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SEEPOS
SE-0018
User manual

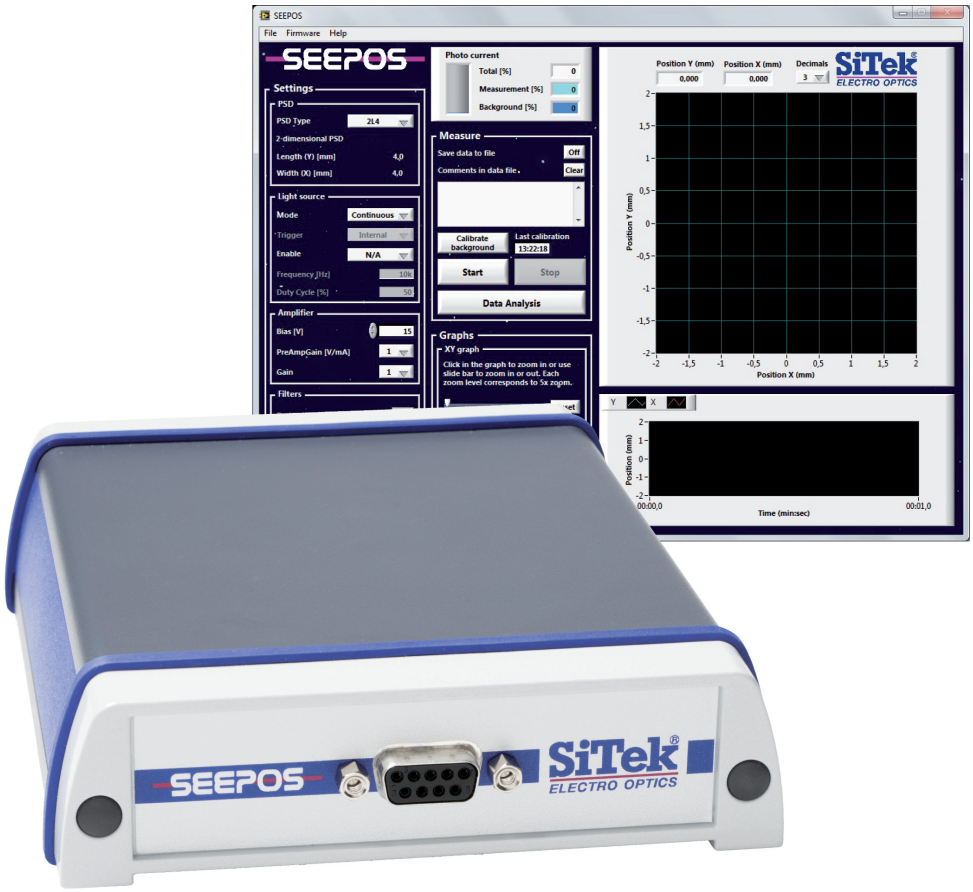


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1. General

The SiTek SEEPOS is a PSD signal processing system optimised for development of PSD applications.

Several parameters, such as PSD bias voltage, amplifier gain, the use of analog and digital filter, etc. are controlled from the software and the light spot position is continuously displayed in both XY and X-t, Y-t graphs.

Included data analysis tool gives the opportunity to scan through large data sets to find specific parts of interest.

2. Getting Started

2.1. Contents

SEEPOS comes in a specially design shipment case to ensure a safe transport and easy storage. In the shipment case you will find the following items:



- SEEPOS amplifier unit
- Power Supply with an interchangeable AC plug
- USB cable
- USB memory stick

If you have ordered a PSD mounted in PSD holder MH01 the following items will also be in the shipment case:

- PSD in PSD holder MH01
- PSD connection cable

SEEPOS amplifier unit

The SEEPOS amplifier unit comes in a rugged metallic enclosure for best performance.

Please follow the instructions in chapter 2.4 Installation of hardware for installation.

Power supply

The power supply is a 12VDC/1.1A power supply with universal input (90-264VAC, 47-63Hz) and interchangeable AC plug. The power supply is delivered with a suitable AC plug for your country. If you need a different AC plug please contact our local distributor or SiTek Electro Optics AB for additional plugs.

