

# **LISST-200X**

# **Path Reduction**

# **Module**

**User's Manual**

**Version 1.0**

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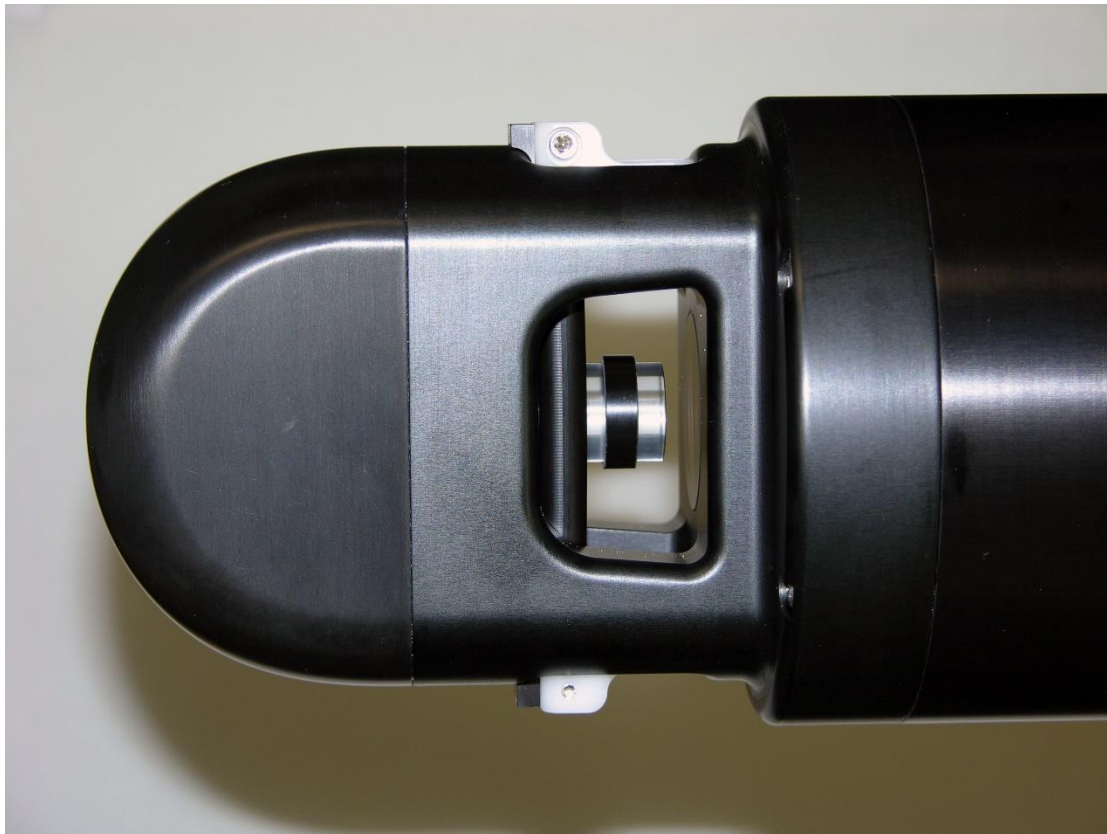
### **Technical assistance**

For technical assistance please contact your local Distributor or Sequoia. Please be sure to include the type of battery pack with any correspondence.

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Path Reduction Module for LISST-200X

# 1. Overview of LISST-200X Path Reduction Module

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The LISST-200X has been designed to cover a wide range of concentrations of particles. However, when the concentrations are high the light scattering from the particles can include multiple scattering which will affect the measurement of particle size and concentration. The concentration where multiple scattering can take effect is dependent on particle size. The finer the particles are the lower the maximum concentration where multiple scattering will occur. The rule-of-thumb we recommend is when the optical transmission is less than 30% multiple scattering may be significant enough to cause errors. The multiple scattering gradually increases as the concentration increases. Therefore, 30% optical transmission is a warning level where multiple scattering may be present. It may still be possible to get reasonable data down to 10% transmission. Below is a table with estimates of the maximum concentration for different sized particles.

