LUMEDICA | OQ LABSCOPE

User Manual

Version 1.2

Contents

Introduction

Please read this instruction manual before operating the OCT imaging system. All statements regarding safety and any technical specifications only apply when the system is operated correctly.

This system is intended for laboratory use only and is NOT cleared or certified for medical applications.

This system contains a superluminescent diode (SLD) which is considered a Class 1 laser device.

There is laser emission from the lens at the end of the scanner.

The Lumedica OQ Labscope OCT Imaging system is an optical coherence tomography system for general laboratory, research, and industrial use. A 840 nm superluminescent diode (SLD) provides the light source. When combined with an interferometer and high-resolution spectrometer, the system generates optical depth images of samples. System is configured with a scanner that may be used in either a handheld configuration or mounted into a scanner stand. An embedded Windows PC provides the user interface for controlling the system and generating the OCT images. The system will image any samples that can be placed about 1 cm from the end of the scanner

Thank you for purchasing an OQ LabScope system from Lumedica. Our goal at Lumedica is to build great OCT systems at affordable prices. We believe that OCT imaging should be available to all who wish to use it in education, research, and industry.

The team at Lumedica is available to support your work. If you have questions or ideas, please contact us at the email address or phone number below.

Contact: Lumedica, Inc., 701 West Main Street, Suite 200, Durham, NC 27701 USA
Email: support@lumedicasystems.com
Phone: 1-919-590-5693

The version number of this manual is 1.2 and it covers the OQ LabScope hardware version 1.1 with software version 1.2.

Safety

General Safety

- Check the supply voltage and cords before plugging in the system. System power supply must be plugged in to a grounded outlet (100 -240 VAC, 50 – 60 Hz). If the provided cords do not match your outlet, please contact Lumedica for a replacement.
- The main unit (or system chassis) requires a supply voltage of 12Vdc and has a maximum power rating of 60W. This power is supplied by a removable 12Vdc mains supply with power cord.
- If the system has been recently shipped; do not operate until the unit temperature has equilibrated to room temperature.
- System must be on a flat, dry, and stable surface for operation.
- There are no user serviceable parts inside the scanner or the computer. Operators may make adjustments to the reference arm inside the OCT engine. Instructions are provided in the section titled 'Customized OCT System Configuration'.
- Do not obstruct the air vents on the bottom or top of the system.
- The safety of any system incorporating this system is the responsibility of the assembler of the combined system.
- If the system is used in a manner not specified by the manufacturer, then protection provided by the system may be impaired.
- Noise Levels for this equipment were recorded at less than 70 db(A).

Foreseeable Misuse

- Do not use this product outdoors.
- Do not store or operate the system in a damp or closed environment.
- Do not use the equipment in a potentially explosive atmosphere.
- Do not use solvents on or near the equipment.
- Do not use equipment unless trained to do so.
- Do not open any of the sealed electrical enclosures.
- Ensure that the equipment is disconnected from the mains power prior to re-locating, any maintenance, and/or cleaning.

Care and Maintenance

Please handle the system with care during packing, transportation, and unpacking. Banging or dropping the system can damage the unit or reduce system performance.

- Do not store or operate the system on surfaces that are susceptible to vibrations.
- Keep away from dust, dirt, and air-borne pollutants.
- The system is not designed for outdoor use. Protect the system from rain, snow, and humidity.
- Do not expose the system to mechanical or thermal extremes.
- The system has a degree of ingress protection of IP32.
- The acceptable environment use conditions for this equipment are:
    - Indoor use only.
    - Altitude up to 2000 m.
    - Temperature range of 5C to 40C.

  - Maximum Relative Humidity (RH) at 80% for temperatures up to 31C, decreasing linearly to 50% RH at 40C.
  - Mains supply voltage fluctuations up to +/- 10% of nominal voltage.
  - Transient over-voltages up to the level of overvoltage category II.
  - Temporary over-voltages occurring on the mains supply.
  - Applicable pollution degree of intended environment is PD2.
- Cleaning optional monitor – monitor screen may be cleaned with an oil-free, lint free type cloth.
- Cleaning the system chassis – the chassis may be wiped down with an oil free, lint free cloth. Canned air duster may be used to blow dust off of main unit.
- Cleaning scanner – scanner may be wiped down with oil free, lint free cloth. Canned air duster may be used to blow dust off of scanner including optics. If optics becomes dirty or smudged, such as with fingerprints, please contact Lumedica customer service.

Residual Risk

Please note the following residual risks associated with this equipment.

