



**PARTICLE
MEASURING
SYSTEMS®**

a spectris company

Lasair® Pro Aerosol Particle Counter



Without measurement there is no control®

OPERATIONS MANUAL

Lasair® Pro Aerosol Particle Counter Operations Manual



**PARTICLE
MEASURING
SYSTEMS®**

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Lasair® Pro Aerosol Particle Counter Operations Manual

Part Number (P/N) 1000025871 Rev K

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Environmental Information

There are no potential means by which asbestos exposure is possible because there are no materials in the design or manufacture of the Lasair Pro containing asbestos.



This equipment must be properly disposed of at the end-of-life by means of an authorized waste management system. Contact our Customer Response Center at (877) 475-3317 or (303) 443-7100 (International Telephone +01 303 443 7100) for dismantling and disposal information.



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Battery Disposal

Lithium ion batteries are classified by the U.S. federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream. Lithium ion batteries contain recyclable materials and are accepted by some regional recycling programs.

Particle Measuring Systems, Inc. encourages users to check with their local municipality for lithium ion battery recycling. In North America, contact the Rechargeable Battery Recycling Corporation (RBRC) at www.call2recycle.org. In Europe, contact the European Portable Battery Association. (EPBA) www.epbaeurope.net.

For California consumers, contact Particle Measuring Systems, Customer Service Department at (877)-475-3317 for instructions on returning used, rechargeable batteries for reuse, recycling, or proper disposal at no cost.

Patent Information

U.S. 6167107; Europe 1196832; Japan 3559782

U.S. and foreign patents for the Lasair Pro particle counter pending.

Wireless Radio Designators

FCC = FCC ID: 2BCDH-LPRO Contains FCCID: SQG-60SIPT

IC = IC: 31142-LPRO Contains IC: 3147A-60SIPT

Japan MIC = Lasair Pro 5100 - 第AC-24098号

Lasair Pro 350 - 第AC-24099号

Lasair Pro 310 - 第AC-24100号

South Korean KC Mark = R-R-Pm4-LasairPro5100

Brazil Anatel = 03288-25-17850

Taiwan NCC = Lasair Pro 310 CCAK25LP1271T9

Lasair Pro 350 CCAK25LP1272T1

Lasair Pro 5100 CCAK25LP1270T7

China CMIIT = Lasair Pro 310 CMIIT ID: 25J995SE5903

Lasair Pro 5100 CMIIT ID: 25J995SEY969

Lasair Pro 350 CMIIT ID: 25J995SEB516

Manual Conventions

This manual uses the following conventions to call the reader's attention to certain text.

WARNING

A warning in the text is used to notify the user of the potential for bodily injury or death.

CAUTION

A caution in the text is used to highlight an item that if not done, or incorrectly done, could damage the instrument and/or any materials or devices affected by the instrument.

-- NOTICE --

A notice in the text is an instructional communication regarding requirements or policies issued by Particle Measuring Systems.

NOTE: A note in the text is used to highlight an item that is of operational importance to the user.

It is important that you observe cautions and warnings while performing the procedures described in this manual. Caution and warning labels are located on and inside the instrument to alert you to potentially hazardous conditions. Please familiarize yourself with this information.

CE and UKCA Declaration of Conformity

Application of Council Directive(s):	CE	2014/30/EU, 2014/53/EU, 2014/35/EU, RoHS 2011/65/EU, 2015/863
	UKCA	Electromagnetic Compatibility Regulations 2016, Electrical Equipment (Safety) Regulations 2016 Radio Equipment Regulations 2017 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
Standard(s) to which Conformity is Declared:	EMC	IEC/EN 61326-1:2021 S.I. 2016 No. 1091
	Safety	IEC/EN61010-1: 2010, 3rd, Ed., IEC/EN 60825-1: 2014, S.I. 2016 No. 1101
	RED	ETSI EN 300 330, 300 328, 301 893, 301 489-17, 301 489-3 S.I. 2017 No. 1206
	RoHS	IEC/EN 63000:2018
Manufacturer's Name:		Particle Measuring Systems, Inc.
Manufacturer's Address:		7477 E. Dry Creek Parkway, Unit 2, Niwot, CO 80503
Manufacturer's Telephone/FAX:		+01 303 443 7100 / +01 303 449 6870
Distributor's Name:		Particle Measuring Systems, S.R.L.
Distributor's Address		Via di Grotte Portella 34 00044 Frascati (Roma) ITALY
Distributor's Telephone/FAX:		+ 39 06 90530130 / + 39 06 9051315
Type of Equipment:		Particle Counter
Model No:		Lasair Pro
I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).		
Signature:		Signature:
		
Full Name:	Brian Knollenberg	Full Name: Frank Panofen
Position:	Chief Technology Officer	Position: Vice President and GM, Life Science Division
Place: Boulder	Date: January 14, 2026	Place: Rome Date: January 14, 2026

CAUTION

All I/O cables and accessories must meet current factory specifications in order for this unit to remain in compliance with CE marking requirements. Consult the factory for details.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

The end user of this product is responsible for ensuring that physical and logical measures are in place that limit physical access to the product to authorized users, devices, and services, limit network access to the product to authorized users, devices, and services, and limit exposure of communicated data to authorized users, devices, and services.

Federal Communication Commission FCC Compliance Statements

Compliance Statement (Part 15.19)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Warning (Part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

To comply with FCC RF exposure limits for general population / uncontrolled exposure, the antenna must be installed to provide a separation distance of at least 20cm from all persons and operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

Industry Canada (IC) - Compliance Statements

Section 8.4 of RSS-GEN

This Device complies with Industry Canada License-exempt RSS standard(s). Operation is subject to the following two conditions: 1) this device may not cause interference, and 2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme aux normes RSS exemptes de licence d'Industrie Canada. Son fonctionnement est soumis aux deux conditions suivantes : 1) cet appareil ne doit pas causer d'interférences et 2) cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

Section 8.3 of RSS-GEN

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

En vertu des réglementations d'Industrie Canada, cet émetteur radio ne peut fonctionner qu'avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvés pour l'émetteur par Industrie Canada. Pour réduire les interférences radio potentielles avec d'autres utilisateurs, le type d'antenne et son gain doivent être choisis de manière à ce que la puissance isotrope rayonnée équivalente (e.i.r.p.) ne soit pas supérieure à celle nécessaire pour une communication réussie.