USB cable

A 2 m USB 2.0 cable type A to Mini-B.

USB memory stick

The USB memory stick includes an installation program which automatically installs the SEEPOS software, instrument drivers, LabView Run-Time Engine as well as a pdf version of this manual.



To open the USB stick simply twist the upper part of the stick and the connector pops out.

PSD in PSD holder MH01 (optional)

The PSD holder MH01 is a mechanical holder for the PSD optimised for use together with SEEPOS. Its DSUB9 connector is pin compatible with the SEEPOS connector and can be connected to the SEEPOS amplifier unit by the supplied cable. The SiTek PSD holder is also suitable, with minor modifications, for direct attachment to the amplifier.

PSD connection cable (optional)

The PSD connection cable is a 1 m shielded cable with DSUB9 connectors for connection between PSD holder MH01 and the SEEPOS amplifier unit.

2.2. Physical overview



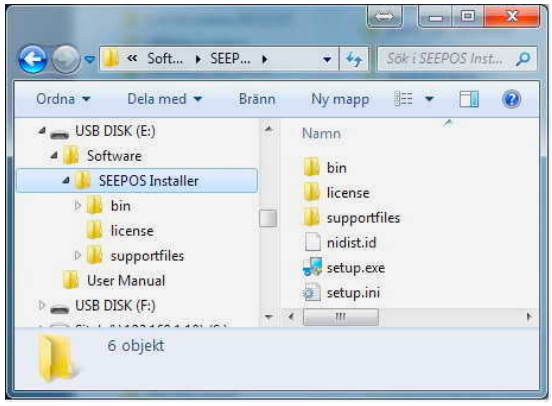
Figure 1 Front View



Figure 2 Rear View

2.3. Installation of software

1. Insert the USB memory stick into your computer.
2. Start the installation program *setup.exe* and follow the instructions.



The installation program will install SEEPOS software, instrument driver and LabVIEW Run-time Engine, which is needed to run the program.

During the installation a shortcut to the SEEPOS software will be created on your desktop and a SEEPOS folder will be created in your Documents folder.

2.4. Installation of hardware

To arrange a measurement set up including SEEPOS follow the instruction below.