To measure higher concentration with the LISST-200X the optical path that the laser passes through needs to be reduced. By reducing the optical path, we decrease the number particles in the laser beam and therefore reduce the chances of having multiple scattering. The maximum concentration scales linearly with the optical path. If we reduce the optical path by  $\frac{1}{2}$  we double the maximum concentration. Sequoia has designed a Path Reduction Module (or PRM) for the LISST-200X that reduces the optical path from 25mm to 5mm. This results in increasing the maximum concentration by a factor of 5 over the standard LISST-200X.

Mean particle diameter		Wentworth grades	LISST-200X Estimated Maximum concentration in mg/L	
$\mu\text{m}$	Phi		25mm Path (Standard)	5mm Path (with PRM installed)
1.95	9.00	Clay	83	416
3.9	8.00	Very Fine Silt	166	831
7.8	7.00	Fine Silt	332	1662
15.6	6.00	Medium Silt	665	3324
31.25	5.00	Coarse Silt	1332	6659
62.5	4.00	Very fine sand	2728	13638
125	3.00	Fine sand	5327	26637
250	2.00	Medium sand	10655	53273

Table 1: Estimated maximum concentration for different sizes and different path lengths


The following sections include detailed instructions for installing, uninstalling and maintaining the Path Reduction Module for the LISST-200X.

## 2. Installing the Path Reduction Module (PRM)

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The PRM for the LISST-200X consists of a highly polished quartz cylinder and mounting hardware. The quartz cylinder is press against the smaller transmit windows with a small drop of highly filtered water. The plastic holder and spacers hold the quartz cylinder in place during deployments. The LISST-200X must be configured for use with the PRM. This will ensure the proper path length is used when computing the particle concentration.

The step-by-step instructions below will show how to install the PRM, obtain a good background, and configure the LISST-200x using the LISST-SOP200X software.

STEP	ACTION	RESULT
1	<ul style="list-style-type: none"> <li>• Locate all the components of the LISST-200X Path Reduction Module as shown below.</li> <li>• The parts include quartz cylinder with retaining ring, PRM Plate, two PRM Plugs and two 4-40 x 7/8 socket head cap screws and an o-ring (size 2-016) that is pre-installed between the quartz cylinder and the PRM Plate.</li> </ul> 	PRM ready to be installed.
2	<ul style="list-style-type: none"> <li>• Secure the 200X in a vertical orientation with the optics endcap on the top.</li> <li>• Clean the optics endcap cavity.</li> <li>• Clean the windows with alcohol or glass cleaner.</li> </ul> <p>Remove any particulates with compressed air.</p>	LISST-200X ready for PRM to be installed
3	<ul style="list-style-type: none"> <li>• Clean both ends of the PRM Glass with alcohol or glass cleaner.</li> <li>• Put a large drop of filtered water on top of the glass rod.</li> <li>• Insert the PRM Plate into the 200X optics head (through one of the square openings) until it is centered.</li> </ul>	PRM mostly installed.