Radiation Exposure Statement:

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 20 cm between the radiator & body extremities.

Déclaration d'exposition aux radiations:

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20 cm entre le radiateur et votre corps.



If you have additional questions after reading this manual, navigate to the Automated Hardware & Software Support page on <https://www.pmeasuring.com/pms-service-repair-and-calibration/>

Brief Contents

CHAPTER 1. QUICK GUIDE	1-1
CHAPTER 2. SPECIFICATIONS.....	2-1
CHAPTER 3. YOUR SYSTEM.....	3-1
CHAPTER 4. CONNECTIONS.....	4-1
CHAPTER 5. SAMPLING OPTIONS.....	5-1
CHAPTER 6. SECURITY	6-1
CHAPTER 7. ALARMS.....	7-1
CHAPTER 8. LOCATIONS	8-1
CHAPTER 9. RECIPES	9-1
CHAPTER 10. DISPLAY, DATA AND REPORTS.....	10-1
CHAPTER 11. STATISTICS.....	11-1
CHAPTER 12. SYSTEM CONFIGURATION	12-1
CHAPTER 13. MAINTENANCE AND DIAGNOSTICS	13-1
APPENDIX A. INTERNATIONAL PRECAUTIONS.....	A-1
APPENDIX B. COMMA SEPARATED VALUE (CSV) FORMAT	B-1

APPENDIX C. TROUBLESHOOTING ETHERNET	C-1
APPENDIX D. MODBUS	D-1
APPENDIX E. WEB API	E-1
APPENDIX F. SERIAL COMMANDS	F-1
APPENDIX G. CONFIGURING THE WI-FI.....	G-1
APPENDIX H. 有毒或有害的物质和元素	H-1

Table of Contents

Confidential Document	ii
Environmental Information	ii
Battery Disposal	iii
Patent Information	iii
Wireless Radio Designators	iii
 and  Declaration of Conformity	v
CHAPTER 1. QUICK GUIDE	1-1
Assembly of Optional Connections	1-3
Printer Roll Installation	1-3
HOME Screen	1-4
Sampling	1-5
Saving a Recipe	1-6
Enabling Security	1-6
Connections	1-7
Using NFC	1-8
Basic WiFi Setup Procedure	1-9
Data Export and Import	1-10
CHAPTER 2. SPECIFICATIONS	2-1
Environmental Conditions	2-4
CHAPTER 3. YOUR SYSTEM	3-1
Recycling	3-1
Standalone or Portable Use	3-2
Firmware	3-2
Memory	3-2
Communication	3-3
Control Software	3-3
Touchscreen	3-4

Table of Contents

HOME Screen	3-5
Environment Data Table	3-7
Sampling Configuration	3-7
Icons and Buttons of the HOME Screen	3-7
Shipkit List	3-14
Accessory List	3-16
Storing Shipping/Packing Materials	3-20
CHAPTER 4. CONNECTIONS	4-1
Back Panel	4-1
Power	4-4
Batteries	4-4
AC Power	4-5
Analog	4-6
Environmental (Analog) Input	4-6
Analog Output	4-10
Status Output	4-11
Lasair Pro Analog 4-20 mA Output Log Mode	4-12
Digital In/Out	4-13
NFC Cards	4-14
Computer Connections	4-15
Control Software and Data Interface	4-15
PMS Software and Communication Protocols	4-16
Communication Protocol	4-16
Configuring Communications	4-17
Configuring Network Outage Buffer	4-17
Third Party Control Software	4-17
Network Configuration	4-17
IP Address	4-18
Network Mask	4-19
Gateway Address	4-20
Multicast Address	4-20
Enable PMS TCP	4-20
MAC Address	4-21
Saving Network Settings	4-21
Instrument to Laptop Ethernet Setup	4-22
Method 1: Modifying the IP Settings on a PC	4-22
Method 2: Modifying Network Settings with Serial Commands	4-24
CHAPTER 5. SAMPLING OPTIONS	5-1
SETTINGS Tab	5-2
Sampling Setup	5-2
Delays	5-3

Sample By	5-3
Units.....	5-3
Data.....	5-3
Buttons	5-4
Example Sampling Setup Report.....	5-5
ADVANCED Tab	5-6
Sampling Start.....	5-6
Options	5-7
Monitoring Mode	5-8
Monitoring Mode Activation	5-9
Example Cleanroom Monitoring Report	5-14
Sampling Accessories	5-15
Sample Probes	5-15
Optional Probes	5-15
Positioning Accessories	5-15
Tripods.....	5-15
Wall/Hand/Tripod Adapters	5-16
Zero Count Filters.....	5-16
Thermal Paper	5-16
HHIPA Accessory.....	5-16
Flowrate.....	5-16
Tubing.....	5-17
Application	5-17
 CHAPTER 6. SECURITY	 6-1
Security Overview	6-2
Usernames.....	6-2
Passwords.....	6-2
Access Levels	6-2
Activate/Deactivate Users	6-3
Settings Tab	6-10
Users Tab	6-12
Example User Setup Report.....	6-14
Audit Tab.....	6-15
Audit Data Tab	6-16
Example Audit Report	6-17
 CHAPTER 7. ALARMS.....	 7-1
Navigation	7-1
GENERAL Tab.....	7-2
PARTICLES Tab	7-3
Size Column (μm).....	7-3
Triggering Value Column (WARNING, Units)	7-4
DATA.....	7-4

