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TEL220PS - October 1, 2020

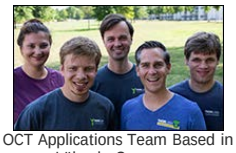
Item # TEL220PS was discontinued on October 1, 2020. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

TELESTO SERIES PS-OCT SYSTEMS

OVERVIEW

Features

- Single-Input Polarization-Sensitive OCT System with Unique Detector Unit for Simultaneous Acquisition of Both Orthogonal Polarizations at Full Imaging Speed
- Robust Setup for Highly Reproducible Measurements
- Configurable Systems Optimized for High-Resolution, High-Depth Imaging
  - 3.5 mm Imaging Depth with 5.5 µm Axial Resolution in Air (1300 nm Center Wavelength)
  - 7.0 mm Imaging Depth with 12.0 µm Axial Resolution in Air (1325 nm Center Wavelength)
- Base Units with A-Scan Rates up to 76 kHz Available
  - 109 dB Max Sensitivity at 5.5 kHz Scan Rate
  - 94 dB Max Sensitivity at 76 kHz Scan Rate
- Includes Computer and ThorImage®OCT Software Package (See the *Software* Tab)
- Build-Your-Own and Preconfigured Systems Available


OCT Applications Team Based in Lübeck, Germany

We're Happy to Assist!

Exploring the Options?

We can provide recommendations based on your needs and partner with you to obtain images of samples provided by you demonstrating the effects of various components on image quality. Demos of our OCT systems can be arranged at our Sterling, VA (USA); Shanghai, China; Tokyo, Japan; and Lübeck, Germany facilities.

In the Budgetary Phase?

System prices vary based on the exact components. Through our conversations, we can ensure your system quote is tailored to your requirements.

OEM or Custom Projects?

Click here to learn about our OEM capabilities.

Choose Components to Build or Customize Your OCT System

- Choose from High-Resolution (1300 nm) or Long-Range (1325 nm) Base Units
- User-Customizable Scanner Available
- Scan Lens Kits to Optimize Lateral Resolution and Focal Length for Your Application
- Ring- and Immersion-Style Sample Z-Spacers for Air or Liquid Imaging Applications
- Scanner Stand and Translation Stage Accessories
- Contact Our OCT Team to Request a Quote and Discuss Building a System

Telesto Series Polarization-Sensitive OCT (PS-OCT) Systems preserve, detect, and process polarization information of samples through noninvasive, subsurface optical imaging. This technology can uncover normally unobserved features of birefringent samples (e.g. tissue, plastic, or crystals) that stem from the internal microstructure. For example, scar tissue will interact differently with polarized light than regular skin tissue, so the polarization information can be used to add an additional layer of contrast to a standard optical coherence tomography (OCT) image. This additional layer can be characterized as the cumulative retardation, optic axis, or degree of polarization uniformity (DOPU).

OCT is an optical imaging technique that produces real-time, 2D cross-sectional and 3D volumetric images of a sample. This technique provides structural information about the sample based on light backscattered from different layers of material within that sample, producing images with micron-level resolution and millimeters of imaging depth. In addition to high resolution, the non-contact, noninvasive nature of OCT makes it well suited for imaging samples such as

biological tissue, small animals, and industrial materials.

The Telesto PS-OCT systems use an incident beam of known polarization and a dual-detector design to incorporate polarization information in 2D cross-sectional and 3D volumetric images of a sample. OCT is typically performed with an incident beam of unknown polarization and a single detector unit. The Telesto PS-OCT systems control the polarization incident on the sample and reflected in the reference arm of the interferometer by using two carefully aligned wave plates. The preserved polarization information is then measured using two detectors (see the *PS-OCT Tutorial* tab).

These OCT systems provide the flexibility required for long-range and high-resolution imaging applications. The detector unit is housed in the same box as the standard Telesto systems and features the same robustness as all Thorlabs OCT systems. No calibration or adjustment is needed after shipping or during use. The compact design of the system allows for easy and mobile operation. The 64-bit software pre-installed on the included computer displays and processes 2D and 3D OCT data in real time. Optional accessories are available below to customize your OCT system to meet the requirements of your application. Additionally, Thorlabs offers two complete, preconfigured OCT systems for 1300 or 1325 nm based on the components sold on this page.

The components below can also be used to upgrade your existing Thorlabs OCT system with additional features and are compatible out of the box with the Thorlabs' OCT systems and accessories sold below. While most systems are upgradable, we recommend contacting the OCT Team to determine the optimal solution for your system and intended application.

Click on the Image Below or in the Table to the Right for Details on Customization Options

Telesto Customization Options
OCT Base Unit (Computer Included)
Scanning System
Scan Lens Kit
Adjustable Scanner Stand
Translation Stage
Preconfigured Systems

PS-OCT TUTORIAL

Polarization-Sensitive OCT

With Thorlabs' Telesto Series Polarization-Sensitive OCT (PS-OCT) Imaging Systems, it is possible to obtain additional information carried by the polarization state of light that has interacted with a sample. When incident light with a defined polarization state is used, changes in the polarization state resulting from the sample can be interpreted. Birefringent material causes a relative delay between two orthogonal polarization states known as phase retardation. This relative delay has an orientation, called the optic axis, which can be visualized with polarization-sensitive OCT. Additionally, the sample can have properties which depolarize the incident polarized light, resulting in an arbitrary polarization state of the light that can be characterized by the degree of polarization uniformity (DOPU). Both these behaviors can be detected with the Telesto PS-OCT systems.

System Design

Click for Details
PS-OCT System
Schematic

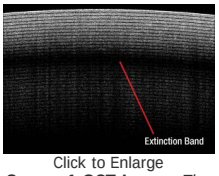
A Telesto PS-OCT system is a phase-stable spectral domain OCT system. It is a single-input device with a unique polarization-sensitive detector unit for simultaneous acquisition of two orthogonal polarization states at full imaging speed. The Telesto PS-OCT system is designed to define the polarization state of light incident on the sample and preserve polarization throughout the system, as shown in the schematic to the right. Starting with linearly polarized light from the superluminescent diode light source, two quarter-wave plates, one in the reference arm and one in the sample arm, are used to alter the polarization state of the light. In the reference arm, the quarter-wave plate has a 22.5° orientation relative to the linearly polarized input; the beam passes through the wave plate twice, so light exits the reference arm with a 45° linear polarization relative to the input light. In the sample arm, the quarter-wave plate is oriented at 45° relative to linearly polarized input light, converting it into circularly polarized light that is incident on the sample. The orientation of these two wave plates enables the system to be as polarization sensitive as possible. In addition to the wave plates, specially designed optical components maintain polarization throughout the whole system.