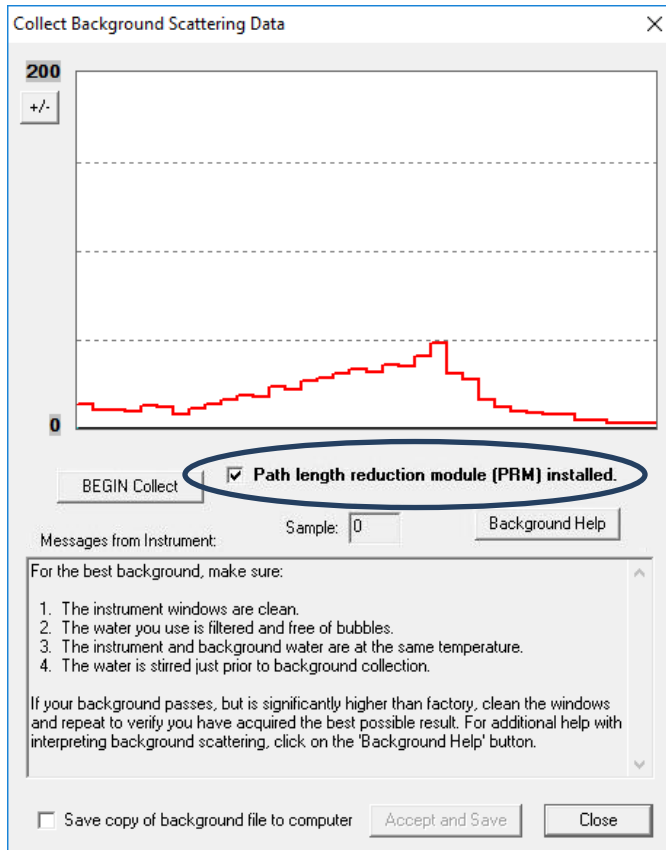
- Insert the white PRM End Plug under the PRM Plate to lift the plate up to the transmit window.
- Insert the second PRM End Plug.



4	<ul style="list-style-type: none"> <li>• Before installing the screws into the PRM Plugs to lock them in place, we recommend checking the clean water background to make sure that there are no bubbles between the window and cylinder or other problems.</li> <li>• Most LISST-200X instruments have very similar optical alignment in both air and water. Therefore, for the purposes of a quick check of the PRM installation it is possible to check the clean water background with air in the 5mm gap between the PRM and the Large Window. This allows the LISST-200X to remain in the vertical orientation while the PRM installation is checked.</li> <li>• Check the Clean Water Background using the Standard procedure described in the LISST-200X User's Guide. The results should be close to the factory values. However, they may not receive a PASS result because of the instrument being in air.</li> <li>• <b>WARNING:</b> A background performed in air is not acceptable for particle measurements. A new background with clean water must be performed before deploying the instrument.</li> <li>• If the background does not look good, remove the PRM, clean the glass surfaces and re-install the PRM until an acceptable background is obtained.</li> </ul>	PRM installation has been checked.
5	<ul style="list-style-type: none"> <li>• Install the two 4-40 x 7/8 socket head cap screws into the PRM Plug using a 3/32" Allen wrench to lock the PRM assembly to the LISST-200X.</li> </ul>	PRM fully installed and ready for use.
6	<ul style="list-style-type: none"> <li>• Before deploying the instrument with the PRM the instrument must be configured for use with the shortened path length. The path length is stored in the data file and is used during data processing, therefore it is critical the instrument is properly configured before collecting data.</li> </ul>	

- Open the LISST-SOP200X program and connect your instrument. A clean water background must be collected with the PRM in place. Open the Collect Background window and select the PRM checkbox. Proceed to collect and save a new background using the Standard procedure described in the LISST-200X User's Guide.

