LISST-PORTABLE | XR

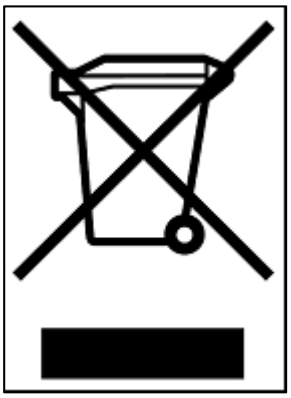
Manual

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Waste Electrical and Electronic Equipment

Smaltimento di apparecchiature elettriche ed elettroniche da rottamare

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1 Introduction

Dear LISST-PORTABLE|XR Customer:

Thank you for purchasing the LISST-PORTABLE|XR Particle Size Analyzer! This instrument delivers the size distribution and volume concentration of particles in a sample of particles suspended in a liquid. The instrument operates in a stand-alone mode using its internal, rechargeable battery and touch panel display. The instrument can collect, process, store and display data. Offload the stored data for display in spreadsheets. Data offloading software (Windows based) is included. The instrument can be powered by an external power supply if it is used mainly in the laboratory.

The LISST-PORTABLE|XR is extremely simple to operate. All commands and operational modes are accessed using buttons on the touch panel display. No PC is required, except for offloading data to a computer.

The intent with this manual is to get you started using the LISST-PORTABLE|XR as quickly as possible. Sequoia's goal with the LISST-PORTABLE|XR is to make the user interface so friendly that no manual should be required for normal operation, except as a first-time introduction to the instrument. During normal operation, most of the questions that the user will want answered can be resolved from the User's Guide. This double sided laminated document is attached to the inside lid of the instrument. The front side shows the general menu structure and the backside has some additional instructions on using the instrument.

The LISST-PORTABLE|XR uses the widely accepted method of laser diffraction to measure the size and concentration of particles suspended in a carrier liquid. The LISST-PORTABLE|XR employs the full Mie theory in its calculations. The instrument delivers the concentration of suspended particles (micro-liters/liter, or µl/l) in 44 size classes. The size analysis covers the range from 0.4 to 500 µm. The useful operating range of the instrument is defined based on optical transmission of the sample chamber. For clean, clear fluids, when the optical transmission exceeds 95%, weak signals from particles result in noisy measurements. On the other end, when the optical transmission is less than 75%, significant contributions from multiple-scattering bias the size distribution results to lower sizes. For this reason, the recommended operating range is 75-95% for optical transmission.

Sequoia Scientific, Inc. is pleased that you have chosen one of our products. Thank you! We strive to make our instruments rugged, reliable, and simple to operate. If you should have any difficulties or questions regarding this product, please feel free to contact your local distributor or us.

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2 Contents and Technical Specifications

2.1 Getting started

The LISST-PORTABLE|XR ships in a Pelican case with foam cushioning. Included in the case are the yellow LISST-PORTABLE|XR, the accessory kit, and this manual. The accessory kit contains the combined 110/220VAC charger/power supply and communication and charging cable, drain tube, funnel for filling chamber, some test particles and the LISST-Portable software on a USB memory card.



The LISST-PORTABLE|XR in its Pelican Shipping case (part # SSA-LPXR-SC) with accessory kit.

The Windows-based PC software is on a USB memory card inside the accessory kit. Insert the USB card into your PC. Navigate to the Ship Disk folder and double-click the file named Setup_Portable.exe. This will install the LISST-PORTABLE|XR software on your PC.

After installation, the software is accessible from the Start Menu. The path is Start > Programs > Sequoia Scientific > LISST-Portable.

After installation, the executable (LisstPort.exe) is located in C:\Program Files\Sequoia\LISST-Portable for 32-bit Windows machines and C:\Program Files (x86)\Sequoia\LISST-Portable for 64-bit Windows machines.



Inside the accessory kit, you will also find the LISST-PORTABLE|XR combined charger/power supply, and communication cable (part # SSA-LPXR-CBL). The instrument ships fully charged. You can use the LISST-PORTABLE|XR while it is charging.



Take the instrument out of the box and place it on a level surface. Open it. Locate the drain tube in the accessory kit and push it into the black push-to-connect fitting on the back of the instrument. Turn on the instrument by pushing the power on button on the top right corner. The connector for the power and communication cable is on the top left corner of the instrument.

LISST-PORTABLE|XR (part # SSP-LPXR) showing the Quick Reference Sheet (part # LPORT-M-0160), the stylus holder (part # LPORT-M-0107), and Sequoia stylus (part # LPORT-M-0110).

2.2 General Features

- Truly portable - completely self-contained with built-in data logger, processor, rechargeable battery, and 7” touch panel color display.
- Touch panel allows for easy SOP programming, sample analysis and display of data without a PC.
- Shock mounted optics block.
- Multiple Mie models as well as Fraunhofer model available for inversion, selectable from the touch panel.
- All data processing is performed on board and stored in ASCII format. No post-processing is necessary.
- Outputs: Total volume concentration, mean size, standard deviation, optical transmission, D5, D10, D16, D25, D50

(median grain size), D60, D75, D84, D90, D95, D60/D10 (Hazen uniformity coefficient), particle surface area, silt fraction, silt volume, size distribution, battery voltage, sample notes.
- Resistant to Ethanol, IPA, diesel.
- Optional built-in ultrasonic probe for complete particle dispersion.
- Small-angle forward laser light scattering (laser diffraction), compliant with the ISO-13320-1 standard.

2.3 Specifications

2.3.1 SIZE AND CONCENTRATION RANGE

- 0.34-500 µm in 44 size classes.
- 30-1,900 mg/l. Concentration range depends on the size distribution of the particles, as per examples in the table below.
- Concentration resolution < 1 mg/l.
- Concentration accuracy: ± 20%.

Material	Concentration [mg/l] @ 95% transmission	Concentration [mg/l] @ 75% transmission	D10 [µm]	D50 [µm]	D90 [µm]	SMD [µm]
ISO Fine	30	170	1.5	7	41	3
ISO Coarse	95	395	4	38	99	10
20-30 µm glass beads	195	1075	19	24	34	24
Sieved sand 75-125 µm	345	1925	85	122	175	112

2.3.2 MECHANICAL AND ELECTRICAL

- Dimensions and weight of instrument: 17.7 cm (7") × 29 cm (11.5") × 44.3 cm (17.5") [H×D×W]; 7.5 kg (17 lbs).
- Dimensions and weight in shipping box: 78 cm (31") × 53 cm (21") × 28 cm (11"); 22 kg (49 lbs).
- Data storage: 128 MB flash card, capable of storing at least 40,000 size distributions and associated sample information.
- RS232 interface with built-in USB-serial adapter.
- Rechargeable Lithium-ion battery provides for 6 hours of sample processing
- AC battery charger (120/240 VAC). The battery charger cannot overcharge the battery pack.
- Optional 25W, 40kHz ultrasonic probe with controller electronics, managed from the touch panel display.