The detection of two polarization states does not slow down the acquisition rate when compared to the standard TEL210 and TEL220 systems, allowing the

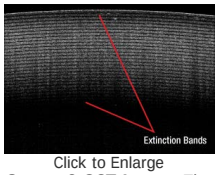
same imaging speeds to be achieved. The system was designed with robustness and easy handling in mind. No calibration of the polarization-sensitive detector unit is necessary at any time, as expected from a true turnkey OCT system. The result is a polarization-sensitive OCT system that yields highly reproducible measurements.

Signal Processing

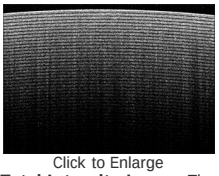
The two individual OCT images from the unique polarization-sensitive detector unit can be shown separately or combined in a total intensity image. Some samples, e.g. scotch tape, may produce changes in polarization state that cause extinction banding. Since the two sensors receive light with orthogonal linear polarizations, the extinction bands will appear in different locations in each image. The total intensity image provides the advantage of eliminating this banding, leading to a better OCT image compared to standard OCT systems.



Click to Enlarge
Sensor 1 OCT Image: The polarization mismatch of the light from the sample and reference arm produces extinction bands.

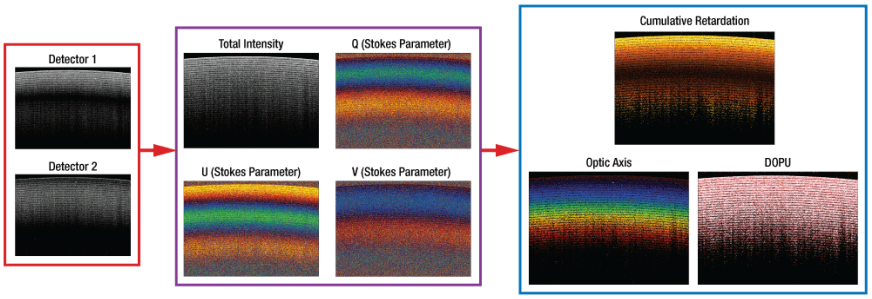


Click to Enlarge
Sensor 2 OCT Image: The polarization mismatch occurs at different depths of the sample compared to sensor 1, due to receiving light with the orthogonal linear polarization state.



Click to Enlarge
Total Intensity Image: The information of both sensors is combined, producing an optimized OCT image without the banding.

To obtain polarization images, the combination of the information from both sensors (red box in the figure below) is necessary. The information provided by two orthogonal polarization states of interfered light enables the calculation of the Stokes vectors (I, Q, U, V) for each image point. Each one of these values (I = Total Intensity) may be imaged individually, as shown in the purple box in the figure below. In addition, the Stokes vectors describing the polarization state of light can be used to determine several more advanced polarization measurements. As shown in the blue box in the figure below, cumulative retardation, optic axis, or degree of polarization uniformity (DOPU) may be calculated. Example images of tape are shown in the figure below (click each box to enlarge).



A roll of tape is imaged with Thorlabs' PS-OCT system using orthogonal polarization information from two sensors to calculate Stokes vectors, which are then used to calculate cumulative retardation, optic axis, or DOPU. With our software, it is possible to see all the images shown in the figure separately. For detailed information, please see the *Software* tab.

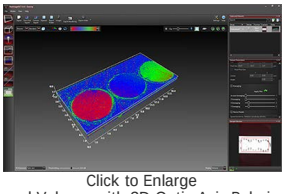
SOFTWARE

ThorImage®OCT Software Index

- Introduction
- Imaging Modes
  - 1D Mode for Single Point Measurements
  - 2D Mode for Cross-Sectional Imaging
  - 2D Polarization-Sensitive Mode for Cross-Sectional Polarization-Sensitive Imaging
  - 3D Mode for Volume Imaging
  - 3D Polarization-Sensitive Mode for Volume Polarization-Sensitive Imaging
  - Doppler Mode for Doppler Flow Imaging
  - Speckle Variance Mode for Angiographic Imaging
- Externally-Triggered Acquisition for Synchronized Measurements
- Easy Probe Calibration for Different Configurations
- Video Showing Screencast of Rendering Capabilities

ThorImageOCT Software

- Interactive Scan Position Control through Video Display for Common Line Scans or Freeform Pattern Scans
- Advanced Dataset Management
- Access to Raw Spectra, Processsed Data, and All Calibration Files Necessary for User-Designed Processing Routines
- High-Speed Volume Rendering of 3D Data
- Polarization-Sensitive Imaging with Algorithms for Displaying Retardation, Optic Axis, or DOPU
- Doppler and Speckle Variance Imaging
- Versatile Scan and Acquisition Control, such as Averaging or Adjustable Scan Speeds



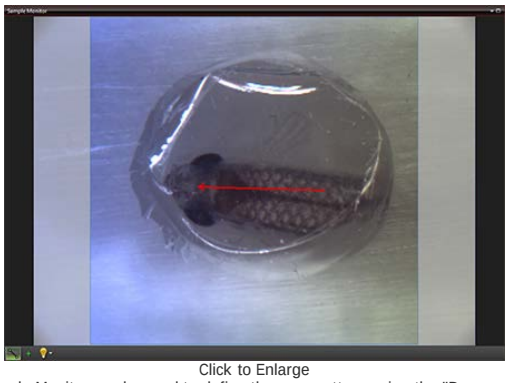
Click to Enlarge
Rendered Volume with 3D Optic Axis Polarization-Sensitive Imaging

ThorImageOCT is a high-performance data acquisition software, which is included with all Thorlabs OCT systems. This 64-bit Windows-based software package performs data acquisition, processing, scan control, and displays OCT images. Additionally, NI LabVIEW and C-based Software Development Kits

(SDKs) are available, which contain a complete set of libraries for measurement control, data acquisition and processing, as well as storage and display of OCT images. The SDKs provide the means for developing highly specialized OCT imaging software for every individual application.