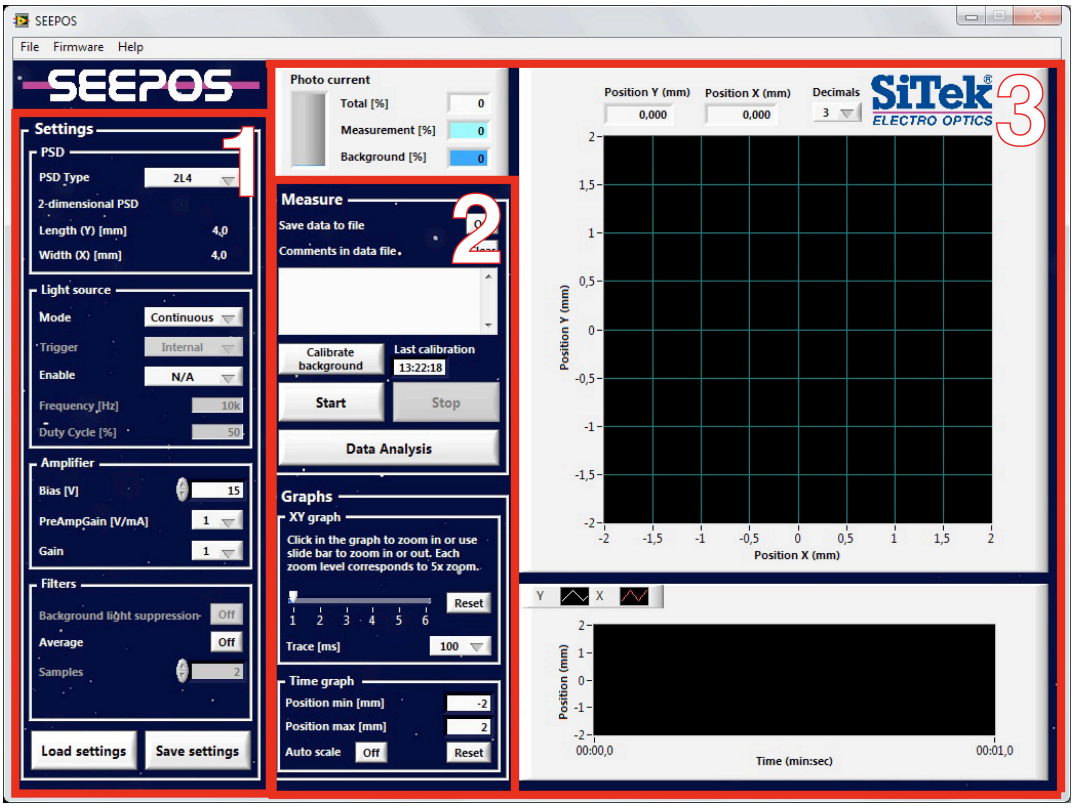
1. Connect the PSD to the SEEPOS amplifier unit.
   If a PSD holder is used this is done by using the supplied PSD connection cable. The PSD holder can also with minor modifications be connected directly to the SEEPOS amplifier unit without cable. If a PSD without the PSD holder is to be connected make sure that wiring is done properly to fit the DSUB9 connector pin out. Incorrect wiring could damage the sensitive SEEPOS amplifier inputs as well as the PSD. For SEEPOS amplifier unit DSUB9 pin out see chapter 6.4 Pin assignment of PSD connector.
2. Connect the USB cable with its male type A connector to the PC and the Mini B type connector to SEEPOS amplifier unit.
3. Connect the interchangeable AC plug to the power supply.
4. Connect the power supply to SEEPOS amplifier unit and to the wall plug.
5. Switch on SEEPOS by pushing the power button. The red Power LED (placed close to the12 VDC connector) should now be lit. If your PC is on and the software has been properly installed the green USB LED (placed close to the USB connection) should also be lit after a few seconds. This indicates that SEEPOS is communicating with your PC and is ready to use.

3. Controlling SEEPOS

Start the SEEPOS software by double-clicking the program icon on your desktop.

To close the SEEPOS software select *File – Exit*.

The control window is divided into three main areas.



Control areas
1 Settings
2 Measure
3 Data displays

3.1. Settings

The settings are placed in the left column of the GUI window. All setting must be done before starting the measurement procedure. No parameters can be changed during the measurement procedure.

PSD

Define the PSD type and dimensions. All SiTek standard PSDs are predefined.

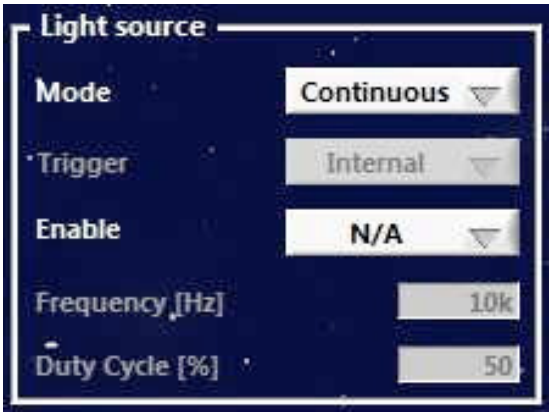
If you use a custom designed PSD select the *PSD Type Custom Designed* and input the relevant data. When saved the customer defined PSD will be added to the list of PSDs for later use.



Light source

Specify the light source parameters.

SEEPOS can handle light sources with both continuous and modulated light.



Continuous mode

In *Continuous* mode it is not necessary to do further light source settings. However, if the light source has an enable input it is possible to connect this to the Internal trigger output and control light source enabling from the software with the *Enable* control.

Modulation mode

In *Modulation* mode the light source modulation trigger signal must be specified. The trigger signal (TTL) can either be supplied by SEEPOS to the light source driver (Internal) or supplied by the light source driver to SEEPOS (External). Connection of the trigger signal output/input is done with a BNC cable on the backside of SEEPOS.