2.4 ASCII data file format (.ASC extension)

The .ASC file is a comma-separated file with 3 rows of text and info before the measurement data. If single sample was chosen as storage mode (see chapter **Error! Reference source not found.**) only one additional row (#6) will be present. If multiple samples was chosen as storage mode several additional rows, one per sample, will be present in the file.

Row 1	Header identifying file as a LISST-PORTABLE|XR data file and the date, time and day number of file creation.
Row 2	Instrument serial number
Row 3	Firmware version and date
Row 4, elements 1-21 (columns A-U)	Headers used for displaying the data in the enclosed EXCEL spreadsheet.
Row 4, elements 22-65 (columns V-BM)	Midpoint of the 44 LISST-PORTABLE|XR size classes in µm.
Row 4, elements 66-84 (columns BN-CF)	Headers used for displaying the data in the enclosed EXCEL spreadsheet.
Row 5	Units for the headers in row 4.
Row 6, element 1	Date in MM/DD/YYYY format
Row 6, element 2	Time in HH:MM:SS format

Row 6, element 3	Optical Transmission [dimensionless]. The optical transmission is the fraction of emitted laser light power that is passing undisturbed through the sample volume, and which therefore does not contribute to the scattering of light off of the particles.
Row 6, element 4	Total Volume Concentration [µl/l]. The Volume Concentration is the total volume of sediment within the size ranges covered by the instrument. It is computed by summing up the volume concentration in each of the 44 size classes.
Row 6, element 5	Total Mass Concentration [mg/l]. The Mass Concentration is computed from the volume concentration multiplied by the density specified by the user. (see section 3.2).
Row 6, element 6	Mean Size [µm]. This is the mean size of the particle size distribution. See the FAQ (chapter 11) for information about how it is computed.
Row 6, element 7	Standard Deviation [µm]. This is the standard deviation of the particle size distribution. See the FAQ (chapter 11) for information about how it is computed.
Row 6, element 8	D5 [µm] is the 5^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 9	D10 [µm] is the 10^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 10	D16 [µm] is the 16^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 11	D25 [µm] is the 25^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 12	D50 [µm] is the 50^{th} percentile of the cumulative percentage undersize by volume of the sediment. It is the median diameter of the sample.
Row 6, element 13	D60 [µm] is the 60^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 14	D75 [µm] is the 75^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 15	D84 [µm] is the 84^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 16	D90 [µm] is the 90^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 17	D95 [µm] is the 95^{th} percentile of the cumulative percentage undersize by volume of the sediment.
Row 6, element 18	D60/D10 [dimensionless] is Hazen's Uniformity Coefficient. It is a measure of the range of particle sizes present in a given sample.
Row 6, element 19	The Surface Area [cm^2] is the total surface area of all particles in the size range covered by the instrument.
Row 6, element 20	Silt Volume [µl/l]. The total volume concentration of particles < 64 µm.
Row 6, element 21	Silt Ratio [dimensionless]. It is the proportion (by volume) that particles < 64µm makes up of the total volume (Row 6, element 4).
Row 6, elements 22-65	Volume concentration [µl/l] in each of the 44 size bins.
Row 6, element 66	Sample Name
Row 6, element 67	Operator Name
Row 6, element 68	SOP Name
Row 6, element 69	SOP Note
Row 6, element 70	Optical model (Fraunhofer or Mie)
Row 6, element 71	The real and imaginary parts of the refractive index for the particles selected for the optical model.

	EMPTY FOR FRAUNHOFER.
Row 6, element 72	Effective Density [g/cm^3]
Row 6, element 73	Mixer Speed [%]
Row 6, element 74	Mixer Duration [seconds]
Row 6, element 75	Ultrasonic Intensity [%].
Row 6, element 76	Ultrasonic Duration [seconds]
Row 6, element 77	Average Duration [seconds]
Row 6, element 78	Single or Multiple Sample flag. 1 if samples are saved as individual files, 0 if samples are appended to file.
Row 6, element 79	Manual Control. 1 is SOP mode is manual control, 0 is SOP mode is automatic control
Row 6, element 80	Battery voltage [V].
Row 6, element 81	Laser reference power in digital counts
Row 6, element 82	Laser transmitted power in digital counts.
Row 6, element 83-84	Reserved for future use.

2.5 Binary data file format (.DAT extension)

The binary data file contains the raw, uncalibrated scattering data from the individual measurement(s). This file is used by Sequoia technical personnel for troubleshooting data and should be offloaded and archived responsibly together with the .ASC and .LOG files created by the instrument.

2.6 Log file format (.LOG extension)

The log file contains information about instrument settings during sampling.

The user can see the average duration, what shape model was selected, instrument serial number, firmware version, file names for processed data and raw data, sampling date and time, and battery voltage.

The log file has a slightly different appearance, depending on the data storage settings for the sample (see section 3.2 for details on storage mode).

2.7 Size ranges

The 44 size classes cover the size range from 0.34-500 µm. The table shows the lower and upper limit of each size bin in µm, together with the median size (also in µm).

Size bin #	Lower	Upper	Median
1	0.343	0.405	0.372
2	0.405	0.477	0.439
3	0.477	0.563	0.519
4	0.563	0.665	0.612
5	0.665	0.784	0.722
6	0.784	0.926	0.852
7	0.926	1.09	1.01
8	1.09	1.29	1.19
9	1.29	1.52	1.40
10	1.52	1.80	1.65
11	1.80	2.12	1.95
12	2.12	2.5	2.30
13	2.50	2.95	2.72
14	2.95	3.48	3.20
15	3.48	4.11	3.78
16	4.11	4.85	4.46
17	4.85	5.72	5.27
18	5.72	6.75	6.21
19	6.75	7.97	7.33
20	7.97	9.40	8.65
21	9.40	11.1	10.2
22	11.1	13.1	12.1
23	13.1	15.4	14.2
24	15.4	18.2	16.8
25	18.2	21.5	19.8
26	21.5	25.4	23.4
27	25.4	30.0	27.6
28	30.0	35.4	32.5
29	35.4	41.7	38.4
30	41.7	49.2	45.3
31	49.2	58.1	53.5
32	58.1	68.6	63.1
33	68.6	80.9	74.5
34	80.9	95.5	87.9
35	95.5	113	104
36	113	133	122
37	133	157	144
38	157	185	170
39	185	218	201
40	218	258	237
41	258	304	280
42	304	359	331
43	359	424	390
44	424	500	460

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3 Operation

3.1 Introduction

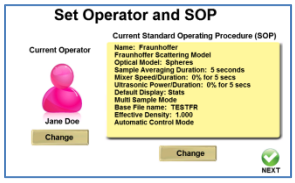
This section describes the procedures, functionality, and settings of the LISST-PORTABLE|XR. The instrument is self-contained. If the battery is charged, you do not need a power supply or PC to obtain, process, store, or display particle size distributions. The LISST-PORTABLE|XR only requires a PC to offload data; see section 8.4 for details.