Scan Control

ThorImageOCT provides numerous scan and acquisition controls. The camera integrated in the scanner of our OCT systems provides live video images in the application software. Defining the scan line for 2D imaging or the scan area for 3D imaging is accomplished through the easy-to-use "Draw and Scan" feature by clicking on the video image.



Click to Enlarge
The Sample Monitor can be used to define the scan pattern using the "Draw and Scan" feature.

With version 5.0, a new freeform scan pattern feature has been implemented. Arbitrary forms defined by the Draw & Scan feature or loaded .txt files can be scanned. The scan pattern can also be adjusted by specifying suitable parameters in the controls of the software, as shown to the right.

Click to Enlarge
Various acquisition parameters can be adjusted in ThorImageOCT.

Click to Enlarge
A predefined circle scan pattern can be loaded and scanned in the software. The size can be changed with the Zoom feature.

Click to Enlarge
A predefined triangle scan pattern can be loaded and scanned in the software. The size can be changed with the Zoom feature.

Additionally, one can further set processing parameters, averaging parameters, and the speed and sensitivity of the device using device presets. By using a high-speed preset, video-like frame rates in 2D and fast volume rendering in 3D are possible, whereas high-sensitivity acquisition is enabled by choosing a preset with a lower acquisition speed.

Dataset Management

ThorImageOCT provides advanced dataset management capabilities, which allow opening several datasets simultaneously. Datasets are uniquely defined using an identifier consisting of a study (or test series) name and an experiment number. Grouping of datasets can be achieved by using the same study name. The "Captured Datasets" list shows an overview of all open datasets, including the dataset identifier, the acquisition mode, and preview pictures of the still video image and the OCT data.

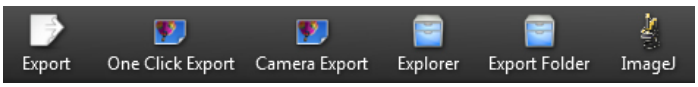
Click to Enlarge
The Dataset Management Window of ThorImageOCT

Datasets can be exported in various image formats, such as PNG, BMP, JPEG, PDF, or TIFF. The set can also be exported in complete data formats suited for post-processing purposes, such as RAW/SRM, FITS, VTK, VFF, and 32-bit floating-point TIFF.

The OCT file format native to ThorImageOCT allows OCT data, sample monitor data, and all relevant metadata to be stored in a single file. ThorImageOCT can also be installed and run on computers without OCT devices in order to view and export OCT data. The user has full access to the raw and processed data from the device, including additional data used for processing, e.g. offset errors.

Third Party Applications

If both ImageJ and ThorImageOCT are installed on the computer, opening acquired OCT data in ImageJ is one mouse click away. This enables a flawless workflow when requiring the advanced image processing functionality provided by ImageJ. Clicking the Explorer button will open the folder and select the file in Windows Explorer where the currently active dataset is stored.



Export buttons are accessible in the Action Toolbar of ThorImageOCT.

Imaging Modes

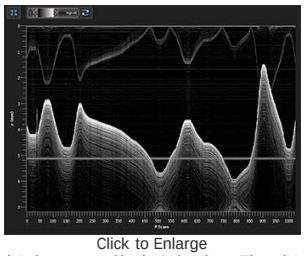
Different OCT imaging modes can be selected using the mode selector. If the ThorImageOCT software finds a compatible system connected and switched on, all operational modes will be selectable. If no OCT device is present, only the data viewing mode for viewing and exporting OCT data will be available.

In the Polarization-Sensitive OCT (PS-OCT) system, two additional imaging modes are available and the 1D mode is augmented to show each camera's

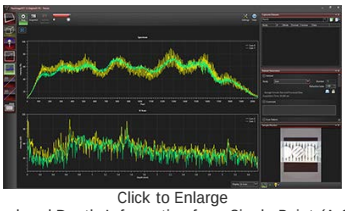
spectra simultaneously. The combination of both cameras, and therefore the unique additional information of the PS-OCT system, is implemented in the 2D and 3D Polarization-Sensitive Imaging Modes.

1D Mode

The 1D Mode provides the possibility to measure at a single point. The single point measurement not only provides spectral information and depth information, but also gives the possibility to observe time related behavior of a sample with an M-Scan. The simultaneously acquired spectra of the two line scan cameras in the PS-OCT system are displayed separately.



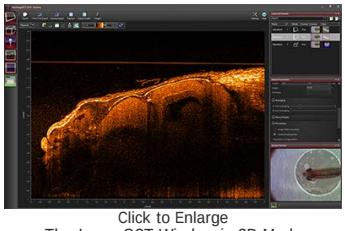
Click to Enlarge
Several A-Scans at a Single Point Over Time (M-Scan)



Click to Enlarge
Spectral and Depth Information for a Single Point (A-Scan)

2D Mode

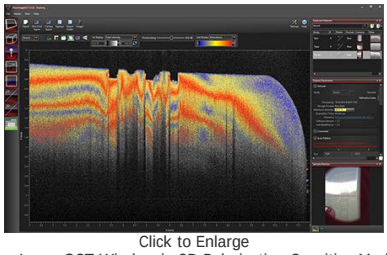
In the 2D imaging mode, the probe beam scans in one direction, acquiring cross-sectional OCT images which are then displayed in real time. Line averaging before or after the Fast Fourier Transform (FFT) is available, as well as B-Scan averaging. Image display parameters, such as color mapping, can be controlled in this mode. We have also implemented an option for automatic calculation of the optimum contrast and brightness of the displayed OCT images.