Table of Contents

ENVIRONMENTAL Tab	7-5
Recipes and Environmental Alarms	7-6
TREND Tab	7-6
REASONS Tab	7-8
Assigning Alarm Reasons	7-10
CHAPTER 8. LOCATIONS	8-1
Buttons	8-9
Example Location Hierarchy Report.....	8-10
CHAPTER 9. RECIPES	9-1
SETUP Tab Buttons	9-6
ASSIGNMENTS Tab Buttons	9-7
Recipe Details	9-9
Statistics Recipe Details	9-10
CHAPTER 10. DISPLAY, DATA AND REPORTS.....	10-1
DISPLAY Tab.....	10-2
TREND Tab	10-4
Example Trend Graph.....	10-6
HISTOGRAM Tab	10-7
REPORTS Tab	10-9
Reports Overview	10-10
Final Sample Report Example	10-11
DATA Screen.....	10-16
TABLE Tab	10-16
GRAPH Tab.....	10-17
Options	10-20
CHAPTER 11. STATISTICS.....	11-1
Overview.....	11-1
HOME Screen	11-2
Data Displays	11-3
Average Mode	11-4
Results	11-5
Switch Mode	11-7
STANDARDS Tab	11-8
SETUP Tab	11-9
Configuration Settings	11-9
Example Certification Setup Report.....	11-12
Walkthrough	11-13

Statistics Report Example	11-16
Cleanliness Standards.....	11-20
ISO 14644-1:2015 Standard	11-20
EU GMP Annex 1 Standard and China GMP	11-21
FS-209E Standard	11-22
CHAPTER 12. SYSTEM CONFIGURATION	12-1
SETUP Tab	12-2
Instrument ID	12-2
Calibration Warning	12-2
Gas	12-3
Language	12-3
Keyboard Inputs.....	12-3
CSV Exporting for Non-Standard Characters.....	12-3
Clone Export and Import	12-8
Buttons	12-10
DATE/TIME Tab	12-11
Buttons	12-11
CHANNELS Tab	12-13
Buttons	12-14
CHAPTER 13. MAINTENANCE AND DIAGNOSTICS	13-1
Cleaning and Disinfecting the Enclosure	13-1
Recommended Cleaning Agents	13-2
Cleaning the Enclosure Case	13-2
Replacing the Printer Paper Roll	13-3
Replacing the Batteries.....	13-4
Battery Disposal	13-4
Calibration Reminder.....	13-5
Other Maintenance.....	13-5
Diagnostics	13-6
APPENDIX A. INTERNATIONAL PRECAUTIONS	A-1
WARNING	A-1
AVERTISSEMENT.....	A-1
WARNUNG.....	A-1
ATTENZIONE	A-1
ADVERTENCIA	A-1
Hazard Symbols	A-2
Symboles de risque.....	A-2
Warnschilder	A-3
Simboli di pericolo	A-3
Simbolos de peligro	A-4

APPENDIX B. COMMA SEPARATED VALUE (CSV) FORMAT	B-1
APPENDIX C. TROUBLESHOOTING ETHERNET	C-1
Connectivity	C-1
APPENDIX D. MODBUS	D-1
Modbus Overview.....	D-1
Configuration	D-2
Data.....	D-5
Holding Registers	D-14
Associated Values for Specific Registry Entries	D-20
Modbus Processing Example	D-21
Modbus Dequeuing Example	D-22
APPENDIX E. WEB API	E-1
Interface Commands.....	E-2
Format	E-2
ExampleCommand.....	E-2
Alarms	E-3
addAlarmReason.....	E-3
configAlarmEnvironmental	E-3
configAlarmParticles.....	E-4
configAlarmSetting	E-6
configAlarmTrend.....	E-7
deleteAlarmReason.....	E-8
deleteAllAlarmReason.....	E-9
getAlarmEnvironmental.....	E-9
getAlarmParticles.....	E-11
getAlarmReasons	E-12
getAlarmSettings.....	E-13
getAlarmTrend.....	E-15
modifyAlarmReason	E-16
setAlarmParticleDataType	E-16
ApiVersion.....	E-17
getInstrumentApiVersion.....	E-17
Audit.....	E-18
deleteAuditData	E-18
getAuditData.....	E-18
Authorization.....	E-19
generateToken.....	E-19
Instrument Control	E-20
getsSamplingStatus	E-20
startSampling.....	E-22
stopSampling	E-22

Locations	E-23
configLocationArea	E-23
configLocationLocations	E-23
configLocationRoom	E-24
createLocationAreas	E-25
createLocationLocations	E-25
createLocationRooms	E-26
deleteAllLocations	E-26
deleteArea	E-27
deleteLocation	E-27
deleteRoom	E-28
getLocationAreas	E-28
getLocationLocations	E-29
getLocationRooms	E-30
Samples	E-31
deleteAllRecipe	E-31
deleteRecipe	E-31
deleteSampleData	E-32
getRecipe	E-32
getRecipeList	E-42
getSampleData	E-43
getSampleSetting	E-58
loadRecipe	E-61
saveRecipe	E-62
setRecipe	E-63
setupMonitoringSetting	E-64
setupSampleSetting	E-64
Security	E-68
addSecurityUser	E-68
configSecurityAudit	E-69
deleteSecurityUser	E-70
getSecurityGeneral	E-71
getSecurityUsers	E-73
setupSecurityGeneral	E-74
System Configuration	E-77
configSystemChannels	E-77
configSystemConfiguration	E-78
configSystemDatetime	E-79
configSystemSettings	E-81
getSystemChannels	E-82
getSystemDatetime	E-83
getSystemSettings	E-84
getSystemStatus	E-86