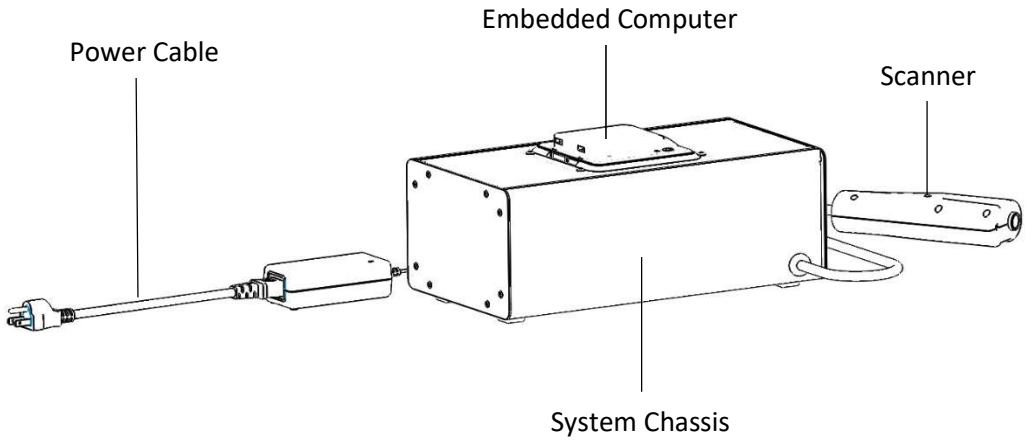
- Possibility of electrical shock if/when working inside electrical enclosures.
- Possibility of ergonomic injury when moving the equipment. The main unit (or system chassis) weighs 4.0 kg, the scanner weighs 0.5 kg, and the optional scanner stand weighs 3.0 kg.

Service

Only trained and approved Lumedica personnel are allowed to service the system. Please contact Lumedica support for more information.

Components

These are your OQ LabScope system hardware components.



Quick Start (Basic System Only)

Carefully open the shipping box and unpack all items. Contents include:

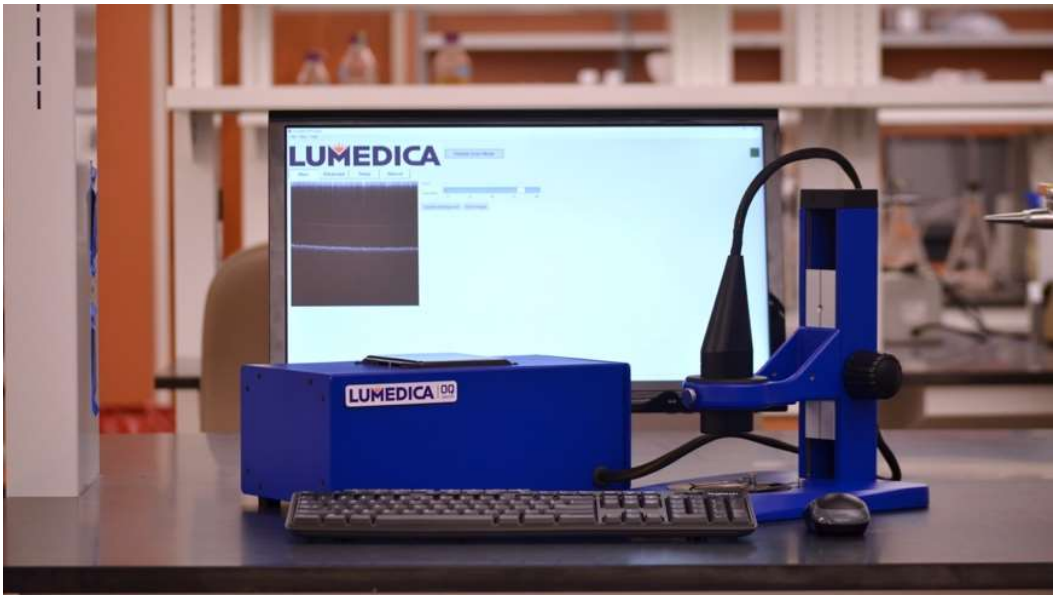
- User Manual
- OQ LabScope system with handheld scanner
- Power supply with 12Vdc cord
- Appropriate country cord for 12Vdc power supply (US, EU, AU, IN, and UK)
- Roll of Scotch™ tape

If any items are missing, please contact us directly at support@lumedicasystems.com.

1. Set up OQ LabScope system within a meter of an electrical outlet.
2. Select country cord for your location and plug into 12Vdc power supply.
3. Plug power supply into wall outlet.
4. Plug 12 Vdc power cord into back of OQ LabScope box.
5. You will need to supply a monitor with a resolution of 1920 x 1080 and an HDMI interface with cord. The software interface is designed for this resolution and may not work at other resolutions.
6. You will need a keyboard and mouse. We recommend using a combination wireless or Bluetooth keyboard/mouse so that only one USB port is required.
7. Make sure that the handheld scanner cable is laid flat and not twisted or kinked.
8. Make sure scanner is in secure location and will not fall off of lab bench.
9. Power up OQ LabScope by pushing the button on top of the box.
10. Windows 10 OS will boot up and take you to the login screen.
11. Login **username** is: **oqlabscope**
12. Login **password** is: **oqlabscope**
13. Start OQ LabScope software by double clicking on Lumedica OQ LabScope icon.

14. Software will come up on "Main" tab.
15. Push "Start Scan" button on "Main" tab.
16. OCT image will begin updating.
17. Push "Update Background" to minimize horizontal noise in image.
18. Place Scotch™ tape under handheld scanner and position scanner and tape so that top of tape is near to the top of the OCT image.
19. Adjust the focus slider on the left side of the image to optimize.