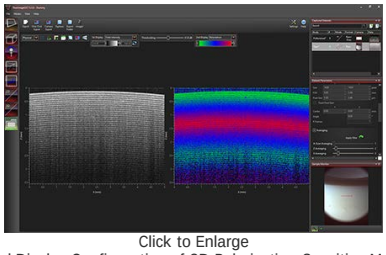
Click to Enlarge
ThorImageOCT Window in 2D Mode

2D Polarization-Sensitive Mode

The 2D Polarization-Sensitive imaging mode acquires cross-sectional OCT images and displays them in real time. It has two configurable displays, each able to show one of the following images: a single camera's intensity, a combination of both cameras' intensities, or polarization data such as retardation, optic axis, DOPU or a single Stokes parameter. To improve the image quality or allow for variable acquisition time, several averaging parameters and adjustable line rates are implemented. Image display parameters, such as color mapping or thresholding, can be controlled in this mode. We have also implemented an option for automatic calculation of the optimum contrast, brightness and thresholding of the displayed OCT images which operates on the intensity and PS-OCT images.



Click to Enlarge
ThorImageOCT Window in 2D Polarization-Sensitive Mode.



Click to Enlarge
Dual Display Configuration of 2D Polarization-Sensitive Mode

3D Mode

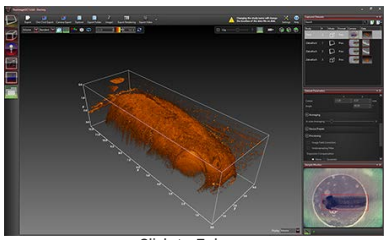
In the 3D imaging mode, the OCT probe beam scans sequentially across the sample to collect a series of 2D cross-sectional images which are then processed to build a 3D image.

In the ThorImageOCT software, 3D volume datasets can be viewed as orthogonal cross-sectional planes (see below) and volume renderings.

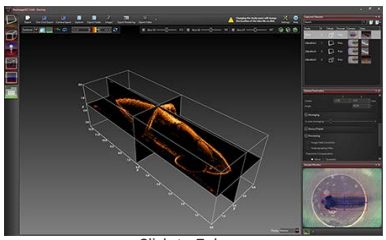
The Sectional View features cross-sectional images in all three orthogonal planes, independent of the orientation in which the data was acquired. The view can be rotated as well as zoomed in and out.

The Rendering View provides a volumetric rendering of the acquired volume dataset. This view enables quick 3D visualization of the sample being imaged. Planes of any orientation can be clipped to expose structures within the volume. The 3D image can be zoomed in and out as well as rotated. Furthermore, the coloring and dynamic range settings can be adjusted.

Utilizing the full potential of our high-performance software in combination with our high-speed OCT systems, we have included a Fast Volume Rendering Mode in the ThorImageOCT software, which serves as a preview for high-resolution 3D acquisitions. In this mode, high-speed volume renderings can be displayed in real-time, providing rapid visualization of samples in three dimensions.



Click to Enlarge
Rendering View of ThorImageOCT

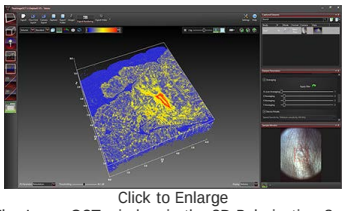


Click to Enlarge
Sectional View of ThorImageOCT

3D Polarization-Sensitive Mode

The 3D Polarization-Sensitive imaging mode extends the 3D imaging mode. The acquisition

and displaying options are the same as in the 3D imaging mode. Additionally, the 3D polarization-sensitive mode includes the possibility to choose which OCT image should be shown. The user may select one of the following rendered volume imaging options: an intensity OCT image (from either a single camera or the combination of both) or a PS-OCT image (such as retardation, optic axis, DOPU or one of the three Stokes parameters). The rendered PS-OCT images can be adjusted with a threshold computed out of the intensity OCT image to only display the polarization-sensitive data of regions above the noise.

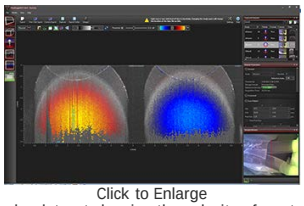


Click to Enlarge
The ThorImageOCT window in the 3D Polarization-Sensitive Mode.

Utilizing the full potential of our high-performance software in combination with our high-speed PS-OCT systems, we have included a Fast Volume Rendering Mode in the ThorImageOCT software, which serves as a preview for high-resolution 3D acquisitions of intensity and PS-OCT images. In this mode, high-speed volume renderings can be displayed in real time, providing rapid visualization of samples in three dimensions.

Doppler Mode

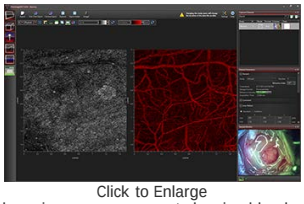
Doppler OCT imaging comes standard with all OCT systems. In the Doppler mode, phase shifts between adjacent A-scans are averaged to calculate the Doppler frequency shift induced by particle motion or flow. The number of lateral and axial pixels can be modified to change velocity sensitivity and resolution during phase shift calculation. The Doppler images are displayed in the main window with a color map indicating forward- or backward-directed flow, relative to the OCT beam.



Click to Enlarge
Doppler dataset showing the velocity of a rotated plastic stick with opposite flow directions.

Speckle Variance Mode

The speckle variance imaging mode is an acquisition mode which uses the variance of speckle noise to calculate angiographic images. It can be used to visualize three dimensional vessel trees without requiring significant blood flow and without requiring a specific acquisition speed window. The speckle variance data can be overlaid on top of intensity pictures providing morphological information. Different color maps can be used to display the multimodal pictures.



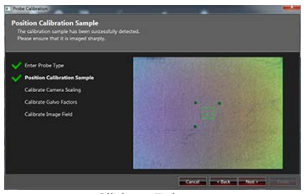
Click to Enlarge
Speckle variance measurement showing blood vessels of a mouse brain.