3.2 Controls and power up

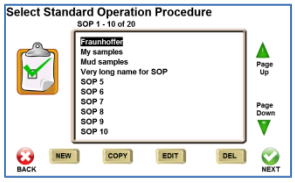


The touch panel display controls operation of the instrument. The only exception to this is the drainage of the instrument, which is via the lever in the bottom left corner of the sample cell, and offloading of data, which is via the serial connector in the upper left corner of the instrument panel. See section 8 for details regarding the software.

There is an ON/OFF button at the top right of the instrument panel. Switch on power by pushing down the power button. After a few seconds, the touch panel display will display the Operator and SOP menu.



The initial menu is the Set Operator and SOP menu. SOP is short for Standard Operating Procedures. SOP's enable you to define procedures for sample processing and store them on the instrument. This ensures that analysis of a particular type of sample always is in the same manner, regardless of the operator. From this menu, you can change operator names and define SOP's. In order to change or add an operator, tap the Change button below the operator icon and follow the instructions. You can add a maximum of 10 operators.

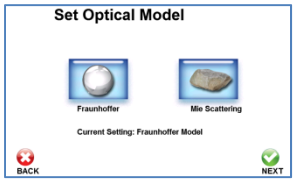


When you have selected or added an operator, you must select or create an SOP. Tap the Change button below the SOP listing. Use the arrows to scroll through existing SOP's and select one by tapping it and then the Next button. If you select an SOP the main menu will show, see section 3.3.

If you want to create a new SOP, tap the New button. You are guided through a set of screens, most of which are self-explanatory but will be described briefly in the following.



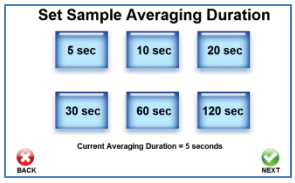
You must first select a descriptive name for your SOP, for example Glass Beads or Location No 21.



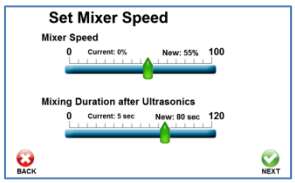
The most important selection is choosing your optical model. If you know exactly what kind of material your sample is made up of, select Mie Scattering, and then select the optical property of the material you are analyzing from the drop down list of materials.

If the material is not on the list, or if you do not know the exact kind of material that makes up your sample, you should select Fraunhofer as optical model.

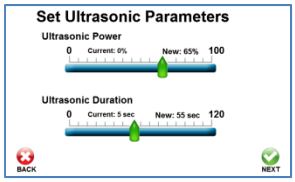
See the FAQ (section 11) for more information on how to choose the appropriate model.



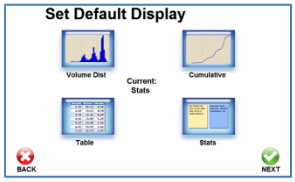
The bottom of the screen shows the current average duration. For most samples, the default setting of 5 seconds will be suitable. However, for samples with low concentration, choose a longer duration as this will decrease the influence of random noise on the result. Select the desired averaging duration by tapping the appropriate button and return to the Setup Menu.



Set the mixer speed and duration. When setting the mixer speed, it is important to observe if the mixer creates bubbles when mixing. If it does, make sure that the mixing chamber is full, or reduce the mixer speed. Be careful that the mixer speed is not too low, as this can cause particles to settle and not be measured.



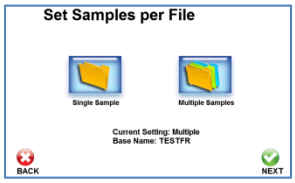
Set the power and duration for the ultrasonic probe (if installed). The ultrasonic probe ensures full dispersion of all particles in the mixing chamber so that the measured size distribution is that of the single particles.



The processed data can be viewed in four different ways:

1) as a graph showing the volume distribution
2) as a graph showing the cumulative distribution
3) in a table format
4) as a statistics summary.

Select which of these four options will be shown **first** when the results are being displayed after being processed. The other three options will always be accessible through a tabbed display.



The current storage mode shows together with the base name.

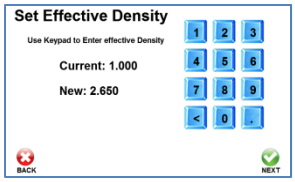
Push the Single Sample button to store the results from each measurement in separate data files.

Push the Multiple Samples button to store several measurements in the same data file.

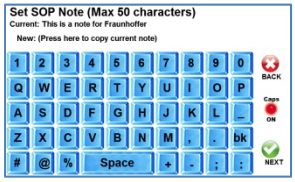


Enter a base name (file name) with a length of maximum 6 characters, e.g. ‘Sand’. The instrument will subsequently add the sample number to the base name if the data storage mode has been set to Single Sample (e.g Sand01.asc, Sand02.asc), up to 99. If the storage mode is Multiple Samples, the instrument will store each new sample in a new line in the file (Sand.asc).

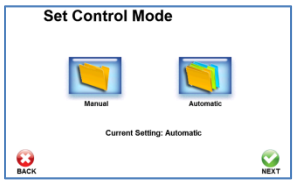
The bk button is the backspace button.



If you wish to have the instrument output the concentration of your sample in mg/l, you must enter the effective density of the particles. Set this number to 0 if you do not know the effective density.



If you wish, you can enter a note for this particular SOP. For example a common sample location or type of samples.



Select the control mode. In Automatic Mode, the instrument will not allow you to control the mixer and ultrasonic probe when you analyze the sample. Select Manual Mode for full control over these settings. CAUTION: In Manual Mode, there is no guarantee that all samples are processed and measured in the same manner.

After completing these steps, the instrument will load the appropriate files and display the main menu.

3.3 Main Menu / Setup Menu



There are four main buttons on the Main Menu screen: Measure, Display, Info, and Setup.



The Measure button guides you through the measuring process in six steps.



The Display button lets you scroll through already processed samples and display them on the touch panel display.



The Info button displays information about the instrument's serial number, battery charge, remaining memory, SOP settings etc.



The Setup button opens up the Setup Menu, where you can change instrument settings, set the date and time, and delete files.



The six buttons on the Setup Menu are Average Duration, Single/Multiple measurements per file, Default Display, Operator/SOP, Base Name, and System Setup.