Quick Start (with Workstation Package)



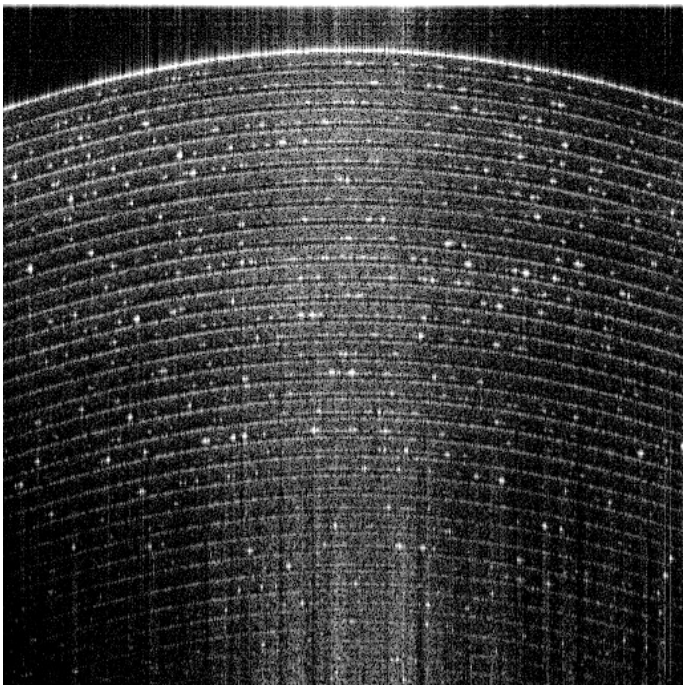
The Workstation Package contains the following additional contents:

- Monitor
- HDMI cable for monitor
- Appropriate country power cord for monitor
- Wireless keyboard
- Wireless mouse
- USB dongle for keyboard and mouse (inside mouse battery cover)
- Scanner stand (includes base, plate for base, vertical stage with travel, Allen keys, and holder for scanner)
- Adapter for integrating handheld scanner into scanner stand

If any items are missing, please contact us directly at support@lumedicasystems.com.

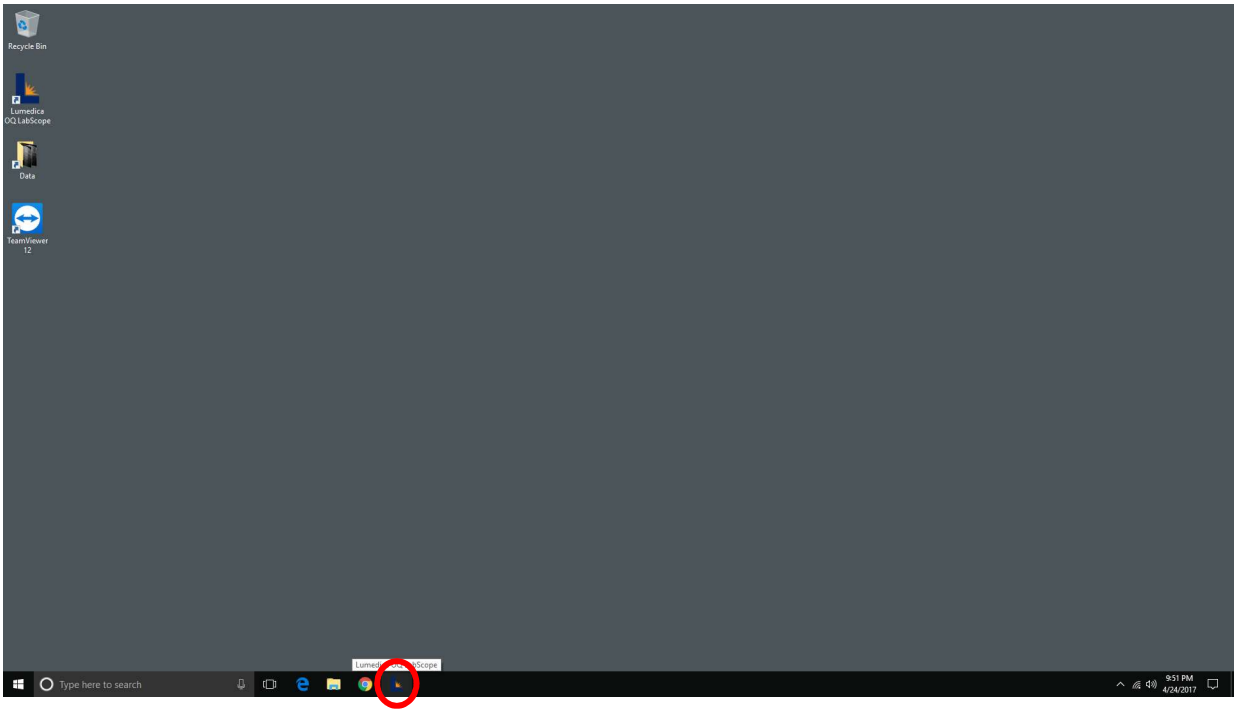
1. Set up OQ LabScope box within a meter of an electrical outlet.
2. Select country cord for your location and plug into 12Vdc power supply.
3. Plug power supply into wall outlet.
4. Plug 12Vdc power cord into back of OQ LabScope box.
5. Set up monitor.
6. Connect HDMI cable to back of monitor and then to back of OQ LabScope box.
7. Connect country power cord to monitor.
8. Plug power cord into mains outlet.
9. Plug USB dongle into either USB port on top of OQ LabScope box.
10. Set up scanner stand.
11. Vertical stage is attached to baseplate with two screws.