Externally-Triggered Acquisition

ThorImageOCT and the SDK APIs provide the ability to externally trigger the acquisition of A-Scans. This enables the user to synchronize measurements from different modalities (e.g. vibrometry and synchronized positioning) with an OCT measurement. Synchronization is greatly simplified with all current CameraLink-based Thorlabs OCT systems (a TTL level trigger signal source required). External triggering is available for all imaging modes and can be toggled in the settings dialog in ThorImageOCT.

Easy Probe Calibration

Changing to a different scan lens kit will generally require a different probe configuration in order to adapt to changes in the optical parameters of the system. When an additional scan lens is purchased for your Thorlabs OCT scanner system, ThorImageOCT enables you to easily create a fitting configuration for your new scan lens by using the calibration sample shipped with the lens and an intuitive step-by-step calibration process (shown to the right).



Click to Enlarge
Probe Calibration Window in ThorImageOCT

Video Showing Screencast of ThorImageOCT Rendering Capabilities

In this video, OCT images of a finger are acquired and manipulated in the 3D volume and cross section modes.

SELECTION GUIDE

Thorlabs offers a variety of OCT Imaging Systems to meet a range of application requirements. The OCT base unit and scan lens kit are key to OCT system performance. Significant performance characteristics, including axial resolution, A-Scan rate, and imaging depth, are entirely or strongly dependent on the design of the OCT base unit. The choice of scan lens kit determines other parameters, such as lateral resolution and field of view. Thorlabs offers a variety of OCT base units and scan lens kits that provide foundations for systems with a wide range of capabilities. The tables below present key performance parameters of our base units and include links to our other OCT imaging system pages. We encourage you to contact us directly at oct@thorlabs.com or via our online request form to discuss specific imaging requirements.

900 nm OCT Base Units

Base Unit Item #[a]	CAL110	GAN210	GAN610	GAN220	GAN620
Series Name (Click for Link)	Callisto	Ganymede			
Key Performance Feature(s)	Laptop PC for Maximum Portability	High Resolution		Very High Resolution	
		General Purpose	High Speed	General Purpose	High Speed
Center Wavelength	930 nm	930 nm		900 nm	
Imaging Depth[b] (Air/Water)	1.7 mm / 1.3 mm	2.9 mm / 2.2 mm	2.7 mm / 2.0 mm	1.9 mm / 1.4 mm	
Axial Resolution[b] (Air/Water)	7.0 µm / 5.3 µm	6.0 µm / 4.5 µm		3.0 µm / 2.2 µm	
A-Scan Line Rate	1.2 kHz	5.5 kHz to 36 kHz	5 kHz to 248 kHz	5.5 kHz to 36 kHz	5 kHz to 248 kHz
[c]	107 dB	101 dB	102 dB	101 dB	102 dB

Sensitivity (Max)					
OCT Type	Spectral Domain				

- a. These Item #s are OCT base units that can be customized using a wide selection of OCT scanners, lens kits, and optional accessories.
- b. Axial resolution and actual imaging depth are dependent on the optical properties of the sample being imaged.
- c. Values for the Callisto and Ganymede systems are typical and were measured using a scanner with a common reference/sample path and 50% path split.

1300 nm OCT Base Units

Base Unit Item #[a]	**TEL210**	**TEL310**	**TEL220**	**TEL320**	**TEL210PS**	**TEL220PS**	**VEG210**	**VEG220**
Series Name (Click for Link)	**Telesto**				**Telesto PS-OCT**		**Vega**	
Key Performance Feature(s)	High Imaging Depth		High Resolution		High Imaging Depth	High Resolution	Long Imaging Range	
	General Purpose	High Speed	General Purpose	High Speed	Polarization-Sensitive Imaging		General Purpose	High Speed
Center Wavelength	1325 nm		1300 nm		1325 nm	1300 nm	1300 nm	
Imaging Depth[b] (Air/Water)	7.0 mm / 5.3 mm		3.5 mm / 2.6 mm		7.0 mm / 5.3 mm	3.5 mm / 2.6 mm	11 mm / 8.3 mm	8.0 mm / 6.0 mm
Axial Resolution[b] (Air/Water)	12 µm / 9.0 µm		5.5 µm / 4.2 µm		12 µm / 9.0 µm	5.5 µm / 4.2 µm	16 µm / 12 µm	
A-Scan Line Rate	5.5 kHz to 76 kHz	10 kHz to 146 kHz	5.5 kHz to 76 kHz	10 kHz to 146 kHz	5.5 kHz to 76 kHz	5.5 kHz to 76 kHz	100 kHz	200 kHz
Sensitivity (Max)[c]	111 dB	109 dB	111 dB	109 dB	109 dB	109 dB	102 dB	98 dB
OCT Type	Spectral Domain						Swept Source	

- a. These Item #s are OCT base units that can be customized using a wide selection of OCT scanners, lens kits, and optional accessories.
- b. Axial resolution and actual imaging depth are dependent on the optical properties of the sample being imaged.
- c. Values for the Telesto systems are typical and were measured using a scanner with a common reference/sample path and 50% path split. Values measured for the Vega systems are typical and were measured using a scanner with a dual path setup.

Telesto Series Polarization-Sensitive Complete Preconfigured Systems

- Complete Preconfigured 1300 nm or 1325 nm OCT Systems (See Tables Below)
  - Item # TEL210PSC2: Long-Range Imaging
  - Item # TEL220PSC2: General-Purpose Imaging
- Fully Customizable Using Components Compatible with OCTP-1300PS User-Customizable Scanner

Thorlabs offers two complete, preconfigured Telesto OCT systems, each of which is fully compatible with Telesto Series OCT components designed for use with the user-customizable scanner. A specialized scanner, based on the OCTP-1300 user-customizable scanner, was exclusively developed for polarization-sensitive OCT imaging and is included in this preconfigured system. The TEL210PSC2 system has a 1325 nm center wavelength with a large imaging depth. The TEL220PSC1 system features a center wavelength of 1300 nm and is designed for general-purpose imaging applications. Both systems feature a maximum A-Scan rate of 76 kHz.

These Telesto Series preconfigured OCT system configurations are built completely from components sold in sections located lower on this page. Each preconfigured system includes the three mandatory OCT system core components (the base unit, a scanning system, and a scan lens kit), as well as two optional accessories (scanner stand and translation stage). For more information about a component included in the preconfigured systems, click on the component description in the table to the lower left to navigate down to the related section on this page.