If your SOP is in manual mode, you can change the settings for, e.g. averaging duration here. The next sample you measure in manual mode will use this new setting and then revert to the setting in the SOP for subsequent samples.



In System Setup, you can set the clock, delete files one by one (for multiple file deletion you must use the Windows® software), set the backlight and mixer time-out, and set screen brightness.



The Quick Reference Sheet on the inside of the instrument lid shows all the possible options available from the start-up screen. Explore the sheet in order to become comfortable with the structure and layout of the menu system, as well as with the feel and operation of the touch panel display.



The Quick Reference Sheet has a backside as well. The backside has more detailed information about the main menu options, as well as maintenance and cleaning tips and tricks.

When navigating the menus, simply press the cancel button to return to the previous menu without making any changes.

The Sequoia button in the bottom left hand of the task bar serves as a home button. Press this at any time to return to the Main Menu without making any changes.

4 Measuring a Sample



This section guides you through the measuring process. There are six steps in measuring a sample – see the upper left corner of the Quick Reference Sheet – detailed in the following.

Before you start you should make sure that you have the following:
1) Particle-free water (e.g. de-ionized, milli-Q, steam-distilled) for background measurements.
2) Funnel for filling the mixing chamber.
3) Sample suspended in an appropriate liquid[1] in a beaker.
4) Container, for example a bucket or a sink for draining the sample from the mixing chamber.



From the Main Menu, tap the Measure button.



Note that you can check the SOP details from the Step 1 screen by pressing the SOP Details button.

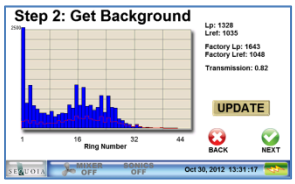
The first step is to make sure that the mixing chamber is clean and fully flush out the previous sample.

Lift off the mixing chamber lid and make sure the drain lever is in the closed position. The lid might be on tight – turning it so you can use the corners to wriggle it might help. Then fill up the chamber approximately half with clean water, put the lid back on adjust the mixer speed up to 150% using the slider.

Let the clean water circulate for ~5 seconds, open the drain lever, make sure the water drains completely out of the chamber (~5-10 seconds), close the drain, and slide the mixer to 0% to turn it off. When there is liquid in the chamber you can also turn on the ultrasonic (if installed) in order to help clean the chamber. The ultrasonic inserts into the chamber using the ultrasonic holder as displayed on the picture.

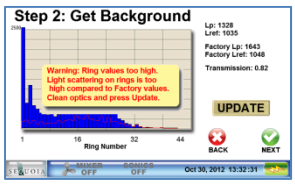
It may be necessary to repeat this cleaning procedure if the previous sample was very turbid and the mixing chamber therefore dirty.

Once you are satisfied that the mixing chamber is clean, tap the NEXT button to proceed to step 2: Get Background.



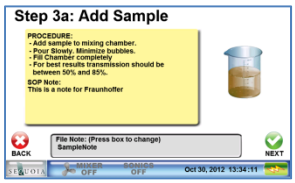
Now that the chamber is clean, fill it with clean filtered water to obtain a background measurement. Press Update to refresh the display of the 44 light scattering sensors. The blue bars are the current values and the red line is the factory values. Compare the measurements to evaluate the quality of the current background (see the backside of the quick guide in the LISST-Portable|XR lid). If the blue bars are higher than the red line try cleaning and rinsing the chamber again.

Tap the Back button to return to Step 1 if needed. Otherwise, tap Next to accept the background and continue.

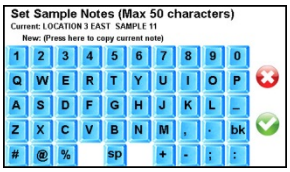


A warning message appears if the laser power is too low. This may indicate that the windows are dirty and need cleaning. In this case, drain the mixing chamber and clean the windows with a Q-tip (see section 10.2).

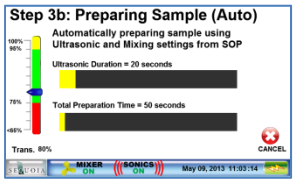
[1] **DO NOT** use any other liquids than water (fresh or salt water), ethanol, isopropanol (isopropyl alcohol) or non-corrosive oils for suspending particles! **Solvents such as acetone, toluene etc. will permanently damage the instrument and immediately void the warranty!**



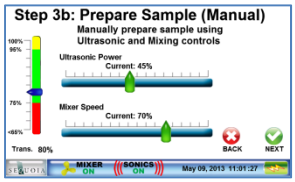
Make sure the drain lever is in the closed position and then add the sample from your beaker to the mixing chamber. You can use the funnel to pour the sample through the hole in the center of the mixing chamber, or you can remove the lid and pour the sample in directly. Make sure that your sample is well homogenized and suspended before you pour it in so that you are not introducing bias into your results.



If you press the grey 'File Note' box the keypad will appear, and you can enter a note with a maximum length of 50 characters.



If the SOP is set for Automatic mode the mixer and ultrasonic automatically turns on and prepares the sample before measurement. The screen will display the time remaining for each step and show the current optical transmission. When the preparation is complete, the sample is measured.



If the SOP is set for Manual mode the mixer and ultrasonic needs to be manually controlled using the sliders on the screen. Turn off the ultrasonic when the sample is ready, but leave the mixer at the desired speed and tap the Next button.

For both Auto and Manual Mode the optimum concentration range is shown as percent optical transmission in the optical bar chart on the left. The transmission values should range from 75 to 95% (green part of the bar).

If your sample causes the transmission to drop to below 65% (bottom red part of the bar) you must dilute the sample – see the FAQ in chapter 11.

If your sample concentration is so low that the transmission is in the yellow part of the bar, above 95%, you should increase the averaging time, see section 3.2.

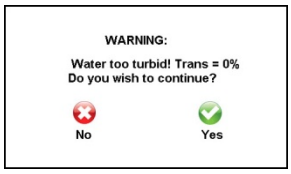


If you did not turn on the mixer, a warning message will appear, asking you to confirm if you really do not wish to turn on the mixer.

Push the Yes button to turn on the mixer and continue.

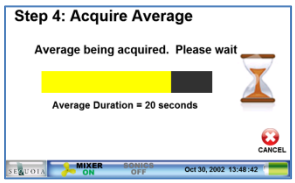
Push the No button to continue without turning on the mixer.

Note: It is HIGHLY recommended that you always turn on the mixer. Otherwise your results will be unreliable, as the particles in the mixing chamber will settle out and only be partially measured, or not measured at all!

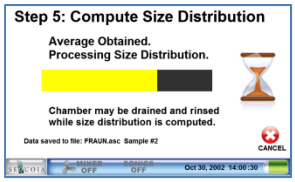


If the optical transmission is below 65% a warning message appears.