12. Holder for scanner attaches to vertical stage with one screw. Note that holder should be orientated with arm at the bottom, otherwise scanner will be too high above the sample.
13. Place plate in base.
14. Insert scanner into scanner adapter and secure with the provided screws.
15. Insert scanner with adapter into holder on scanner stand.
16. Power up monitor by pressing power switch.
17. Power up OQ LabScope by pushing the button on top of the box.
18. Windows 10 OS will boot up and take you to the login screen.
19. Login **username** is: **oqlabscope**
20. Login **password** is: **oqlabscope**
21. Start OQ LabScope software by double clicking on Lumedica icon.
22. Software will come up on "Main" tab.
23. Push "Start Scan" button on "Main" tab.
24. OCT image will begin updating.
25. Push "Update Background" to minimize horizontal noise in image.
26. Place Scotch™ tape under handheld scanner and position scanner and tape so that top of tape is near to the top of the OCT image.
27. Adjust the focus slider on the left side of the image to optimize.
28. Image should look like this:



Software

The software is started by clicking on the L icon on the taskbar.



Main Tab

This tab provides the interface needed to run the software. Software functionality is organized by tabs: Main, Processing, Advanced and Configuration

Buttons:

Start Scan/Stop Scan — Used to start and stop the acquisition of OCT images.

Update Background — Available when the system is acquiring OCT images, i.e. the Start/Stop button says "Stop Scan". When this button is pressed the system will acquire a background frame which is then subtracted from all subsequent frames. As the system drifts over time, horizontal lines will appear in the OCT image. Updating the background will minimize these horizontal lines. Remove the sample before updating the background so that the OCT image does not become part of the background.

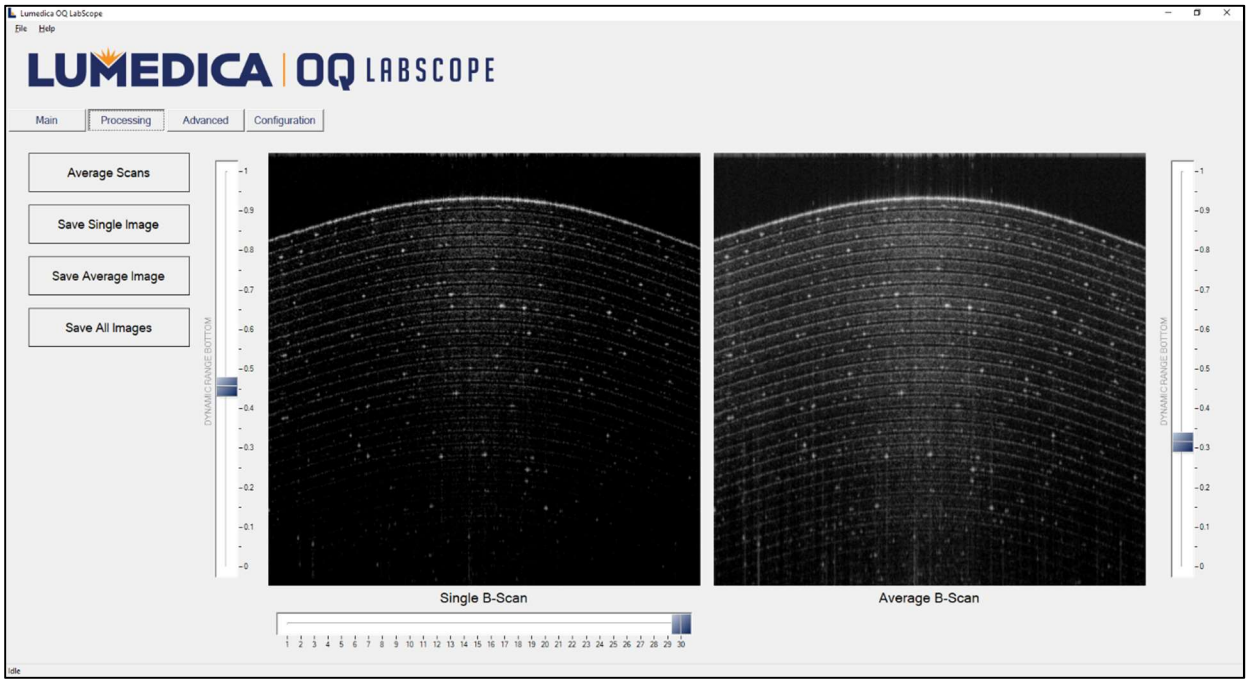
Save B-Scan Image — Available when the system is not acquiring OCT images, i.e. the Start/Stop button says "Start Scan". When this button is pressed, the system will save the displayed image to a .tif and a .jpg file. The files are saved to C:\Users\Public\Documents\Lumedica\OctEngine\Data and are named "BSCAN-SGL-#date#-#time#" where #date# is the current date and #time# is the time when the file was saved.