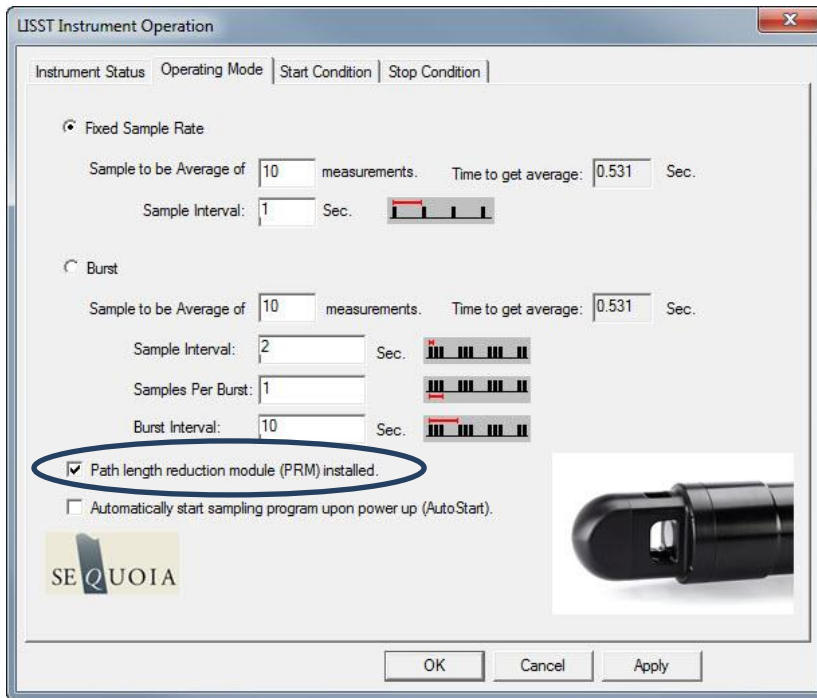
Clean water background collected with PRM installed.





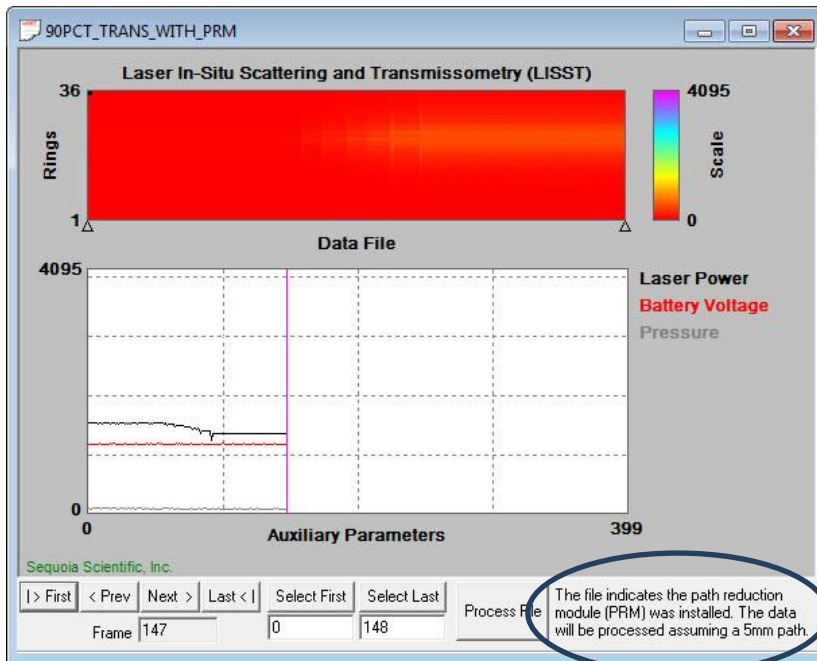
- Next, open the instrument configuration window in the LISST-SOP200X. Under the Operating Modes tab select the PRM checkbox. Press the 'OK' button to finish configuring the instrument.

Instrument sampling program configured with PRM installed



- When processing a data file collected with the PRM installed, a message will appear in the data preprocessing window. This indicates the data are being processed assuming a reduced path length.

Data processed using the correct path length.



### 3. Removing the PRM

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The procedures shown below describes the recommend method for removing PRM for the LISST-200X.