Table of Contents

BIDI-API Guide Examples	E-88
Generate Token (login)	E-88
Instrument information (calibration date, S/N, Instrument ID)	E-89
Location handling (creation of area/room/locations)	E-90
Release Token (logout)	E-91
Bidirectional HTTP Status Codes	E-91
Schema for 4XX Status Responses	E-92
Bidirectional Error Codes	E-92

APPENDIX F. WEB API..... E-1

Interface Commands	E-1
Format	E-1
ExampleCommand	E-1
WW	E-2
Alarms	E-4
addAlarmReason	E-4
configAlarmEnvironmental	E-4
configAlarmParticles	E-6
configAlarmSetting	E-6
configAlarmTrend	E-7
deleteAlarmReason	E-7
deleteAllAlarmReason	E-7
getAlarmEnvironmental	E-8
getAlarmParticles	E-8
getAlarmReasons	E-8
getAlarmSettings	E-9
getAlarmTrend	E-9
modifyAlarmReason	E-10
setAlarmParticleDataType	E-10
ApiVersion	E-11
getInstrumentApiVersion	E-11
Audit	E-11
deleteAuditData	E-11
getAuditData	E-11
Authorization	E-12
generateToken	E-12
Instrument Control	E-12
getsSamplingStatus	E-12
startSampling	E-13
stopSampling	E-13
Locations	E-14
configLocationArea	E-14
configLocationLocations	E-14
configLocationRoom	E-15

createLocationAreas	E-15
createLocationLocations	E-16
createLocationRooms	E-16
deleteAllLocations.....	E-16
deleteArea	E-17
deleteLocation	E-17
deleteRoom	E-18
getLocationAreas	E-18
getLocationLocations	E-19
getLocationRooms	E-19
Samples	E-19
deleteAllRecipe	E-19
deleteRecipe.....	E-20
deleteSampleData.....	E-20
getRecipe	E-21
getRecipeList	E-21
getSampleData.....	E-21
getSampleSetting.....	E-22
loadRecipe	E-22
saveRecipe.....	E-23
setRecipe	E-23
setupMonitoringSetting.....	E-24
setupSampleSetting	E-24
Security	E-24
addSecurityUser.....	E-24
configSecurityAudit	E-25
deleteSecurityUser.....	E-25
getSecurityGeneral	E-26
getSecurityUsers	E-27
setupSecurityGeneral	E-27
System Configuration	E-29
configSystemChannels	E-29
configSystemConfiguration.....	E-29
configSystemDatetime.....	E-30
configSystemSettings	E-30
getSystemChannels	E-30
getSystemDatetime.....	E-31
getSystemSettings	E-31
getSystemStatus	E-31
BIDI-API Guide Examples	E-32
Generate Token (login).....	E-32
Instrument information (calibration date, S/N, Instrument ID).....	E-33
Location handling (creation of area/room/locations).....	E-34
Release Toke (logout).....	E-35
Bidirectional Error Codes.....	E-35

APPENDIX G. SERIAL COMMANDS	F-1
Lasair Mode Serial Interface Commands	F-3
Change Setup Parameters Command Help	F-5
 APPENDIX H. CONFIGURING THE WI-FI	 G-1
Networks	G-3
USB serial port Wifi commands:.....	G-5
Basic WiFi Setup Procedure	G-6
Wi-Fi Country Agency Certificates	G-7
 APPENDIX I. 有毒或有害的物质和元素	 H-1

List of Figures and Tables

CHAPTER 1. QUICK GUIDE	1-1
Figure 1-1. Details of the HOME screen, swipe left to change the display (circled)	1-4
Figure 1-2. SETTINGS tab, SAMPLE	1-5
Figure 1-3. Keyboard	1-6
Figure 1-4. NFC Tab	1-8
Figure 1-5. Wireless Tab	1-9
Figure 1-6. Clone Export and Import buttons, SETUP tab, SYSTEM	1-11
 CHAPTER 2. SPECIFICATIONS	 2-1
Table 2-1. Specifications	2-1
Table 2-2. Environmental conditions	2-4
 CHAPTER 3. YOUR SYSTEM	 3-1
Figure 3-1. Navigation options	3-4
Figure 3-2. Default sampling display (Cumulative Normalized Counts)	3-5
Figure 3-3. Other data formats	3-6
Figure 3-4. HOME icon	3-7
Table 3-1. HOME screen icons and buttons	3-8
Table 3-2. Default shipkit list	3-14
Table 3-3. Accessory list	3-16
 CHAPTER 4. CONNECTIONS	 4-1
Figure 4-1. Positioning the Lasair Pro to see connections	4-1
Table 4-1. Items required for AC power source connection	4-5
Figure 4-2. ENVIRONMENTAL tab, IN/OUT	4-7
Figure 4-3. Enabling/disabling sensors	4-8
Figure 4-4. Example environmental sensor table	4-8
Figure 4-5. Environmental sensor data display, HOME screen	4-9
Figure 4-6. ANALOG OUTPUT tab, IN/OUT	4-10
Table 4-2. 4-20 mA Analog Output Status Channel	4-11
Figure 4-7. DIGITAL OUTPUT tab, IN/OUT	4-13
Figure 4-8. NFC tab, COMM	4-14
Figure 4-9. NETWORK tab, COMM	4-18
Figure 4-10. Confirm network settings	4-21
Figure 4-11. Ethernet/LAN Properties window	4-23
Figure 4-12. Adjusted Internet protocol properties	4-24