Capture C-Scan — Available when the system is not acquiring B-Scan OCT images, i.e. the Start/Stop button says "Start Scan". When this button is pressed, the system will initiate a single C-Scan with the default value of 32 B-Scans per C-Scan. The number of B-Scans per C-Scan is selectable on the Configuration tab. The images are stored in the image buffer and can be saved to disk using the "Save All Images" button on the Processing tab.

Sliders:

Focal Value — Located to the left of the OCT image, this slider controls the liquid lens in the scanner. Moving the slider up and down sets the focus position of the OCT scanning beam. When the slider is at the top of the screen, the focus is closest to the scanner and when the slider is at the bottom of the screen the focus is farthest away from the scanner.

Processing Tab



This tab contains the image processing controls. This functionality is only enabled when the OCT system is not scanning. That is, the Start/Stop button on the Main tab says "Start Scan."

The OQ LabScope software maintains a circular buffer of the last 30 images acquired by the system. This corresponds to about 3 seconds of imaging time.

Buttons:

Average Scans — Averages all of the scans that are in the image buffer. Displays the result in the right hand panel on this tab.

Save Single Image — Stores the selected single B-Scan image that is displayed in the left-hand panel to disk. This image is saved in both .tif and .jpg formats. The directory where the files are saved is C:\Users\Public\Documents\Lumedica\OctEngine\Data. The files are named "BSCAN-SGL-#date#-#time#" where #date# is the date and #time# is the time when the file was saved.

Save Average Image — Stores the average B-Scan image that is displayed in the right-hand panel to disk. This image is saved in both .tif and .jpg formats. The directory where the files are saved is C:\Users\Public\Documents\Lumedica\OctEngine\Data. The files are named "BSCAN-AVG-#date#-#time#" where #date# is the current date and #time# is the time when the file was saved.

Save All Images — Stores all B-Scan images in the image buffer to disk. These images are saved in .jpg format. The files are saved to a new folder in C:\Users\Public\Documents\Lumedica\OctEngine\Data\#date#-#time# where #date# is the

current date and #time# is the time when the files were saved. The files are named "BSCAN-SGL-#number#" where #number# is the number of the image in the buffer, zero-padded to three digits (e.g. 001).

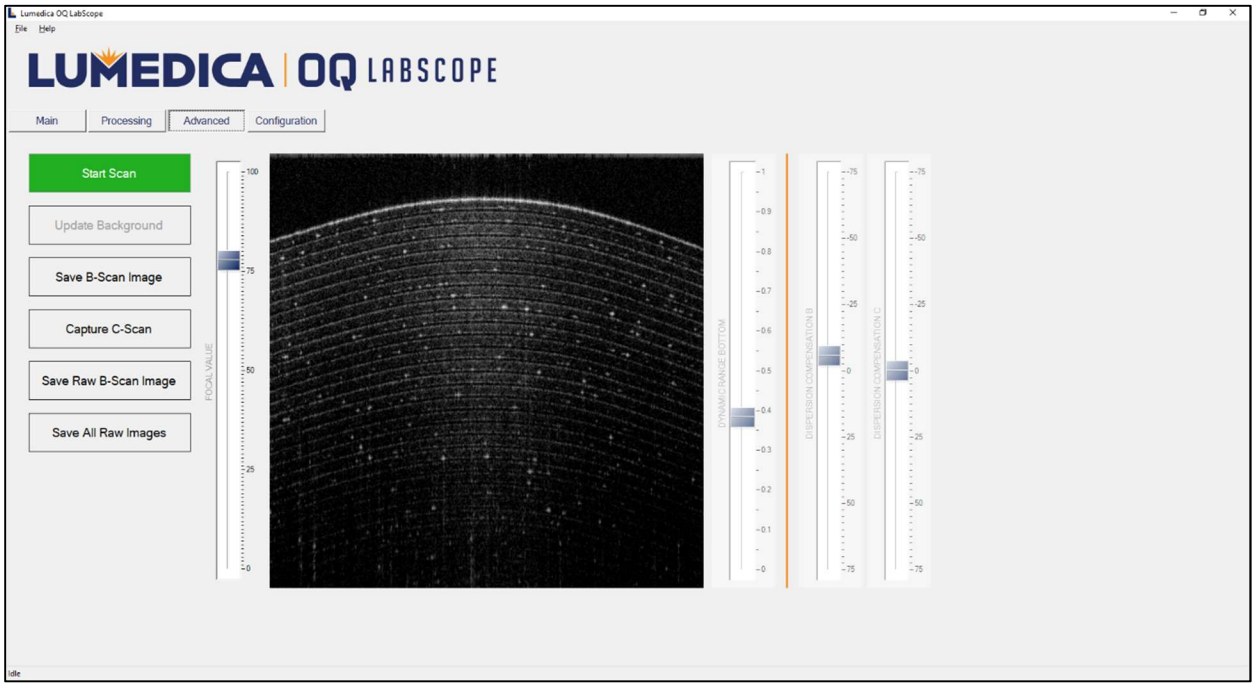
Sliders:

Single B-Scan Dynamic Range Bottom — Located to the left of the Single B-Scan OCT image, this slider controls the bottom value of the intensity range of this image. Sliding this all the way to the bottom will typically make the image look brighter and noisier. Sliding this toward the top will typically make the image look blacker and less noisy, but will start to suppress the image signal. As the slider approaches the top of the range, only the most intense areas of the image will still be visible.