Whether to set *Enable* to be active high or low depends on the polarity of the laser driver used. If the light source is on when the trigger pulse is high choose *High active* and vice versa.

The modulation *Frequency* can be set between 1 Hz and 250 kHz.

The *Duty Cycle* can be set to 10-90 %.

Note! The pulse length cannot be shorter than 2 µs. If the duty cycle is specified so that the pulse length is shorter than 2 µs it will be automatically coerced.

Amplifier

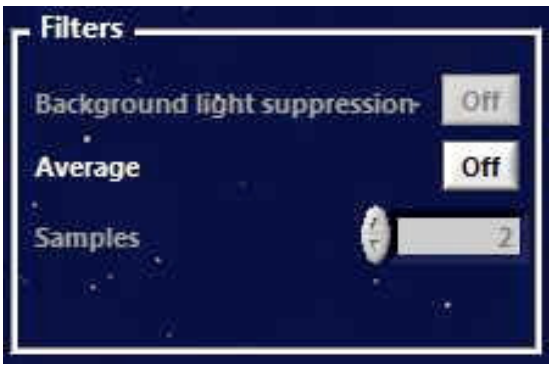
The PSD bias voltage can be set to 0-30 V by typing the value or click the up or down arrow.



The total amplification is the product of *PreAmpGain* and *Gain*. The total amplification shall be as high as possible without exceeding a photo current of 100%. See Photo current graph to verify the amplifier settings. To reduce noise, try to adjust gain such that P*reAmpGain* is as high as possible.

Filters

In *Modulation* mode background light can be suppressed by using the *Background light suppression* function. This function introduces a high pass filter with a cutoff frequency of 150 Hz which might give you the possibility to use a higher amplifier gain without saturating the amplifiers.



SEEPOS samples with a sampling frequency of 1 MHz. In *Continuous* mode all the sampled values are sent to the computer via USB. In *Modulation* mode the set of sampled measurements within each pulse are automatically averaged, and one value for each pulse is sent to the computer.

To increase the resolution in the position measurement it is possible to use the *Average* function. This function allows you to average over two or more measurement values. Please note that averaging will reduce the bandwidth of the system.

Save settings

Save the current settings for later reuse. The settings file will per default be saved in the *settings files* folder.



Load settings

Reuse of previously saved settings. Per default the software takes you to the *settings files* folder. It is possible to browse to other folders by normal Windows standard.

3.2. Measure

In *Continuous* mode, a calibration is required before the first measurement, and an error message will appear if this is not done.

If you would like to save the result you need to select *Save data to file On* before every measurement procedure.

Note! It is not possible to select save after the measurement procedure is done.

Click *Start* to perform the measurement.

Click *Stop* when the measurement procedure is done.

If *Save data* to file is set to *On*, measurement data is stored in binary format in a folder named *YYMMDD_hh_mm_ss* in the *result* folder. Information about the settings used in the measurements as well as comments are also saved.