CHAPTER 5. SAMPLING OPTIONS.....	5-1
Figure 5-1. Sampling configuration settings.....	5-2
Table 5-1. SETTINGS tab, SAMPLE	5-4
Figure 5-2. Example Sampling Setup Report (page 1)	5-5
Figure 5-3. Advanced sampling settings	5-6
Figure 5-4. Particle count values to trigger an audio cue	5-7
Figure 5-5. Final Sample Report example	5-8
Figure 5-6. Switch Mode window	5-9
Figure 5-7. HOME screen, Monitoring Mode	5-10
Figure 5-8. Maximum and average counts	5-11
Figure 5-9. Average counts for each location.....	5-12
Figure 5-10. Sampling is complete at the selected location	5-12
Figure 5-11. Monitoring Mode sampling completed.....	5-13
Figure 5-12. Confirmation window to terminate Monitoring Mode	5-13
Figure 5-13. Cleanroom Monitoring Report example.....	5-14
Figure 5-14. Hand-held Isokinetic Probe Attachment (HHIPA).....	5-17
 CHAPTER 6. SECURITY	 6-1
Figure 6-1. LOGIN window	6-1
Table 6-1. Access levels	6-2
Table 6-2. Screen accessibility by access level.....	6-3
Figure 6-2. Access levels for a new user	6-4
Figure 6-3. ON/OFF column.....	6-5
Figure 6-4. NFC tab, COMM	6-7
Figure 6-5. Internal NFC card reader location.....	6-8
Figure 6-6. Orange circular waiting animation	6-9
Figure 6-7. SETTINGS tab, SECURITY	6-10
Table 6-3. SETTINGS tab, SECURITY	6-11
Figure 6-8. List of users	6-12
Table 6-4. USERS tab, SECURITY	6-13
Figure 6-9. Example User Setup Report	6-14
Figure 6-10. Audit trail settings	6-15
Table 6-5. AUDIT tab, SECURITY	6-16
Figure 6-11. Audit Data listing	6-16
Table 6-6. AUDIT DATA tab, SECURITY	6-17
Figure 6-12. Audit Trail Report example	6-17
 CHAPTER 7. ALARMS.....	 7-1
Figure 7-1. GENERAL tab, ALARMS	7-2
Figure 7-2. PARTICLES tab, ALARMS	7-3
Table 7-1. DATA , PARTICLES tab	7-4
Figure 7-3. ENVIRONMENTAL tab, ALARMS	7-5
Figure 7-4. TREND tab, ALARMS	7-6
Figure 7-5. REASONS tab, ALARMS	7-8
Table 7-2. REASONS tab, ALARMS	7-8
Figure 7-6. Warning/Alarm Acknowledgement button (circled) on the HOME screen.....	7-10
Figure 7-7. Particle Alarm information	7-11
Figure 7-8. Particle Warning information.....	7-11

CHAPTER 8. LOCATIONS	8-1
Figure 8-1. Locations configuration for recipes	8-1
Figure 8-2. Hierarchy of areas, rooms, and locations.....	8-2
Figure 8-3. Sampling data (left), and the HOME screen (right).....	8-2
Figure 8-4. Add Item window.....	8-3
Figure 8-5. Type listing circled	8-6
Figure 8-6. Area and Room assignment list	8-7
Figure 8-7. Delete all location facility data.....	8-8
Figure 8-8. Recover all location facility data.....	8-8
Table 8-1. Buttons of the LOCATIONS screen	8-9
Figure 8-9. Example Location Hierarchy Report	8-10
CHAPTER 9. RECIPES	9-1
Figure 9-1. SETUP tab, RECIPES	9-1
Figure 9-2. RECIPES DETAILS window	9-2
Figure 9-3. ASSIGNMENTS tab, RECIPES	9-3
Figure 9-4. NFC tab, COMM	9-4
Figure 9-5. Internal NFC card reader location.....	9-5
Table 9-1. Buttons of the SETUP tab, RECIPES	9-6
Table 9-2. Buttons of the ASSIGNMENTS tab, RECIPES	9-7
CHAPTER 10. DISPLAY, DATA AND REPORTS.....	10-1
Figure 10-1. DISPLAY tab, DISPLAY	10-2
Table 10-1. DISPLAY tab, DISPLAY	10-2
Figure 10-2. TREND tab, DISPLAY	10-4
Table 10-2. TREND tab, DISPLAY	10-4
Figure 10-3. Example trend graph, MAIN screen	10-6
Figure 10-4. HISTOGRAM tab, DISPLAY	10-7
Table 10-3. HISTOGRAM tab, DISPLAY	10-7
Figure 10-5. REPORTS tab, DISPLAY	10-9
Table 10-4. Final Sample Report legend	10-12
Figure 10-6. Table display of sampling data	10-16
Figure 10-7. GRAPH tab, swipe left/right to for additional formats	10-17
Figure 10-8. Additional formats on the GRAPH tab, DATA	10-18
Table 10-5. TABLE and GRAPH buttons.....	10-18
Figure 10-9. Options dialog	10-20
CHAPTER 11. STATISTICS.....	11-1
Figure 11-1. Example Cleanroom Certification Report	11-1
Figure 11-2. HOME screen, Statistics Mode	11-2
Figure 11-3. Swipe left to switch between displays	11-3
Figure 11-4. HOME screen displays for Average mode.....	11-4
Figure 11-5. Average mode report, first page	11-6
Figure 11-6. Virtual locations in Statistics Mode.....	11-7
Figure 11-7. STANDARDS tab, STATISTICS	11-8
Figure 11-8. SETUP tab, STATISTICS	11-9
Table 11-1. SETUP tab, STATISTICS	11-9
Figure 11-9. Certification Setup Report example	11-12