Average B-Scan Dynamic Range Bottom — Located to the right of the Average B-Scan OCT image, this slider controls the bottom value of the intensity range of this image. The effect is similar to the slider on the left, however, the averaged image is typically less noisy, so it may be possible to set the slider to a lower value while still maintaining a good image.

Single B-Scan — This slider at the bottom of the Single B-Scan OCT image selects which image from the image buffer is being displayed. The image buffer contains up to 30 images when capturing B-Scans and all of the B-Scans captured when acquiring a C-Scan.

Advanced Tab



This tab provides additional control over how the OCT image is acquired and processed.

Buttons:

Start Scan/Stop Scan — Start and stop the acquisition of OCT images.

Update Background — Available when the system is acquiring OCT images, i.e. the Start/Stop button says "Stop Scan". When this button is pressed the system will acquire a background frame which is then subtracted from all subsequent frames. As the system drifts over time, horizontal lines will appear in the OCT image. Updating the background will minimize these horizontal lines. Remove the sample before updating the background so that the OCT image does not become part of the background.

Save B-Scan Image — Available when the system is not acquiring OCT images, i.e. the Start/Stop button says "Start Scan". When this button is pressed, the system will save the displayed image in both .tif and .jpg formats. The directory where the files are saved is C:\Users\Public\Documents\Lumedica\OctEngine\Data. The files are named "BSCAN-SGL-#date#-#time#" where #date# is the current date and #time# is the time when the file was saved.

Capture C-Scan — Available when the system is not acquiring B-scan OCT images, i.e. the Start/Stop button says "Start Scan". When this button is pressed, the system will initiate a single C-Scan acquisition with the default value of 32 B-Scans per C-Scan. The number of B-Scans per C-Scan is selectable on the Configuration tab. The images are stored in the image buffer and can be saved to disk using the "Save All Images" button on the Processing tab.

Save Raw B-Scan Image — Available when the system is not acquiring OCT images, i.e. the Start/Stop button says "Start Scan". When this button is pressed the system will save a copy of the raw B-scan data from the spectrometer to a file. The image format is .tif and is in the directory C:\Users\Public\Documents\Lumedica\OctEngine\Data. The files are named "BSCAN-RAW-#date#-#time#" where #date# is the date and #time# is the time when the file was saved. The current background subtraction data is also saved with the name "BSCAN-BKGD-#date#-#time#".

Save All Raw Images — Available when the system is not acquiring OCT images, i.e. the Start/Stop button says "Start Scan". When this button is pressed the system will save a copy of all the raw B-Scan data in the queue from the spectrometer to a set of files. The image format is .tif and they are saved to a new folder in C:\Users\Public\Documents\Lumedica\OctEngine\Data\#date#-#time# where #date# is the current date and #time# is the time when the files were saved. The files are named "BSCAN-RAW-#number#" where #number# is the number of the image in the buffer, zero-padded to three digits (e.g. 001). The current background subtraction data is also saved in this folder with the name "BSCAN-BKGD".

Sliders:

Focal Value — Located to the left of the OCT image, this slider controls the liquid lens in the scanner. Moving the slider up and down sets the focus position of the OCT scanning beam. When the slider is at the top of the screen, the focus is closest to the scanner and when the slider is at the bottom of the screen the focus is farthest away from the scanner.

Dynamic Range Bottom — This slider on the right side of the image sets the bottom value of the intensity range of the left-hand image. Sliding this all the way to the bottom will typically make the image look whiter and noisier. Sliding this toward the top will typically make the image look blacker and less noisy, but will start to suppress the image signal. As the slider approaches the top of the range, only the most intense areas of the image will still be visible.

Dispersion Compensation B — Sets the second order coefficient in the dispersion compensation. This may be adjusted while the system is running to optimize the value.

Dispersion Compensation C — Sets the third order coefficient in the dispersion compensation. This may be adjusted while the system is running. Typically, the value of this coefficient is close to zero.

Configuration Tab

Buttons:

Scan Direction — Set to either "Horizontal" or "Vertical". The vertical scan direction is aligned with the long side of the handheld scanner. The horizontal scan direction is aligned with the short side of the handheld scanner. When the scanner is placed in the scanner stand, the horizontal direction is left to right scanning and the vertical scan is front to back scanning.

Sliders:

Scan Width — Sets the relative length of the B-Scan. The longest scan is "1" and it may be shortened down to "0", at which point the scanner is not moving. This will give a time series at one point, which is referred to as an M-mode scan. A scan length of 1 corresponds to 7 millimeters of scan range. All B-scans have the same number of A-scans, i.e. a shorter scan of a curved surface will make the image appear flatter.

B-Scans Per C-Scan — Set the number of B-Scans captured in a C-Scan. Options are 32, 64, 128, 256, and 512. C-Scan capture time scales with the number of B-Scans and can be as long as 120 seconds for a C-scan with 512 B-Scans.