For information about these systems or to inquire about custom configurations, please contact oct@thorlabs.com.

Preconfigured System Included Components		
System Item #	**TEL210PSC2**	**TEL220PSC2**
Base Unit	TEL210PS	TEL220PS
Scanning System	OCTP-1300PS (User-Customizable Scanner)	
Scan Lens Kit	OCT-LK3	
Accessories: Stand and Stage	OCT-STAND(/M) (Scanner Stand) and OCT-XYR1(/M) (Translation Stage)	

- a. Click on the component description to navigate down to the related section on this page.

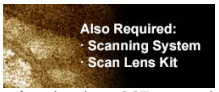
Preconfigured System Key Specifications		
System Item #	**TEL210PSC2**	**TEL220PSC2**
Imaging Depth (Air/Water)	7.0 mm / 5.3 mm	3.5 mm / 2.6 mm
Axial Resolution (Air/Water)	12 µm / 9.0 µm	5.5 µm / 4.2 µm
Lateral Resolution	13 µm	
A-Scan/Line Rate	5.5 - 76 kHz[a]	
Sensitivity (Max)	109 dB (at 5.5 kHz)	

- a. Four Discrete A-Scan Rates: 5.5 kHz, 28 kHz, 48 kHz, and 76 kHz

Part Number	Description	Price	Availability
TEL210PSC2	Customer Inspired! Spectral Domain PS-OCT System, 1325 nm, 12 µm Resolution, 5.5 to 76 kHz	$94,420.10	Lead Time
TEL220PSC2	Customer Inspired! Spectral Domain PS-OCT System, 1300 nm, 5.5 µm Resolution, 5.5 to 76 kHz	$100,785.50	Lead Time

OCT Base Units (Required OCT System Component)

- 1300 nm or 1325 nm Center Wavelength Options
  - 1300 nm, High Resolution: 3.5 mm Imaging Depth and 5.5 µm Resolution in Air
  - 1325 nm, Long Range: 7 mm Imaging Depth and 12 µm Resolution in Air
- Each Base Unit has Four A-Scan Rates for Flexibility in Imaging Speed and Sensitivity
  - 5.5 kHz to 76 kHz A-Scan Rate; 109 dB Max Sensitivity



To be functional, an OCT system build must include a base unit, a scanning system, and a scan lens kit.

The imaging performance of any OCT system is largely dependent on the design and components incorporated into the base unit. All of Thorlabs' OCT base units include an OCT engine, high-performance computer, pre-installed software, and a software development kit (SDK). For the Telesto Polarization-Sensitive OCT Base Units, the engine is comprised of a superluminescent diode light source, scanning electronics, and a linear InGaAs array-based spectrometer for detection. The engine and detection components are integrated into a 420 mm x 320 mm x 149 mm (16.55" x 12.61" x 5.88") housing. For a fully operational system, one scanning system and a scan lens kit (both sold separately below) must be purchased along with a base unit.

Deep-Imaging Base Unit
The TEL210PS Deep-Imaging Base Unit is designed using an SLD1325 superluminescent diode that provides over 100 nm of spectral bandwidth and enables the base unit to achieve a very high 7.0 mm imaging depth with 12 µm of axial imaging resolution. For these reasons, this base unit is the ideal choice for long-range imaging of highly-scattering samples in an air medium. The TEL210PS is capable of operating at A-Scan rates up to 76 kHz and offers a maximum sensitivity of 109 dB at 5.5 kHz.

High-Resolution Base Unit
The TEL220PS High-Resolution Base Unit features Thorlabs' highest resolution OCT imaging capability at 1300 nm. An ideal choice for high-resolution imaging in scattering samples, these base units utilize Thorlabs' unique matched-pair superluminescent diodes for over 170 nm of bandwidth that translates to 5.5 µm axial resolution at an imaging depth of 3.5 mm. The TEL220PS is capable of operating at A-Scan rates up to 76 kHz and offers a maximum sensitivity of 109 dB at 5.5 kHz.

Base Unit Item #	TEL210PS	TEL220PS
Description	Long-Range Imaging	High-Resolution Imaging
Center Wavelength	1325 nm	1300 nm
Imaging Depth (Air/Water)	7.0 mm / 5.3 mm	3.5 mm / 2.6 mm
Axial Resolution (Air/Water)	12 µm / 9.0 µm	5.5 µm / 4.2 µm
A-Scan Line Rate	5.5, 28, 48, & 76 kHz	
Sensitivity[a]	94 dB (at 76 kHz) to 109 dB (at 5.5 kHz)	
Maximum Pixels per A-Scan	1024	
Compatible Scanners	OCTP-1300PS, OCTP-1300PS/M	

- a. Typical Values Measured Using a Scanner with a Common Reference/Sample Path and 50% Path Split

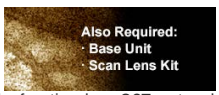
Computer Specifications[a]	
Operating System	Windows 10, 64 Bit
Processor	Quad Core, 3.6 GHz
Memory	32 GB
Hard Drive	512 GB SSD
Data Acquisition	Camera Link

- a. Computer Specifications Subject to Change

Part Number	Description	Price	Availability
TEL210PS	Customer Inspired! Telesto PS-OCT Base Unit, 1325 nm, 12 µm Resolution, 5.5 to 76 kHz	$74,263.00	Lead Time
TEL220PS	Customer Inspired! Telesto PS-OCT Base Unit, 1300 nm, 5.5 µm Resolution, 5.5 to 76 kHz	$80,628.40	Lead Time

Scanning System (Required OCT System Component)

- Scan an OCT Light Source Beam Across a Sample to Acquire 2D or 3D Images
- Polarization-Sensitive User-Customizable Scanner with Open Construction for Customization of Scan Path



To be functional, an OCT system build must include a base unit, a scanning system, and a scan lens kit.