Figure 11-10. Switch Mode window, virtual locations added.....	11-13
Figure 11-11. Automatic list of virtual locations, HOME screen	11-14
Figure 11-12. Statistics sample complete	11-14
Figure 11-13. Sample Confirmation/Acknowledgement window	11-15
Figure 11-14. Statistics plan complete message	11-15
Figure 11-15. Example statistics sampling report	11-17
Table 11-2. Statistics Printout legend.....	11-17
Table 11-3. ISO 14644-1:2015 Standard Class Details	11-20
Table 11-4. EU GMP Grade and ISO classes.....	11-21
Table 11-5. Maximum Limits for Total Particles.....	11-21
Table 11-6. Maximum Particles Per Unit Volume.....	11-22
 CHAPTER 12. SYSTEM CONFIGURATION	 12-1
Figure 12-1. STATUS tab, SYSTEM	12-1
Figure 12-2. SETUP tab, SYSTEM	12-2
Figure 12-3. Change to another language keyboard	12-4
Figure 12-4. Press and hold the ‘s’ letter on the DE keyboard for more options	12-5
Figure 12-5. Clone Export and Import buttons, SETUP tab, SYSTEM	12-8
Figure 12-6. Clone Export window	12-9
Figure 12-7. Clone Import window	12-10
Table 12-1. SETUP tab, SYSTEM	12-10
Figure 12-8. DATE/TIME tab, SYSTEM	12-11
Table 12-2. DATE/TIME tab, SYSTEM	12-11
Figure 12-9. CHANNELS tab, SYSTEM	12-13
Table 12-3. CHANNELS tab, SYSTEM	12-14
 CHAPTER 13. MAINTENANCE AND DIAGNOSTICS	 13-1
Figure 13-1. Steps to install printer roll.....	13-3
Figure 13-2. TESTS tab, DIAGNOSTICS	13-6
 APPENDIX A. INTERNATIONAL PRECAUTIONS	 A-1
 APPENDIX B. COMMA SEPARATED VALUE (CSV) FORMAT	 B-1
Table B-1. CSV fields and descriptions	B-1
 APPENDIX C. TROUBLESHOOTING ETHERNET	 C-1
Figure C-1. Example for ping test.....	C-1
Figure C-2. Example for ipconfig command.....	C-2
 APPENDIX D. MODBUS	 D-1
Table D-1. Configuration descriptions	D-3
Table D-3. Data descriptions.....	D-6
Table D-4. Data section of the Input Register.....	D-9
Table D-5. Holding Registers description	D-14
Table D-6. Holding Registers section of the Modbus Map	D-15
Table D-7. Holding Registers description	D-16
Table D-8. Coils section of the Modbus Map	D-18
Table D-9. Associated values for specific registry entries.....	D-20
Figure D-1. Modbus Setup and Running Example	D-21
Figure D-2. Modbus Dequeuing Example.....	D-22

APPENDIX E. WEB API	E-1
Table E-1. Bidirectional HTTP Status Codes	E-91
Table E-2. Bidirectional Error Codes	E-92
 APPENDIX F. WEB API.....	 E-1
Table F-1. System Configuration Commands	E-35
 APPENDIX G. SERIAL COMMANDS	 F-1
 APPENDIX H. CONFIGURING THE WI-FI	 G-1
Figure H-1. COMM Menu without WiFi enabled (Left) and with WiFi enabled (Right)	G-1
Figure H-2. Wireless Tab of COMM Menu	G-1
Table H-1. WIRELESS tab, COMM	G-2
Figure H-3. Available Networks	G-3
Figure H-4. Connect to Network Menu	G-3
Figure H-5. Used Networks	G-4
Figure H-6. ISED Certificate	G-7
Figure H-7. FCC Grant.....	G-8
Figure H-8. Japan MIC Certificate.....	G-10
Figure H-9. South Korean KC Mark Certificate	G-11
Figure H-10. Brazil Anatel Certificates.....	G-12
Figure H-11. Taiwan NCC Certificates.....	G-15
Figure H-12. China CMIT Certificates.....	G-18
 APPENDIX I. 有毒或有害的物质和元素	 H-1

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Chapter 1

Quick Guide

Portable, lightweight, and durable, the [Lasair® Pro Aerosol Particle Counter](#) is for applications where portability is crucial, such as cleanroom monitoring, facility certification, and trending analysis.



The particle counter's touchscreen controls and intuitive user interface make setup for particle sampling simple. You can easily:

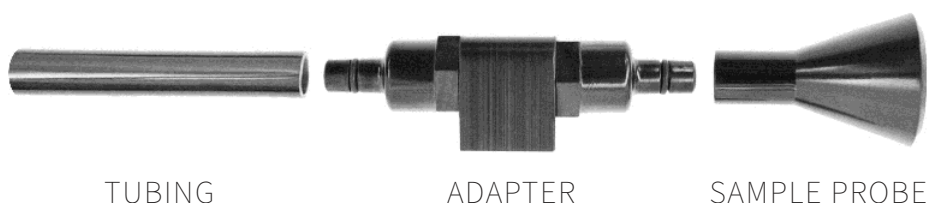
- Set the start and stop time intervals for particle sampling
- Display sampling results
- Set alarm parameters
- Review counter status and analog data

Scan or click for a
*Quick General Demo of
the Lasair Pro Instrument*



Assembly of Optional Connections

1. Remove the protective cap from the particle counter's sample inlet.
2. Press tubing or ISP over the sample inlet base.
3. If using tubing, insert the free end of the tubing into one end of an adapter (supplied with each ISP).
4. Place the sample probe on the other end of the adapter. The adapter's O-ring will hold the sample probe securely to the adapter.



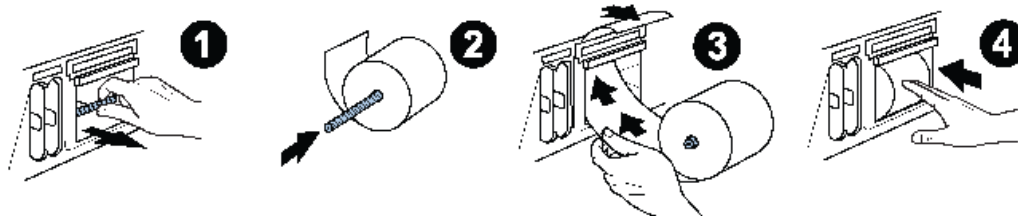
5. Mount the adapter using the two 1/4-inch screw holes as necessary.