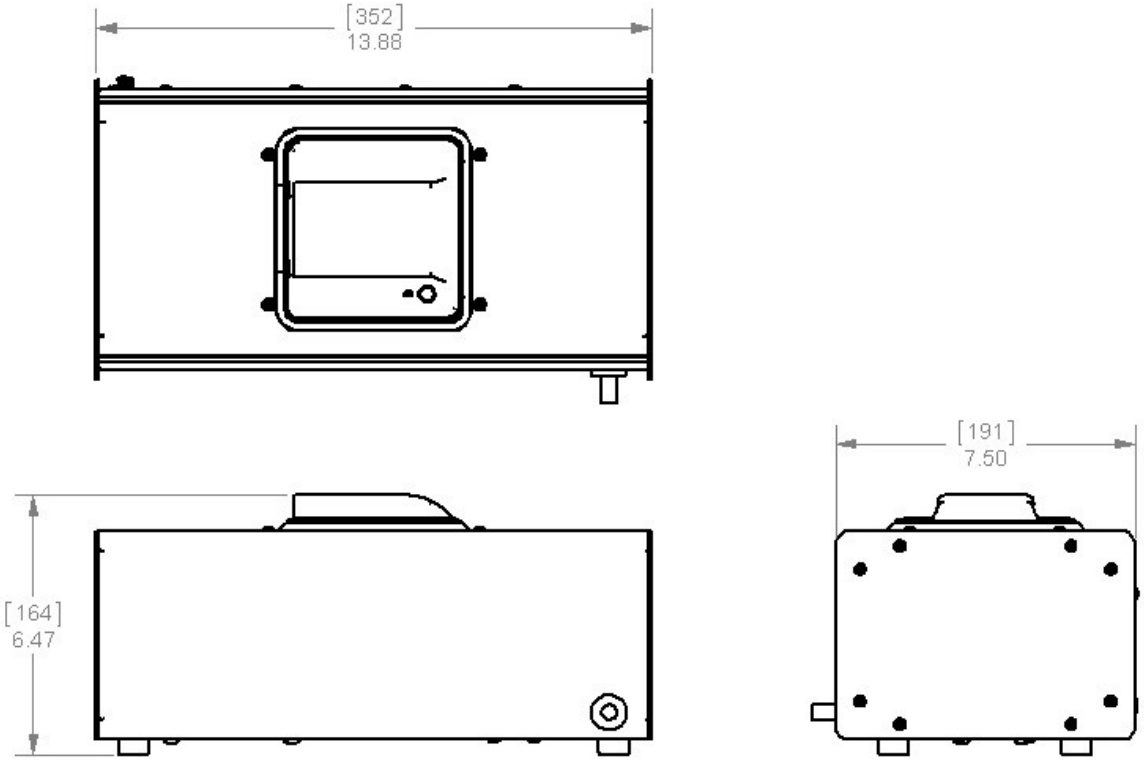
Hardware

System Specifications

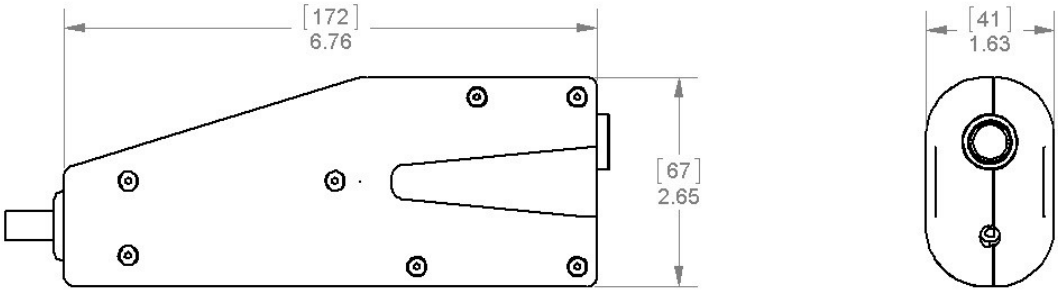
Image Size	*512px x 512px*	**A-Scan Line Rate**	*8,800/second*	**Output Power**	*750 µW max.*
Depth Resolution	*7 µm in air, 5 µm in tissue*	**B-Scan Image Rate**	*12/second*	**System Size**	*33w x 19d x 15h cm.* *13w x 7.5d x 6h in.*
Transverse Resolution	*15 um*	**C-Scan Image Rate**	*Set by number of B-scans in C-scan*	**Scanner Size**	*11w x 6.4d x 4.8h cm.* *4.5w x 2.5d x 1.9h in.*
Center Wavelength	*840 nm*	**Linear Scan Range**	*7 mm*	**System Weight**	*4.0 kg.*
Sensitivity (OSNR)	*100 dB*	**C-Scan Range**	*5mm x 5mm*	**Scanner Weight**	*0.5 kg.*

Mechanical Drawings

System Chassis



Scanner



Customized OCT System Configuration

Software configuration file

There is a configuration file for the software that can modify some of the parameters that are not available in the graphical user interface. If you need access to the configuration file, please contact us at support@lumedicasystems.com.

Hardware – inside the box

The hardware inside the OQ LabScope box includes the light source, spectrometer, reference arm, and computer.

It is possible to make adjustments to the reference and sample arm; however we only recommend this to users with some experience with OCT systems.

To access the hardware inside of the box, unscrew the four screws holding the top panel onto the box. There are two on the left side and two on the right side.

