below. Consult the relevant SDS for specific precautions and instructions:

- Read and understand the Safety Data Sheets (SDSs) provided by the chemical manufacturer before you store, handle, or work with any chemicals or hazardous materials. To obtain SDSs, see the "Documentation and Support" section in this document.
- Minimize contact with chemicals. Wear appropriate personal protective equipment when handling chemicals (for example, safety glasses, gloves, or protective clothing).
- Minimize the inhalation of chemicals. Do not leave chemical containers open. Use only with sufficient ventilation (for example, fume hood).
- Check regularly for chemical leaks or spills. If a leak or spill occurs, follow the manufacturer cleanup procedures as recommended in the SDS.
- Handle chemical wastes in a fume hood.
- Ensure use of primary and secondary waste containers. (A primary waste container holds the immediate waste. A secondary container contains spills or leaks from the primary container. Both containers must be compatible with the waste material and meet federal, state, and local requirements for container storage.)
- After emptying a waste container, seal it with the cap provided.
- Characterize (by analysis if needed) the waste generated by the particular applications, reagents, and substrates used in your laboratory.
- Ensure that the waste is stored, transferred, transported, and disposed of according to all local, state/provincial, and/or national regulations.
- **IMPORTANT!** Radioactive or biohazardous materials may require special handling, and disposal limitations may apply.

Biological hazard safety

WARNING! Potential Biohazard. Depending on the samples used on this instrument, the surface may be considered a biohazard. Use appropriate decontamination methods when working with biohazards.

WARNING! BIOHAZARD. Biological samples such as tissues, body fluids, infectious agents, and blood of humans and other animals have the potential to transmit infectious diseases. Conduct all work in properly equipped facilities with the appropriate safety equipment (for example, physical containment devices). Safety equipment can also include items for personal protection, such as gloves, coats, gowns, shoe covers, boots, respirators, face shields, safety glasses, or goggles. Individuals should be trained according to applicable regulatory and company/ institution requirements before working with potentially biohazardous materials. Follow all applicable local, state/provincial, and/or national regulations. The following references provide general guidelines when handling biological samples in laboratory environment.

- U.S. Department of Health and Human Services, *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*, 6th Edition, HHS Publication No. (CDC) 300859, Revised June 2020
  www.cdc.gov/labs/pdf/CDC-BiosafetymicrobiologicalBiomedicalLaboratories-2020-P.pdf
- Laboratory biosafety manual, fourth edition. Geneva: World Health Organization; 2020 (Laboratory biosafety manual, fourth edition and associated monographs)
  www.who.int/publications/i/item/9789240011311

E Certificate of decontamination

Name: _____

Address: _____

Telephone/Fax: _____

Instrument: _____ Serial Number: _____

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, and Radioactive

_____

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

_____

Specific information about contaminants:

_____

_____

Decontamination procedure:

_____

Note: Please include decontaminating solution used.

_____

_____

_____

Date and place:_____

Signature:_____

Printed name:_____

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

Date and place:_____

Signature:_____

Printed name:_____

Documentation and support

Customer and technical support

Visit **thermofisher.com/support** for the latest service and support information.

- Worldwide contact telephone numbers
- Product support information
  - Product FAQs
  - Software, patches, and updates
  - Training for many applications and instruments
- Order and web support
- Product documentation
  - User guides, manuals, and protocols
  - Certificates of Analysis
  - Safety Data Sheets (SDSs; also known as MSDSs)

  Note: For SDSs for reagents and chemicals from other manufacturers, contact the manufacturer.

Limited product warranty

Life Technologies Corporation and/or its affiliate(s) warrant their products as set forth in the Life Technologies' General Terms and Conditions of Sale at **www.thermofisher.com/us/en/home/global/terms-and-conditions.html**. If you have any questions, please contact Life Technologies at **www.thermofisher.com/support**.