NOTE: When particles greater than 1 μm are targeted, use the minimum length required to reach the sampling area. In pharmaceutical applications, tubing length should be a maximum of 2 m (about 6.5 ft).

Printer Roll Installation

Pull the right case cover out with the finger notch, as shown on page 1-2.

1. Turn on the Lasair Pro and remove the printer roll holder.
2. Insert the printer roll holder into the printer roll's center.
3. Thread the paper into the top of the interior cavity as shown until the automatic feed is engaged. The cutter will automatically snip a small portion of the roll.
4. Roll the paper so that it fits snug inside the interior cavity. Close the case and



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Quick Tutorial Video about
How to Replace Paper Rolls





**Scan or click for a Quick Demo Video
about Initial Setup of the Instrument**
(Units, Date/Time, Language, Channels, NTP, etc.)

HOME Screen

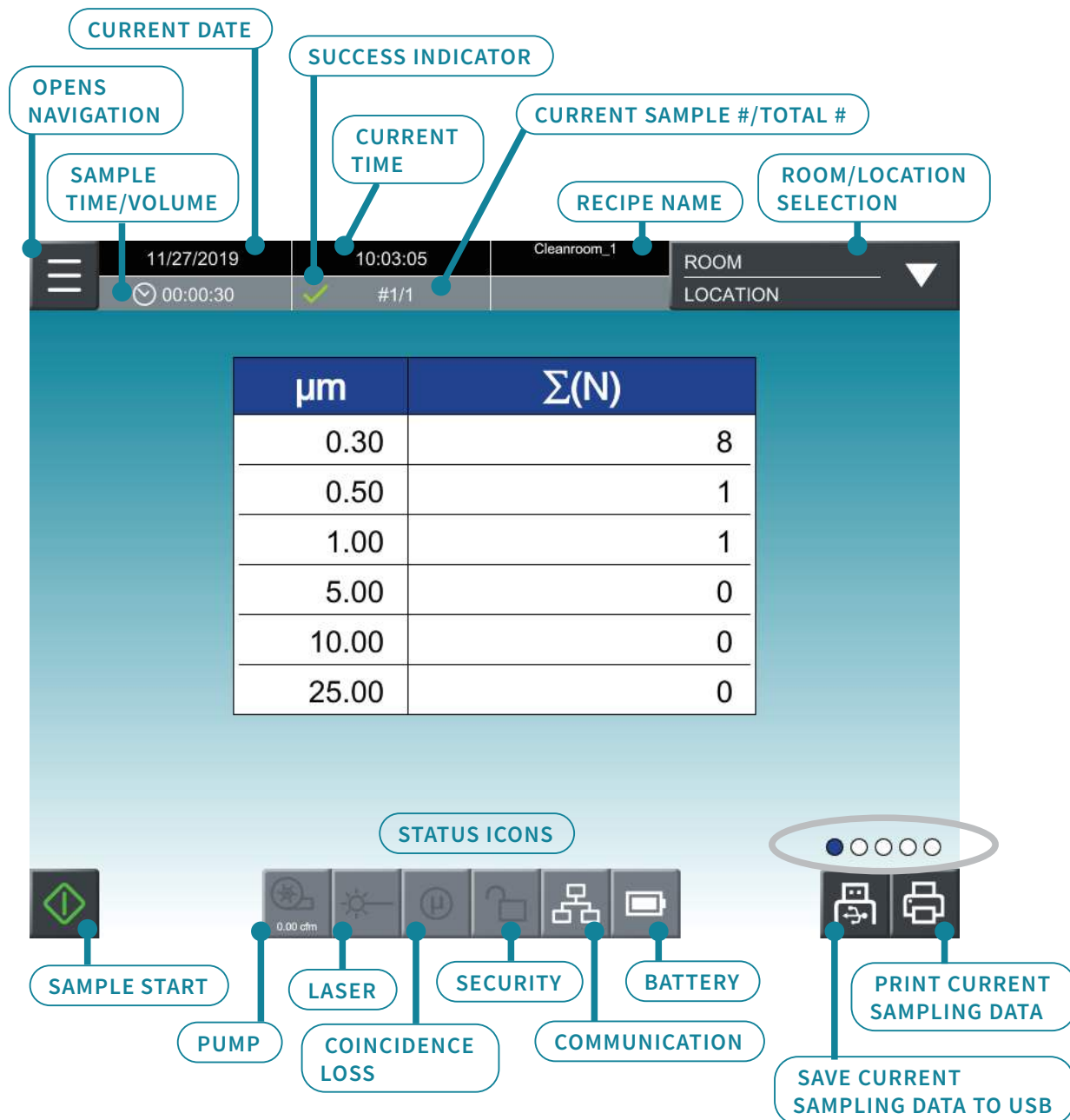


Figure 1-1. Details of the **HOME** screen, swipe left to change the display (circled)

Sampling

1. Press the **POWER** button.
2. On the **HOME** screen, press .
3. The Lasair Pro takes a sample with default settings. To adjust these settings, navigate to  >  > **SETTINGS**. The font for the current tab you are on will be enlarged and bold.