OCT scanning systems scan the OCT light source beam across a sample for 2D cross-sectional and 3D volumetric imaging. OCT applications can vary widely, from live animal imaging to industrial materials analysis, with each requiring a different set of scanning parameters. The polarization-sensitive user-customizable scanning system is specifically designed for use with our Telesto polarization-sensitive base units.

Scanner Type	Item #	Compatible Base Units
Polarization-Sensitive User-Customizable Scanner	OCTP-1300PS(/M)	TEL210PS TEL220PS

The scanner contains an OCT interferometer with a sample arm and a reference arm. The reference arm of the OCT interferometer is placed near the sample and housed within the scanning system itself to guarantee the phase stability of the sample arm relative to the reference arm. To account

for different sample distances and reflectivities (e.g., while imaging through water), the reference arm path length, as well as the reference arm intensity, is user-adjustable. To minimize image distortion caused by dispersion, our OCT systems are designed to optically match the reference and sample arm lengths to the greatest extent possible. Dispersion effects from the sample (e.g., imaging through water or glass) can be compensated for using the included ThorImage OCT software.

The specialized Polarization-Sensitive User-Customizable Scanner contains the two additional quarter-wave plates (compared to the regular User-Customizable Scanner) which are necessary to obtain polarization images. Since the interference of light depends on its polarization state, it is necessary to change the polarization state of the light in the reference arm to be sensitive to all possible polarization states of the light in the sample arm. Hence, one quarter-wave plate is located in the reference arm and a second quarter-wave plate is located in the sample arm to create a polarization state which leads to a maximum contrast in the polarization images. Please see the *PS-OCT Tutorial* tab for more details.

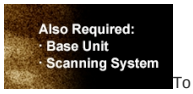
The scanner is equipped with an integrated camera that can obtain real-time *en face* video of the sample during OCT measurements when used with our ThorImage OCT software (see the *Software* tab for details). Illumination of the sample is provided by a ring of user-adjustable white light LEDs around the exit aperture of each scanner.

The OCTP-1300PS(/M) User-Customizable Scanner is designed with an open construction to enable easy customization of the optical beam path using Thorlabs' standard optomechanical components. This scanner features SM1 (1.035"-40) ports and 4-40 tapped holes at several locations that allow mounting of SM1-threaded or 30 mm cage-compatible components, respectively. The scan lens port is directly compatible with either M25 x 0.75 or SM1-threaded components, and can be converted to other thread standards, such as RMS (0.800"-36) via our selection of thread adapters. Additional scanning and non-scanning optical input/output ports are available for integration of a laser for fluorescence excitation or additional sample illumination.

Part Number	Description	Price	Availability
OCTP-1300PS/M	Customer Inspired! User-Customizable Scanner for 1300 nm & 1325 nm PS-OCT Systems, Metric	$16,019.59	Lead Time
OCTP-1300PS	Customer Inspired! User-Customizable Scanner for 1300 nm & 1325 nm PS-OCT Systems, Imperial	$16,019.59	Lead Time

Scan Lens Kits (Required OCT System Component)

- Telecentric Scan Lenses Provide Flat Imaging Plane
- Lens AR Coated for 1315 ± 65 nm
- Scan Lens Kits Include:
  - Telecentric Scan Lens
  - Illumination Tube
  - IR Card
  - Calibration Target



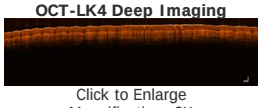
To be functional, an OCT system build must include a base unit, a scanning system, and a scan lens kit.

The cross sectional images of a finger pad, shown below, were taken with a Telesto Series OCT system fitted with the OCT-LK2 (left) and OCT-LK4 (right) scan lens kits. The selection of available Telesto series components offer significant flexibility in building an OCT system optimized for your application.

OCT-LK2 High Resolution

Click to Enlarge
Magnification: 10X
Scan Region: 6 mm x 3.5 mm
Lateral Resolution: 7 µm

OCT-LK4 Deep Imaging



Click to Enlarge
Magnification: 3X
Scan Region: 16 mm x 3.5 mm
Lateral Resolution: 20 µm

Thorlabs' Scan Lens Kits enable easy exchange of scan lenses in an OCT system, providing the flexibility to tailor imaging resolution or working distance for each application. Based on our line of OCT telecentric scan lenses, these lens kits minimize image distortion without extensive post-image processing and maximize coupling of the light scattered or emitted from the sample surface into the detection system. As seen in the table below, we offer scan lens kits compatible with the user-customizable (Item # OCTP-1300PS) scanners.

Each kit includes a telecentric scan lens, illumination tube, IR card, and calibration target. The included illumination tube serves as a light guide that channels light from the LED illumination ring down to the sample area. The IR card and calibration target are provided for calibration of the scanning mirror and lens kit, ensuring the best image quality when swapping between scan lenses.

Item #	OCT-LK2	OCT-LK3	OCT-LK4
Click Image to Enlarge			
Design Wavelength	1300 nm / 1325 nm		
Compatible Scanner	OCTP-1300PS(/M)		
Lateral Resolution[a]	7 µm	13 µm	20 µm
Focal Length	18 mm	36 mm	54 mm
Working Distance	3.4 mm (with Tube)[b] 7.5 mm (without Tube)	24.9 mm (with Tube)[b] 25.1 mm (without Tube)	41.6 mm (with Tube)[b] 42.3 mm (without Tube)
Field of View	6 mm x 6 mm	10 mm x 10 mm	16 mm x 16 mm
Lens Threading	M25 x 0.75	M25 x 0.75	M25 x 0.75

- a. $1/e^2$ Beam Diameter at Focus
- b. The illumination tube is user-removable.