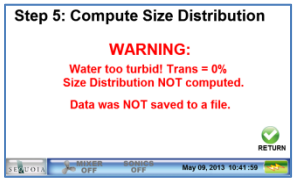
If you wish to continue, push the Yes button, otherwise push the No button and try diluting the sample.



The instrument now acquires a sample average while displaying a progress bar.



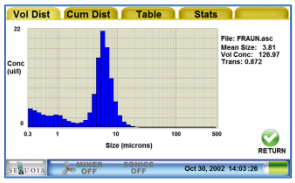
Finally, the instrument computes the size distribution from the averaged data. This step takes about 45 seconds. During this time, you can rinse and drain the mixing chamber in preparation for the next sample. When the processing is complete the results will be displayed to the screen.



If the transmission is below 5% the warning message to the left will appear, and the size distribution will not be computed from the measurement, nor will any data be saved to the file.

If this message appears you must dilute your sample prior to measuring it again.

Push the button in order to return to Step 1.



The results displays in one of four screens. The SOP includes a setting for the screen to be shown first. To view the other screens press the tab at the top of the screen. Tap Return to go to the Step 1 screen in order to measure the next sample.

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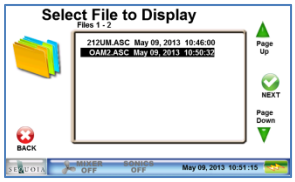
5 Displaying a Saved Measurement



The upper right corner of the Quick Reference Sheet explains how to display an already processed and saved measurement.

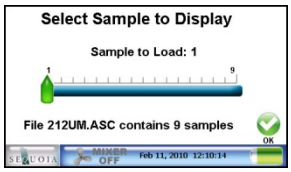


Tap the Display button on the Main Menu.

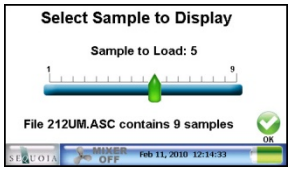


If more than 10 files are stored you will need to use the arrows to scroll up and down the pages until you come to the page with the file you want to display. Highlight the filename you want to display by tapping it.

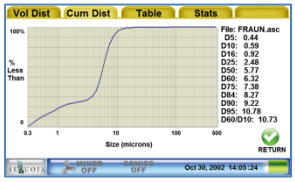
Tap the ✓ button in order to open up the selected file and display the data.



If you had selected multiple files as storage mode, you will have to select the sample to load. For example, for file 212UM.ASC, there are 9 samples in total in the file.



Push down and drag the green slider across the bar to select the sample number you want to load and display. In this case sample number 5 will be loaded. Once you have selected the sample number, push the ✓ button in order to open up the sample and display it.



The sample displays. Tap the tabs to display the sample in other ways, e.g. as a cumulative distribution, in a table format or as a statistics summary.

Push the ✓ button in order to return to the Main Menu.

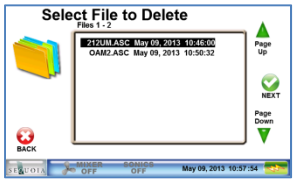
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6 Deleting Files



There are two ways to delete file(s) on the instrument: Using the touch panel display, or using the Windows software provided with the instrument.

This section explains how you can delete single files on the instrument using the touch panel display. Section 8.5 explains how to delete single or multiple files using the Windows software.



From the Main Menu, tap Setup -> System Setup -> Delete Files

Use the arrows to page through the list of files. Tap a file in order to highlight it and select if for deletion. Tap the button in order to delete the file. You must confirm the file deletion.

Please note that every time the LISST-PORTABLE|XR creates a new file, 3 separate files are created: An .ASC file with the processed data as comma separated values, a binary .DAT file and a .LOG file with information about instrument settings. All these files will be completely deleted and cannot be recovered.

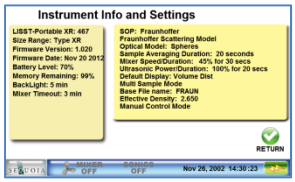
Please note that for multiple storage mode files, all samples in the file will be deleted. It is not possible to delete individual samples within a file.

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7 Reviewing Instrument Info and Settings



To review the instrument settings and info, tap the Info button.



The instrument info and settings screen will appear, displaying the current SOP settings, as well as instrument serial number, size range, firmware version and date, and battery and memory level.

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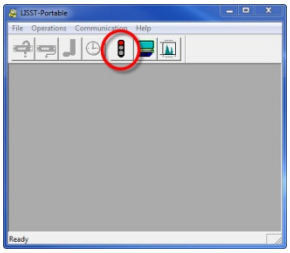
8 Use of the Windows Software

8.1 Software Installation

Section 2.1. covers the software installation and file location.

8.2 Establish Connection

Turn on the LISST-PORTABLE|XR. Connect the cable between the instrument and an USB port on your computer.

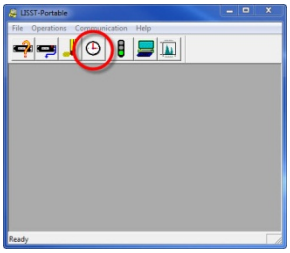


Open up the LISST-PORTABLE|XR program. Click the traffic light to establish connection to the instrument. Connection is via a USB-serial adapter built in to the USB connector. The serial port settings are 9,600 baud with a File Offload Baud Rate at 115,200 baud.

As the traffic light changes to green, the display on the instrument show that the external interface is activated. In this mode, the instrument does not respond to the touch panel, until you have clicked the stoplight in the Windows software and changed it back to red.

When connection is established, the traffic light turns green and all he icons become active.

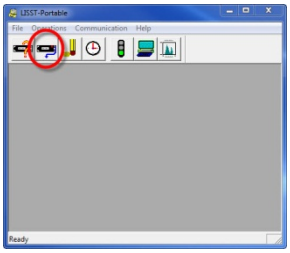
8.3 Set Date and Time



Make sure there is connection to the instrument (see chapter 8.2).

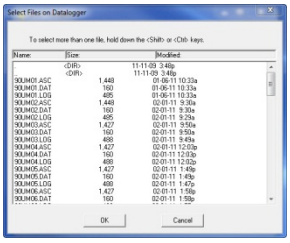
Click the clock icon in order to set the clock. The instrument time will be set to the computer time, and a status message displayed.

8.4 Offload Files



Make sure there is connection to the instrument (see chapter 8.2).

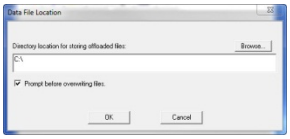
Click the offload icon in order to display the files on the instrument.



A list of files on the data logger onboard the instrument is displayed.