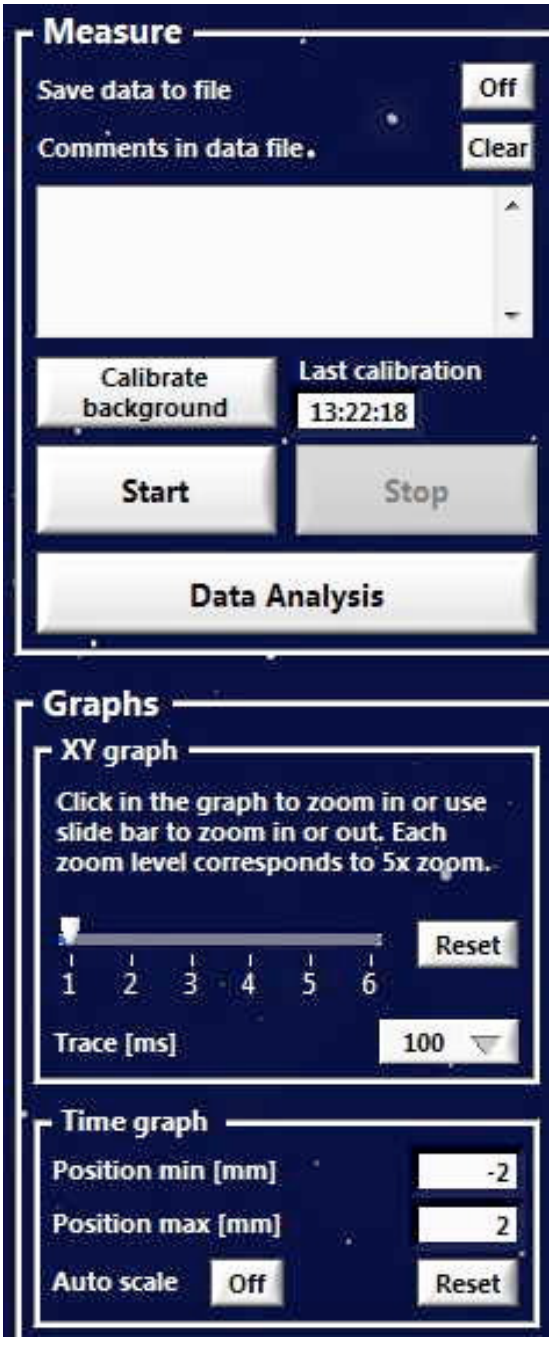
Graphs

During measurements, two graphs, the *XY graph*, which displays the position movement in the XY plane, and the *Time graph*, which displays the X and Y position as a function of time, are continuously updated with position data. The graphs are updated with 10 Hz and all measured data is displayed. To study details in the measured data, use the *Graphs* controls for zoom and trace.

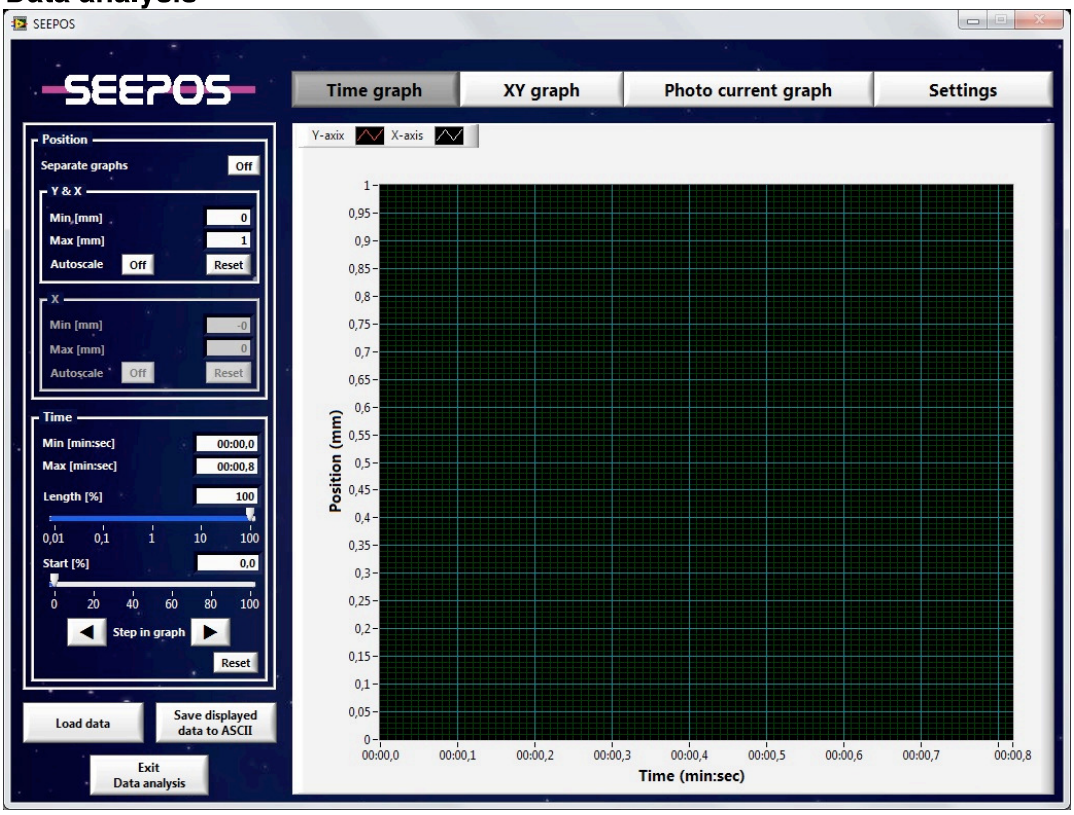
With the *Trace* function the amount of data displayed in the XY graph can be controlled. If a trace of 100 ms is chosen only the last update is displayed while a trace of 1000 ms will display all data displayed in the *Time graph*.