STEP	ACTION	RESULT
1	<ul style="list-style-type: none"><li>• Clean the LISST-200X optics head and PRM components to remove any large debris that could scratch the glass windows or cylinder when the PRM is removed.</li><li>• It may be necessary to remove any hard growth, such as barnacles, before removing the PRM.</li><li>• Be careful not to scratch the glass surfaces.</li></ul>	LISST-200X and PRM clean and ready for disassembly.
2	<ul style="list-style-type: none"><li>• Remove the two 4-40 x 7/8 long socket head cap screws from the PRM plug using a 3/32" ball driver or Allen wrench.</li><li>• While holding the PRM Plate, remove the two PRM Plugs. The PRM Removal Tool will be helpful for pulling out the PRM plugs. Be sure to hold the PRM Plate so that it does not fall out or drop unexpectedly.</li><li>• Carefully slide the PRM Plate with quartz cylinder from the optics of the LISST-200X.</li><li>• The PRM plate may need to be tipped to separate the PRM from the glass window.</li></ul>	PRM removed.
3	<ul style="list-style-type: none"><li>• After removing the PRM, clean the optics of the LISST-200X and all the PRM parts before storage.</li><li>• Be sure to protect the quartz cylinder from scratches or impacts that could damage the optical surfaces.</li><li>• It is also highly recommended to change the instrument configuration on the LISST-200X to reflect that the PRM is no longer installed.</li></ul>	

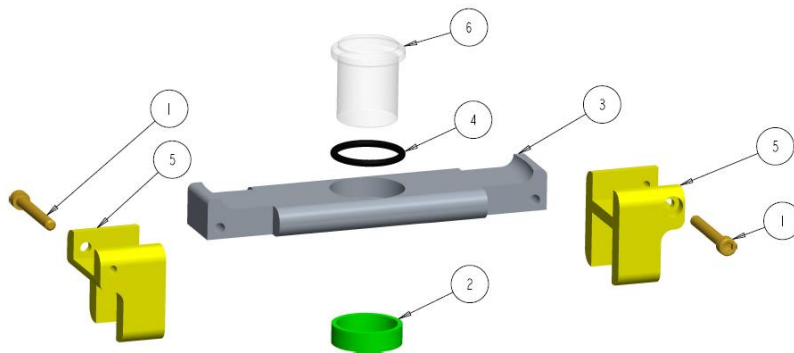
## 4. Maintaining the LISST-200X Path Reduction Module

Usually a simple cleaning of the Path Reduction Module is all that is necessary to maintain it in optimum working condition. However, it may be necessary to completely disassemble the PRM components to fully clean them. The following text describes the procedure for fully disassembling the PRM.

STEP	ACTION	RESULT
1	<ul style="list-style-type: none"><li>Remove the PRM from the LISST-200X and clean the assembly as much as possible.</li><li>Carefully clean the outside surface of the quartz cylinder so that the plastic retaining sleeve can be removed.</li><li>Note: Full disassembly is usually not required and is only recommend if absolutely necessary.</li></ul>	PRM components clean and ready for full disassembly.
2	<ul style="list-style-type: none"><li>The quartz cylinder is designed with a step to allow it to be captured by the PRM Plate. A plastic sleeve is pressed onto the cylinder to keep it from falling out during assembly.</li><li>The plastic sleeve is held on to the glass by a friction fit. It can be removed so that the cylinder can be separated from the plate. The sleeve may be easy to slide off or it could be tight on the glass cylinder. Be careful when forcing the sleeve off cylinder. Do not use sharp tools that could damage the sleeve or the cylinder.</li><li>There is an O-ring between the lip of the cylinder and the PRM Plate. This O-ring is not use as a seal but as a spring to keep the cylinder press against the small window. The size of this O-ring is 2-016.</li></ul>	PRM disassembled.

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- After cleaning all the components re-install the O-ring onto the cylinder and insert it into the PRM Plate. Note the correct orientation as shown in the picture below.



- Install the plastic sleeve onto the quartz cylinder. The sleeve should not up against the PRM Plate. There should be about a 3mm gap between the parts. Refer to the picture below for guidance. The cylinder should be able to move freely.
- Reattached the PRM Plugs using the two screws to keep all parts together.
- Wrap the optics with protective soft tissue and store the assembly in a safe place.



PRM re-assembled and ready to use.