Select the files you wish to offload. Select multiple files by holding down the <Shift> or <CTRL> key while selecting.

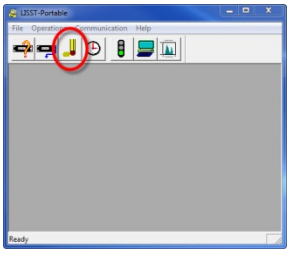
NOTE: You should always offload corresponding .ASC, .DAT and .LOG files. The .ASC files are the processed data in a comma-separated format (for display in e.g. spreadsheets), the .DAT file is a binary data file containing the raw data (to be used by Sequoia for troubleshooting data), and the .LOG file is a file displaying instrument info and settings.



Specify an offload destination. Also specify if existing files with the same file name should be automatically overwritten.

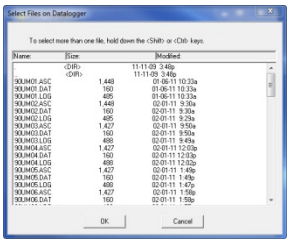
Click the OK button and the files will subsequently offload to the specified folder. After offloading a status message is displayed. Click the OK button to continue.

8.5 Delete Files



Make sure there is connection to the instrument (see chapter 8.2).

Click the delete icon in order to display the files on the instrument.



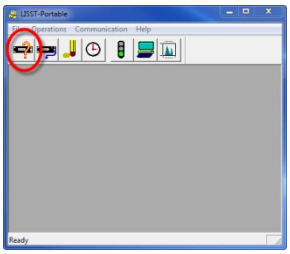
A list of files on the datalogger onboard the instrument is displayed.

Select the files you wish to delete. Select multiple files by holding down the <Shift> or <CTRL> key while selecting.

NOTE: You should always delete corresponding.ASC, .DAT and .LOG files, but not until you are sure that they have been properly offloaded and saved in a secure location.

A file deletion confirmation box appears. You must confirm file deletion by clicking the Yes button.

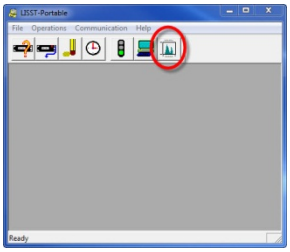
8.6 Query Instrument



For troubleshooting purposes, Sequoia may ask you to query the instrument. Make sure there is connection to the instrument (see chapter 8.2). Click the query icon.

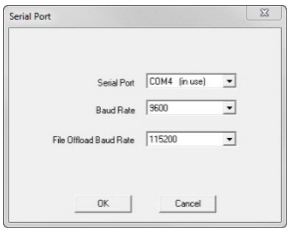
A window displaying the LISST-PORTABLE|XR serial number. Firmware version and other status info show. Click the OK button to close.

8.7 Change Serial Port Settings



Make sure there is connection to the instrument (see chapter 8.2).

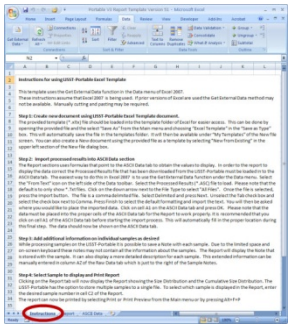
In order to change the offload baud rate, select display serial port settings.

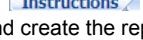


The Select Port window will open up. On the drop down menu, select the appropriate serial port and baud rate. If you experience offload problems, try to minimize the Baud Rate (NOT the File Offload Baud Rate), and make sure the serial port you have selected is the one used by the instrument.

9 Create report using the Excel template

The enclosed EXCEL 2007 template spreadsheet loads the .ASC file created by the LISST-PORTABLE|XR. When loaded, the user can then select which sample to display in order to generate a report sheet for the sample.



Open up the EXCEL spreadsheet named 'Portable V3 Report Template.xltx' and click the Instructions  tab. Follow the instructions on the instructions tab in order to load the .ASC file and create the report.

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10 Handling, Cleaning, Maintenance and Storage

10.1 Handling

WHEN HANDLING THE INSTRUMENT, AT ALL TIMES PLEASE REMEMBER THAT THE LISST-PORTABLE|XR IS A HIGH-PRECISION OPTICAL INSTRUMENT.

AVOID MECHANICAL SHOCKS AND IMPACT TO THE HOUSING, AS THIS MAY CAUSE MISALIGNMENT OF THE OPTICAL PARTS.

AVOID SCRATCHING THE TOUCH PANEL DISPLAY.



TO CHARGE THE LISST-PORTABLE|XR, PLUG THE JACK CONNECTOR INTO THE DB-9 CONNECTOR ON THE POWER CABLE, CONNECT THE POWER CABLE TO THE LISST-PORTABLE|XR AND CONNECT THE POWER SUPPLY TO A 110/220V SOURCE.

IF YOU USE THE POWER SUPPLY THAT SHIPS WITH THE LISST-PORTABLE|XR YOU CANNOT OVER CHARGE THE INTERNAL BATTERY.

10.2 Cleaning

CLEAN THE PANEL USING ONLY LUKEWARM WATER, A MILD SOAP (E.G. LIQUID HAND SOAP) AND A SOFT CLOTH.

NEVER USE ANY ABRASIVE CLEANERS.

IF YOU HAVE BEEN USING LIQUIDS WITH A HIGH VISCOSITY (E.G. OILS) AND NEED TO RINSE THEM OUT, FIRST CIRCULATE LUKEWARM WATER WITH A MILD SOAP SOLUTION. THEN FINISH OFF WITH JUST LUKEWARM WAER.

NEVER USE SOLVENTS SUCH AS TOLUENE OR ACETONE FOR CLEANING THE INSTRUMENT – THIS WILL DAMAGE SENSITIVE OPTICS PARTS AND THE WARRANTY VOIDED!

IF YOU HAVE BEEN ANALYZING CEMENT POWDERS, MAKE SURE THAT YOU RINSE OUT THE SYSTEM THOROUGHLY USING ISOPROPYL ALCOHOL, LEAVING NO CEMENT INSIDE THE INSTRUMENT.



For cleaning of the windows, rinse out the mixing chamber with clean (filtered or de-ionized) water several times in order to flush out all particles from the mixing chamber and the mixing system.

Now gently wipe the windows in the optical cell with a cotton swab dipped in a mild soap solution (e.g. liquid hand wash soap). INSERT THE COTTON SWAB FULLY INTO THE MIXING CHAMBER AND MAKE SURE IT IS IN CONTACT WITH THE WINDOWS. Rinse several times with clean water and check the background again.

10.3 Storage

For storage for more than a few days, drain the instrument completely, clean the windows as described above, and put the lid on the mixing chamber to avoid dust falling into it. Store the instrument in a dry location between 5 and 45°C.