Data Analysis button

Clicking the *Data Analysis* button takes you to the data analysis area. See more details in chapter 3.3 Data analysis.



3.3. Data analysis



If the software is not running measurements, it is possible to do analysis of previously saved measurements. The *Data analysis* window consists of four tabs of which three displays data (*Time graph*, *XY graph* and *Photo current graph*) while the fourth displays the *Settings* used during the measurement.

Click the *Data Analysis* button in the *Measure* area to enter into the analysis mode. If data has been saved during the measurement session you are asked if you would like to display the latest measurement with the question *Open data from latest measurement.*

- *Yes* displays the latest measurement data.

- *No* allows you to load older measurement data, per default from the *result* folder. It is also possible to browse for data in normal Windows manner.
  Mark the measurement folder of interest and click *Current Folder*

Time

As default you see data for the full extent of the measured time. To see in more detail use the slide bars to select the *Length* and the *Start* of the data of interest. It is also possible to type values in the numeric fields.

The *Step in graph* function steps one window (depending of the selected *Length*) backward or forward.

The selected time interval is conserved when switching between different views of the data.

Graph

The graphs are shown in three different views.

The *Time graph* plots the X and Y positions as a function of time.

The *XY graph* plots the motion of the measurement in the XY plane.

The Photo current graph plots the Total photo current and the Background photo current as a function of time.

In the *Time graph* and the *Photo current graph* the two parameters can be shown in separate graphs or in the same graph by selecting Separate graphs On or Off.

The photo current data only consists of data points corresponding to every 60th data point in the Time graph and the Photo current graph can therefor look a bit inexact.

Save displayed data

The *Save displayed data to ASCII* saves data to a text file, which can easily be imported to other applications. Only the actual displayed interval will be saved.

The file will be saved in the *result ASCII* folder.

Load data

To display previously saved measurement data click *Load data*.

Mark the measurement folder of interest and click *Current Folder.*

4. Measurement considerations

To maximise the utility of your SEEPOS PSD signal processing system there are some things to remember:

The PSD is a light to current converter; it converts all light regardless of the incident position. The generated photo current is the sum of all light sources. The position signal derived from the PSD terminals could be called “the centre of gravity of the incident light”. It is therefore important to use a clean light spot and to keep the entire light spot within the active area of the PSD. It is also important to avoid secondary reflections which could influence the measurement if they hit the PSD surface.

Since the PSD is an analog device, the signal-to-noise ratio determines the resolution. To get high signal, use as much light as possible without saturating the PSD. To minimise losses in the signal, especially in low light applications, it is important to use high quality optics and mirrors as well as antireflection coatings optimised for your wavelength.

The PSD size should be chosen as small as possible. If you only have small movements and are able to align your light spot to the centre of the PSD a small PSD will give better performance than a large one.

The highest resolution is found in the centre of the PSD. Hence, for high resolution measurements it might be worth spending some time to align the light spot close to the centre of the PSD.

The best performance will be obtained if the measurement system is not disturbed by background light and if a stable, continuous, high power light source is used. Furthermore, the cable between the PSD and SEEPOS should be as short as possible. The cable supplied with SiTek PSD holder is a shielded pair twinned cable with the length of 1 m. The length is chosen for convenience and not from an optimum performance point of view. The best performance will be obtained if the PSD Holder is connected directly to the SEEPOS input. This can be done with minor modifications of the screws.