Part Number	Description	Price	Availability
OCT-LK2	OCT Scan Lens Kit, 18 mm FL, 1300 nm / 1325 nm	$2,056.02	Lead Time
OCT-LK3	OCT Scan Lens Kit, 36 mm FL, 1300 nm / 1325 nm	$1,406.75	Lead Time
OCT-LK4	OCT Scan Lens Kit, 54 mm FL, 1300 nm / 1325 nm	$1,406.75	Lead Time

Sample Z-Spacers (Optional Accessories)

Click to Enlarge
Z-Spacers for the OCTP-1300PS(/M) Scanners

- Sample Z-Spacers Position Scanner at Optimal Working Distance From Sample
- Ring (Air) and Immersion (Liquid) Z-Spacers Available

Thorlabs offers both ring and immersion style sample Z-spacers that enable optimal positioning of a scanning system relative to the sample. The OCT-AIR3, OCT-IMM3, and OCT-IMM4 Z-Spacers feature knurled rings that allow the spacing distance to be adjusted and locked in place for increased stability. Several Z-spacer options are available; please see the table below for compatibility with our scanners and lens kits.

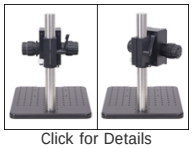
Our ring-style Z-spacers provide a distance guide between the scanner and sample. The sample is in contact with the ring-shaped tip of the spacer and should only be used when air is the scanning medium. In contrast, our immersion spacers are equipped with a glass plate that contacts the sample surface within the scanning area. Unlike the ring-style spacers, immersion spacers enable access to samples contained within a liquid environment while also providing sample stabilization. Better index matching and a tilted glass plate also help reduce strong back reflections from the sample surface and enhances the contrast of the image.

Item #	Type	Adjustable	Adjustment Range	Lockable	Compatible Scanner	Compatible Scan Lens Kit
OCT-AIR3	Ring (Air)	Yes	+3.5 mm / -1.0 mm	Yes	OCTP-1300PS(/M)	OCT-LK3
OCT-IMM3	Immersion	Yes	+3.4 mm / -1.1 mm	Yes		
OCT-IMM4	Immersion	Yes	+1.0 mm / -17.0 mm	Yes		OCT-LK4

Part Number	Description	Price	Availability
OCT-AIR3	**Ring-Style Sample Z-Spacer for OCT-LK3(-BB) Scan Lens Kit**	**$772.63**	**Lead Time**
OCT-IMM3	**Immersion-Style Sample Z-Spacer for OCT-LK3(-BB) Scan Lens Kit**	**$938.20**	**Lead Time**
OCT-IMM4	**Immersion-Style Sample Z-Spacer for OCT-LK4(-BB) Scan Lens Kit**	**$1,048.57**	**Lead Time**

Scanner Stand (Optional Accessory)

- Recommended Stand for Mounting Standard or User-Customizable Scanners
- Focus Block with Coarse/Fine Z-Axis Travel on Ø1.5" Stainless Steel Post
- 12" x 14" (300 mm x 350 mm) Aluminum Breadboard with 1/4"-20 (M6) Tapped Holes


Click for Details
The focus block can be rotated 45° to move the scanner head away from the sample.

For convenient mounting of our Standard or User-Customizable Scanners, we offer a scanner stand that is ideal for use in vibration-sensitive studies such as angiography. It consists of a post-mounted focus block with knobs that provide both coarse (40 mm/rev) and fine (225 µm/rev) z-axis travel. A rotation and height collar underneath the focus block allows it to rotate 45° in order to move the scanner head away from the sample to make adjustments.

The focus block attaches to a 12" x 14" (300 mm x 350 mm) aluminum breadboard via the included Ø1.5" post. The aluminum breadboard has side grips and rubber feet for easy lifting and transportation. There is an array of 1/4"-20 (M6) tapped holes for mounting optomechanics. Four extra 1/4"-20 (M6) tapped holes allow the mounting of the OCT-XYR1 Translation Stage (sold below) to the OCT-STAND and the OCT-XYR1/M Translation Stage to the OCT-STAND/M directly underneath the scan lens. A 1/4"-20 (M6) counterbore is also provided for securing the Ø1.5" post.

Part Number	Description	Price	Availability
OCT-STAND/M	**Stand for Standard and User-Customizable OCT Scanning Systems, M6 Tapped Holes**	**$2,164.24**	**5-8 Days**
OCT-STAND	**Stand for Standard and User-Customizable OCT Scanning Systems, 1/4"-20 Tapped Holes**	**$2,164.24**	**Lead Time**

Translation Stage (Optional Accessory)

- Optional Translation Stage with 0.5" (13 mm) of XY Travel and 360° Rotation
- Includes Cover Plate for Sample Mounting
- Can Mount Optomechanics by Removing Cover Plate

Specifications	
Horizontal Load Capacity (Max)	10 lbs (4.5 kg)
Mounting Platform Dimensions	Ø4.18" (Ø106 mm)
Stage Height	1.65" (41.8 mm)
Linear Translation Range	1/2" (13 mm)
Travel per Revolution	0.025" (0.5 mm)
Graduation	0.001" (10 µm) per Division


Click to Enlarge
The cover plate is removable for access to tapped holes and the SM1-threaded central hole.

Precise translation and rotation are often required for optimal positioning of a sample before and during OCT imaging. The OCT-XYR1(/M) is an XY linear translation stage with a rotating platform and solid plate for sample mounting and easy cleaning. The OCT-XYR1 or OCT-XYR1/M stage can be secured to the OCT-STAND or OCT-STAND/M, respectively, using the 1/4" (M6) counterbores at the corners. The top plate is removable for access to 4-40, 8-32 (M4), and 1/4"-20 (M6) tapped holes and an SM1-threaded (1.035"-40) central hole for mounting optomechanical components. The XYR1A Solid Sample Plate can be purchased separately as a direct replacement for the top plate.

The X and Y micrometers offer 1/2" (13 mm) of travel with graduations every 0.001" (10 µm). The stage's rotation and translation can be freely changed without compromising the stability of attached components. An engraved angular scale along the outer edge of the stage's rotating platform allows the user to set the angular orientation of the stage, which can then be fixed using the 5/64" (2 mm) hex locking setscrew. Locking the rotation of the stage does not prevent XY translation using the actuators.

Part Number	Description	Price	Availability
OCT-XYR1/M	XY Stage with Solid Top Plate, 13 mm Travel, 360° Rotation, Metric Taps	$772.63	Today
OCT-XYR1	XY Stage with Solid Top Plate, 1/2" Travel, 360° Rotation, Imperial Taps	$772.63	5-8 Days