Rechargeable batteries power the instrument. If charged with the supplied power adaptor they cannot be overcharged. Fully charge the batteries before long-term storage.

11 FAQ's

What is an optical model? What model should I choose?

The foundation of the LISST-PORTABLE|XR is the laser diffraction principle. This principle relies on the fact that if you know the optical properties of the particles in your sample, then you can compute the size distribution of the particles. The optical properties of a wide range of materials are included in the LISST-PORTABLE|XR. If you have absolutely no knowledge about the material in your sample, you should choose the Fraunhofer model.

However, if you have just some information it might often be better to choose the Mie model, and then select the optical model that best fits your knowledge of your sample. For example, for sediment particles use either Fraunhofer or a model based on the most common mineral in your sample (e.q. quartz or orthoclase).

No matter what model you choose it is extremely important that you only compare measurements analyzed using the same model. The same measurement of light scattering can give two very different size distributions if two different optical models are used.

How do I dilute a sample?

Do a background measurement and confirm that it is OK. Drain out the water.

Pour the suspended sediment sample into the mixing chamber so that it fills to the top of the lid. Use the funnel to top of the chamber through the small hole at the top of the lid, if necessary. Seal the hole in the top of the lid with the black fitting. Start the mixer. Observe if the instrument gives you a warning that the concentration is too high.

If this is the case, use a pipette to siphon off 50 ml of the sample, while it is circulating, then add 50 ml of clean, particle free water and let it mix for 5-10 seconds with the mixer pump running.

Observe if the concentration is still too high. If it is, siphon off another 50 ml, and add 50 ml of clean water. Repeat this procedure until the concentration is in the correct range, and then add a note about how the number of dilutions, and proceed with the analysis.

When you offload the data, you must use the number in the note to correct your volume concentrations to the actual values. Because it is a diluted sample, the data file will contain the concentration for the diluted sample, but you want the concentration for the un-diluted sample.

The volume of the mixing chamber is 117 ml. If you had performed 2 dilutions, and each time siphoned off 50 ml, then the original, undiluted concentration (VC_org) can be computed from the measured concentration after dilution (VC_dil) as follows:

$$\mathrm{VC_org} = \frac{\mathrm{VC_dil}}{\left(1 - \frac{50}{117}\right)^2}$$

A more general formula would be

$$\mathrm{VC_org} = \frac{\mathrm{VC_dil}}{\left(1 - \frac{\mathrm{SV}}{117}\right)^{\mathrm{N}}}$$

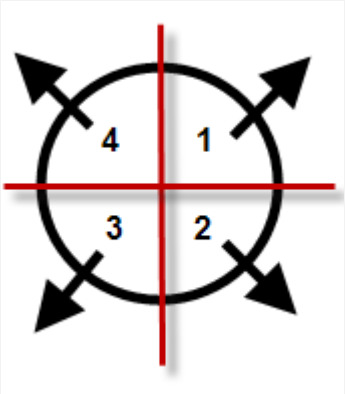
Where SV is the volume (in ml) you have siphoned off for each dilution and N is the number of dilutions you have performed.

Note that the above equations only work if the mixing chamber is filled completely to the top and if the volume siphoned off is the same each time.

How do I take a representative subsample?

This is a more fundamental question that everybody involved in particle size analysis will have to consider at some point. There is no universal answer, but the following guidelines may be useful.

If you have a sediment sample from, say a dry grab sample or a dry soil sample, you can pile it up into a cone-formed shape. The figure shows the cone from above. Divide it into the 4 quadrants using a ruler or similar and move them apart from each other.

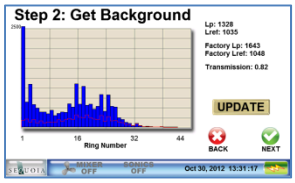


Now combine 2 diagonally opposed quadrants (e.g. 1 and 3) into a new and smaller cone shaped pile, and then repeat until your sample is small enough to be suspended and analyzed.

This procedure obviously does not work if you have a sample already suspended in a liquid. In that case, pour the sample into the instrument and measure it. If the concentration is too high you can dilute the sample as per the description in the 'How do I dilute a sample?' FAQ.

However, if the volume of your sample is already larger than the volume of the LISST-PORTABLE|XR mixing chamber, then you must split the sample first. Wet splitting a sample requires specialized laboratory equipment - do a Google search for 'Wet sample splitter' or 'Wet sample divider'.

How do I evaluate the background measurement?



Upon obtaining a background, the red line shows the factory background and the blue bars show the current background. They should be close together, and the optical transmission should be in the range from 0.95 to 1.

Strongly increased values on the middle and outer rings (ring numbers 8-44) suggest dirty windows. Increased values on the inner rings (1-8), together with a transmission value significantly below 1 suggests that the optics has become misaligned. Consult Sequoia for a diagnostic of how serious the problem is and how to proceed.

The figure to the left suggests that the windows are slightly dirty (increased values on the middle rings compared to factory values), but not extremely dirty (the transmission is at 0.96, so above 0.95). There is no indication of misalignment, which would be seen as increased scattering on rings 1-8.

Can I reprocess a set of data on board the instrument?

No. Now this is not possible. However, it is possible to first process a sample using one optical model or SOP, then change the optical property model or SOP to another model, and then measure the sample again, retaining the same zscat as for the first sample.

Does the LISST-PORTABLE|XR require any calibration?

No. All that is required is that the user makes a background measurement before the sample is measured. This is necessary for evaluation of the state and cleanliness of the optical system. If this is good (e.g. the current background measurement is close to the factory background, see FAQ above) the instrument will deliver good data.

What happens if there are particles present outside of the size range covered by my LISST-PORTABLE|XR?

This is a more complex question. Very briefly, the presence of sediment particles outside the size range covered by the instrument will cause some additional scattering on the inner- or outermost rings of the ring detector. In turn, this increased scattering will be detected as particle volume, so that the net effect is to increase the particle volume in the smallest and/or largest size classes.

Typically, the effect can be seen if there is a significant amount of particles outside the size range, so that a rising tail will appear in the coarse and/or fine end of the size spectrum.

Does the instrument measure NTU, FTU or any other turbidity units?

No. All laser diffraction based instruments measure the volume distribution of the suspended particles. This may or may not be related to NTU.

Can I overcharge the rechargeable battery inside the instrument?

No. If you charge the battery with the power adaptor supplied by Sequoia as part of the instrument you cannot overcharge the battery.