Open the top by lifting from the front side. Be careful since the computer is mounted to the top and there are several USB cables running from the computer to other parts of the system. You may need assistance holding the top open while making adjustments inside the box.

Polarization control

Inside the OQ LabScope are two sets of polarization paddles. Each set has two paddles. The set at the back is in the sample arm and the set closer to the front is in the reference arm. The amount of polarization rotation is set by the position of each of the two paddles in the two arms.

The reference arm should remain static and should not require any polarization adjustment.

The sample arm may need adjustment if the orientation of the handheld scanner is significantly different than when it was assembled. Before adjusting the paddles, make sure that the scanner umbilical is not looped across itself and that the umbilical does not have a twist in it. Both of these conditions may affect the polarization.

If the polarization is still misaligned, the position of the two paddles can be adjusted to re-optimize. We recommend having a known sample to image while making the adjustment, such as the roll of Scotch™ tape supplied with the system.

Reference arm pathlength and power control

The reference arm consists of a fiber optic section and a free space section. Within the free space section there is a collimating lens, a focusing lens and a mirror.

Pathlength adjustment – the pathlength of the reference arm can be adjusted by unscrewing the locking ring and screwing in or out the assembly consisting of the focusing lens and mirror. Once the pathlength is adjusted, the locking ring can be tightened down to hold the pathlength in place.

Power adjustment – the power returned by the reference arm is set by the spacing between the focusing lens and the mirror at the far end of the reference arm tube. If the distance from the lens to the mirror is very close to the focal length of the lens, then a large amount of power will be reflected back to the interferometer. If the mirror is closer to the lens than the focal length, less light will be coupled back into the interferometer. By adjusting the spacing between the lens and mirror, the reference arm power can be controlled with reasonable precision.

To make an adjustment, unscrew the locking ring closest to the end of the reference arm. Then screw the tip with the mirror farther away from the lens for more light or closer to the lens for less light. Once the power level is adjusted, tighten down the locking ring.

Note that adjusting the power level also adjusts the pathlength. After adjusting power, it may be necessary to adjust pathlength as well.

Hardware – inside the scanner

There are no user adjustable or serviceable parts inside the scanner.

Regulatory

As required by WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Lumedica offers all end users in the EC the possibility to return end of life systems without incurring disposal charges.

Systems must be:

- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- A complete system, not disassembled and not contaminated.

This service does not cover:

- OEM products that are integrated into other systems
- Components
- Mechanics and optics
- Left over parts of disassembled systems.

Please contact Lumedica for details on how to return end of life systems.

If you do not return an end of life system to Lumedica, you must deliver it to a company that specializes in waste recovery. Do NOT dispose of the system in a litter bin or at a public waste disposal site.

Warranty

Standard Warranty

Lumedica offers a standard 90-day warranty on all OCT imaging systems.

Extended Warranty

Extended warranties may be purchased from Lumedica, Inc. Please contact Lumedica to determine if your system already has an extended warranty or to receive a quote for further warranty coverage.

Non-Warranty Repairs

Systems returned for repair that are not covered by warranted will incur repair charges in addition to all shipping expenses. Any repair charges will be quoted to the customer and accepted by the customer before any work is performed.

Warranty Exclusions

Warranty does not apply to systems which are (1) custom, modifications or otherwise nonstandard, (2) ESD sensitive items whose static protection has been opened or compromised, (3) repaired, modified or altered by any party other than Lumedica, (4) used in conjunction with equipment not provided by or acknowledged as compatible by Lumedica, (5) subjected to unusual physical, thermal, or electrical stress, (6) damaged due to improper installation, misuse, abuse, or storage, or (7) damaged due to accident or negligence in use, storage, transportation, or handling.

Certifications and Compliance

CE CE

CE DECLARATION OF CONFORMITY

Manufacturer:

Lumedica Inc.
1312 Dollar Ave
Durham, NC 27701
USA

Product: OQ LabScope
Power: 12 Vdc
Serial #: OQL-01-0018 through OQL-01-0118

Description: Optical coherence tomography imaging system

We, as the manufacturer, hereby declare that the Products described above (and on the attachment page), are in conformity with the applicable requirements in accordance with the following European Directive(s):

Low Voltage Directive 2014/35/EU
EMC Directive 2014/30/EU

The object of the declarations described above is in conformity with the relevant Union harmonization legislation. This declaration of conformity is issued under the sole responsibility of the manufacturer for the aforementioned product(s).

The following Harmonized Standard(s) and normative references were complied with -

EN 61010-1:2010 - Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements

EN 55011: 2009/A1:2010 - Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

EN 61326-1: 2013 - Electrical equipment for measurement, control and laboratory use - Part 1: General requirements

European person authorized to compile the Technical File, on behalf of the Manufacturer, is:

Dianne Cowley of Laicon Consulting Service Ltd
300 Pennistone Rd
Sheffield, S6 2FU
England

Signed for and on behalf of:

Lumedica Inc.
1312 Dollar Ave
Durham, NC 27701
USA

Name of signatory: William Brown

Signature:

Function/Position: Chief Technology Officer

Date: 01/12/2017

CE ORIGINAL DECLARATION OF CONFORMITY CE