4.1. SEEPOS settings

For most applications a Bias voltage of 15 V is recommended. A higher Bias voltage can be useful in high light power applications to avoid saturation or in high speed applications to increase the speed of the PSD. A higher Bias voltage will however also increase the leakage current of the PSD.

To optimise the amplifier performance the *PreAmpGain* and *Gain* settings should be set to as high values as possible without reaching 100 % photo current. First set the *PreAmpGain* setting as high as possible and then set the *Gain* setting.

4.2. Background light

If background light is present it is recommended to use a modulated light source. The modulation frequency should be chosen as low as possible regarding the light spot movement but high enough to be able to use the *Background light suppression* function. A common choice is somewhere around 10 kHz. The *Background light suppression* function uses an electrical high pass filter to remove DC and low frequency signals from the measurement and it is recommended to always use this function if possible.

In most cases the use of a modulated light source is enough to suppress the influence of background light but in cases with very bright background light it is recommended to use an optical filter to avoid saturation.

Optical filters are also a solution if a modulated light source for some reason cannot be used. In these cases it is very important to keep the background light level stable during the measurement and to use the Background calibration function.

4.3. Mechanical considerations

Stable mechanical mounting of all used parts is of great importance in all PSD applications. If the measurement system is built in a lab it is recommended to use dedicated opto-mechanical products such as those supplied by the optical catalog companies.

A problem when designing a measurement system is to keep the optical system fixed relative to the mechanical system. For high resolution measurements it is therefor also important to consider movements due to thermal expansion. Differences in thermal expansion between different parts may create movements with change in temperature.

5. FAQ

I get the warning message saying "Warning! The instrument seems not to be connected". What should I do?
Check that the USB cable is connected and that SEEPOS power is on. Restart SEEPOS by pushing the power button twice.

I get a warning message saying "Warning! Measurement data has been lost due to insufficient USB capacity". What does that mean?
In *Continuous* mode a large amount of measurement data is transferred over the USB bus. If your computer is not fast enough, or busy doing other things, this might cause loss of data. The data transfer rate can be reduced by averaging samples in the hardware. In the initialisation file *SEEPOS.ini* in the *SEEPOS* folder the value of the parameter *average_dc* determines the number of samples which is averaged in the hardware. The value of this parameter can be between 1 and 100. Please note that this limits the overall bandwidth of the system and that when using the *Average* function in the software the hardware averaging is not taken into account.

The measurement is very noisy at high modulation frequencies. How come?
In *Modulation* mode an average of the sampled values over each pulse is used (the A/D converters continuously sample with a frequency of 1 MHz). If the light source, or the PSD have a rise time longer than 1 µs the some sample will be taken during the flank of the pulse which can give noisy and erroneous values. Depending on the cause this can be solved in different ways:

- If the light source is too slow, use a faster light source.
- If the PSD is too slow due to saturation, reduce the light power. The shape of the analog pulses can be measured with an oscilloscope at the analog outputs on the backside of SEEPOS. The saturation threshold of the PSD can also be increased by increasing the Bias voltage.
- Change the parameter *points_to_skip* in the initialisation file *SEEPOS.ini*. This parameter defines the number of initial samples to remove from the average calculation. Please note that when the value of this parameter is increased the maximum modulation frequency is also reduced.

When the modulation frequency is increased the measured position value changes. How come?
If some samples are taken during the flank (see previous question) the value of the average calculation will be erroneous. At low modulation frequencies this error will be small but at high frequencies, with a small number of samples on each pulse the error can be large. For solutions see previous question.

On the gray areas located on the left and on the right side of the text Step in graph in the Time section of the Data analysis, the letters "t" and "u" appears. What does that mean?
On these gray areas arrows should show the direction to step. If the letters "t" and "u" are shown it means that the font Wingdings 3 is not installed on your computer. Please install the font Wingdings 3.

6. Appendix

6.1. Certifications and compliances

SEEPOS conforms with the essential requirements of Directives

2004/108/EC	Electromagnetic Compatibility (EMC)
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

It has been tested for emission (class B, group 1) and immunity (basic requirements) and was found to be in conformity with the applicable requirements of:

EN 61326-1:2013	Electrical Equipment for Measurements, Control and Laboratory Use EMC requirements

It does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of Directive 2011/65/EU.