What liquids can I use for suspending my particles?	Use ONLY water (fresh or salt water), ethanol or isopropanol (isopropyl alcohol) or non-corrosive oils for suspending particles! **Use of solvents such as acetone, toluene etc. for suspending particles will permanently damage the instrument and void the warranty!!**
Does the instrument detect different types of particles?	Regardless of the type of suspended particles, the LISST-PORTABLE|XR will measure the size and volume concentration of the particles. However, it cannot discriminate different types of particles (e.g. quartz and feldspar; organic and inorganic) from each other.
What is the volume of the mixing chamber?	When the mixing chamber is filled to the top with the lid in place it contains 117 ml.
What are the units for the concentration measurements?	The units for the concentration are in terms of particle volume per unit volume of liquid – micro-liters / l or µl/l.
Can I convert volume concentration or mass concentration to ppm (parts-per-million)?	Yes. If you are looking for ppm by VOLUME, then the volume concentration in µl/l is equivalent to ppm by VOLUME. If your ppm is by MASS, then you must convert the volume concentration to mass concentration (see above) with units of mg/l. The units of mg/l are equivalent to ppm by MASS.
What is the operating range of the instrument in terms of optical transmission?	The operating range of the LISST-PORTABLE|XR in terms of optical transmission is 75-95%. Above 95% transmission the data will become increasingly noisy. Below 75% optical transmission the data will become increasingly influenced by multiple scattering and you may end up 'inventing' fine particles.

Do you have a question not answered here? Try the FAQ webpage on our website (http://www.SequoiaSci.com/faq/?SectionName=faq)! Otherwise contact us; see the front of this manual for detailed contact information.

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12 Warranty

STATEMENT OF LIMITED WARRANTY AND LIABILITY

This Statement of Limited Warranty applies to all Sequoia Scientific, Inc. (“SEQUOIA”) products ("Products"). Any additional or different terms, including any terms in any purchase order, will be of no effect unless agreed to in writing by an authorized representative of SEQUOIA as reflected in a written SEQUOIA quotation.

1. Limited Warranty
SEQUOIA warrants that upon delivery by SEQUOIA (a) the Products will be free from defects in materials and workmanship, (b) the Products will perform substantially in accordance with SEQUOIA's applicable specifications, and (c) any Products (or components or parts thereof) that are manufactured by SEQUOIA do not infringe any U.S. patent or copyright.

2. Correction of Non-Compliance
If, during the twelve months after delivery (the “Warranty Period”), any Product does not comply with the warranties set forth in 1(a) and 1(b) above, SEQUOIA will, at its option, either (a) repair the Product, (b) replace the Product, or (c) refund the purchase price paid by Customer to SEQUOIA for the Product; provided that Customer gives SEQUOIA written notice of the noncompliance within the Warranty Period and ships the Product to SEQUOIA within one month after the end of the Warranty Period. As to any Product repaired or replaced by SEQUOIA, the Warranty Period will end upon the later of the end of the original Warranty Period or 90 days after SEQUOIA's delivery of the repaired or replacement Product to Customer. Any Product, component, part or other item replaced by SEQUOIA becomes the property of SEQUOIA. SEQUOIA may use refurbished components in the repair of Products supplied hereunder.

SEQUOIA's warranties shall be void and not apply if the Product has been subjected to misuse or alteration or repaired by a party not approved by SEQUOIA or the serial number on a product (if applicable) has been altered or defaced. SEQUOIA shall not be liable for normal wear and tear (such as replacement of consumables), nor for defects or failure caused by maintenance, misuse, negligence or failure resulting from non-compliance with SEQUOIA’s specifications, operating or maintenance manuals.

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If any Product does not comply with the warranty set forth in 1(c) above, SEQUOIA will defend and indemnify Customer against any third-party claim asserted in any proceeding against Customer based on this noncompliance; provided that Customer gives SEQUOIA prompt written notice of the claim, SEQUOIA has exclusive control over the defense and settlement of the claim, Customer provides such assistance as SEQUOIA may request in connection with the defense and settlement of the claim (in which event SEQUOIA will reimburse the reasonable out-of-pocket costs incurred by Customer to provide such assistance), Customer does not settle the claim without the prior written consent of SEQUOIA and, upon SEQUOIA's request, Customer returns the Non-Complying Product to SEQUOIA for modification, replacement or a refund of the purchase price paid by Customer to SEQUOIA for the Non-Complying Product, less a reasonable allowance for Customer's use prior to return.

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SEQUOIA will not be liable for any indirect, incidental, special or consequential damages, any cover, or any loss of revenue, profit, data or use.

7. Limitations of Liability
SEQUOIA's liability (whether in contract, tort, or otherwise; and notwithstanding any fault, negligence, strict liability or product liability) with regard to any Product (including, but not limited to, any breach of or default by SEQUOIA) will in no event exceed the purchase price paid by Customer to SEQUOIA for such Product. Further, SEQUOIA will not be liable for, or be in breach of or default on account of, any delay or failure to perform as a result of any cause, condition or circumstance beyond SEQUOIA's reasonable control.

8. Indemnification by Customer
Customer acknowledges that the Products are designed and manufactured for use in non-critical, monitoring situations. If Customer chooses to purchase a Product or Products for use in applications that could result in damages in excess of the price of the Product if the Product does not operate properly or otherwise fails, Customer acknowledges and agrees that it is Customer’s responsibility to provide for redundancy and/or other safety or back-up measures sufficient to assure that failure of a Product(s) will not cause such damages. Customer agrees that it will defend and hold SEQUOIA harmless from any and all claims and costs (including but not limited to attorney’s fees and other costs of defense against such claims) in excess of the price of the Products arising directly or indirectly from such Customer’s use of the Products. Such indemnification is a critical part of the consideration being provided by

Customer (over and above the price paid for the Product(s)) for the right to use the Products for such purposes and Customer shall not use a Product or Products for such purposes if it is unwilling or unable to provide such indemnification.

9. Statute of Limitations
Customer will not commence any action based on breach of warranty with respect to any Product more than 18 months after SEQUOIA's delivery of such Product.

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The Products may include or be delivered with certain computer programs, databases or other software that is proprietary to SEQUOIA. SEQUOIA hereby grants Customer a nonexclusive license to use such software solely for the purpose of operating Products. Customer will not: use any such software for any other purpose; modify, adapt, translate, or create derivative works based on any such software; or disassemble, decompile or reverse engineer any such software. No title to or ownership of any software or intellectual property rights are transferred to Customer.

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12. Controlling Document
In the event of any conflict or inconsistency between any provision of this Statement of Limited Warranty and any other provision of the Order, the provision of this Statement of Limited Warranty will control.

13. Controlling Law
This Statement of Limited Warranty will be governed by the laws of the State of Washington without reference to its rules relating to choice of law for the purpose of applying another jurisdiction’s law. The U.N. Convention on Contracts for the International Sale of Goods will not apply.

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