6.2. Technical data

Analog part

Input photo current range	50 nA – 5 mA
Pre amplifier gain	1 000 V/A, 50 000 V/A
PSD bias voltage	0 – 30 V (continuously variable)
HP-filter cutoff frequency	150 Hz (on/off)

Digital part

A/D conversion	16 bit
Sampling frequency	1 MHz (parallel)
Light source trigger frequency (TTL)	DC – 250 kHz
Computer interface	USB 2.0 High speed

Others

External light source trigger frequency (TTL)	DC – 100 kHz
Dimensions W x H x L	124,4 mm x 36,2 mm x 148 mm

6.3. System requirement

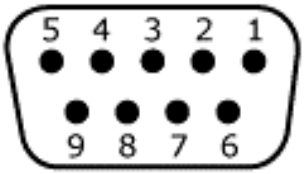
- Windows Vista, Windows7 eller Windows8
- RAM: 4 GB
- USB-port: USB2.0 High speed
- External trigger: TTL with frequency jitter <100 ns

6.4. Pin assignment of the PSD connector

(female DSUB9 connector)

SEEPOS is designed to be used together with any of SiTek's PSDs, those included in our standard range as well as custom designed ones. If a PSD mounted in a PSD holder is used, it can be directly connected to the SEEPOS amplifier with the supplied PSD connection cable. PSDs not mounted in the PSD holder can also be used but in order to not damage the PSD or the sensitive SEEPOS amplifier inputs special care must be taken to assure that the wiring is properly done to fit the DSUB9 connector.

For best performance use a shielded pair twisted cable and with a length as short as possible. We recommend the twisted pairs to be chosen as X1-X2, Y1-Y2 and Ground-Bias. We also recommend to connect the cable shield to the back shell of the DSUB9 connector.



Pin-out for PSD female connector

Pin no.	Input
1	X1 (only 2D-PSD)
2	X2 (only 2D-PSD)
3	Y1
4	Y2
5	Ground
6	Not connected
7	Not connected
8	Bias (only 1D-PSD)
9	Not connected

Caution!

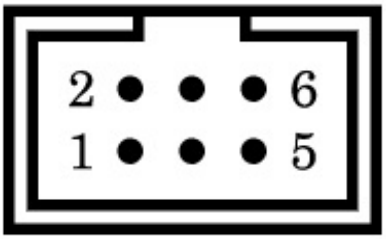


These inputs are very sensitive to static discharges and can be damaged by electrostatic charge. They must therefore be handled with care. Always turn power off when adding or removing a PSD from SEEPOS.

6.5. Pin assignment of the analog connector

(male 6-pin IDC connector)

The analog connector on the back panel of SEEPOS gives access to the analog PSD signals. These are the PSD signals prior to A/D-conversion amplified with the settings in the software. To simplify analyses of e.g. curve shape, rise time, etc. the signals X1 and X2 (2-dimensional PSDs only) are AC coupled with a 150 Hz cut frequency high pass filter.



Pin no.	Output	Voltage range
1	Y2	0 – 5 V
2	X2 High pass filtered (only 2D-PSD)	-2.5 – +2.5 V
3	Ground	
4	Bias	0 – 30 V
5	Y1	0+ – 5 V
6	X1 High pass filtered (only 2D-PSD)	-2.5 – +2.5 V

6.6. SiTek „End of Life" policy (WEEE)



Waste of electrical and electronic equipment (WEEE) is rapidly increasing and a few years ago the European Community introduced Directive 2002/96/EC on waste electrical and electronic equipment (WEEE directive). The directive has undergone a number of revisions since then but the aim of the WEEE directive remains; to reduce waste associated with end-of-life equipment materials going into landfill, by requiring all manufacturers and producers to take responsibility for what happens to the products they sell at the end of their lives.

SiTek Electro Optics AB strives to be an environmentally responsible company and operates under full compliance with the WEEE Directive. For information about how to proceed if you want to dispose your SEEPOS unit please contact our local distributor or SiTek Electro Optics AB.

6.7. Addresses

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