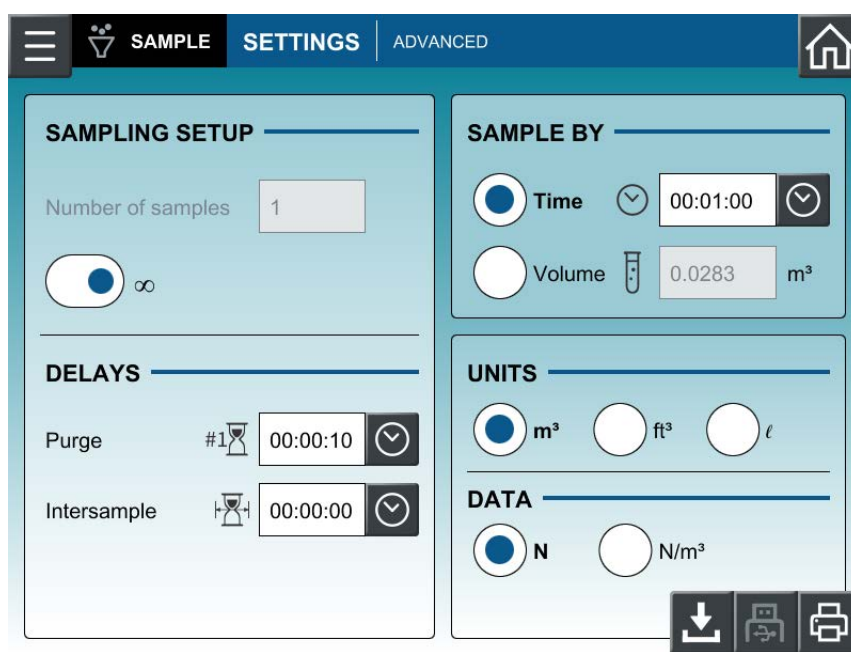


Figure 1-2. SETTINGS tab, SAMPLE

- **Sampling Setup:** Choose a number of samples or activate unlimited samples (∞).
- **Sample By:** Choose the sample time or sample volume.
- **Delays:** Choose time before first sample (Purge) and time between samples (Intersample).
- **Units:** Choose volume units (m^3 , ft^3 , or l).
- **Data:** Choose raw (N) or normalized (N/ft^3).

Scan or click for a
Quick Tutorial Video about
How to Create a Recipe



Saving a Recipe

1. After adjusting sampling settings, press  .
2. Enter the Recipe Name using the keyboard.
3. Press **OK**.
4. You can view, select, and assign saved recipes by navigating to  >  .
5. Assigned Statistics and Monitoring recipes can be accessed by selecting the room they are assigned to from the main screen pull-down location selection box.

Enabling Security

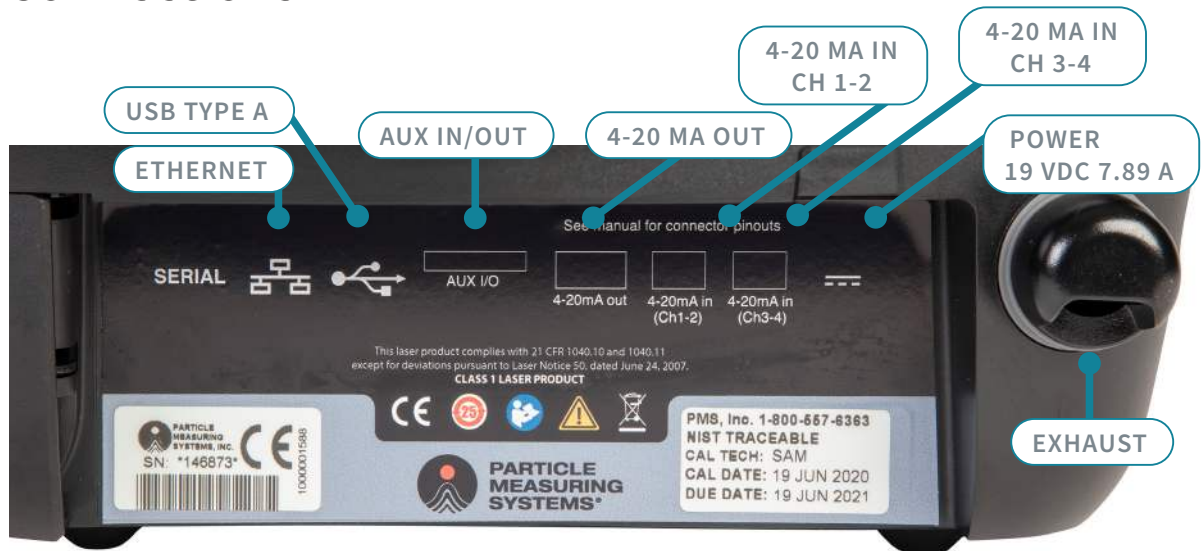
1. Press  >  > **USERS** .
2. Press  .
3. Add the desired amount of users. Ensure an administrator user is created and ON before proceeding. The minimum required length for usernames is 3 characters, and 8 characters for passwords.



Figure 1-3. Keyboard

4. Navigate to **SETTINGS**.
5. Press **Enable Security** to move the dot from left to right.
6. Select the administrator account. You will now be able to log in.

Connections



BACK PANEL

- **(1) Ethernet** – Use to connect to control software (i.e., Facility Net, FacilityPro, Pharmaceutical Net Pro). PMS software stores data, provides additional analysis, and reports results that are 21 CFR Part 11 compliant for one or more Lasair Pro particle counters.
- **(2) USB Type A** – There are two USB ports, one on the side and one on the back panel, for transferring data from the Lasair Pro particle counter to your computer.
- **(1) Aux I/O** – Use to connect to external signal equipment for instrument start/stop.
- **(4) 4-20 mA OUT** – Use to read particle data on a separate device, such as Programmable Logic Controller (PLC).
- **(4) 4-20 mA IN** – Connect up to four analog environmental sensors using the Lasair Pro particle counter's 4-20 mA input connectors.
- **Power** – Use to power the instrument and charge the removable lithium batteries.
- **Exhaust** – Air discharge from instrument.

Using NFC

NFC cards can store one user's credentials or one recipe configuration for ease of use. To enable NFC:

Scan or click for a
*Quick Tutorial Video to
Setup & Program NFC Cards*



1. Press , then  (**COMM**).
2. Go to the **NFC** tab and press the **Enable Security**, **Enable Locations/Recipes**, and **Enable Write NFC** indicators. The orange dot will appear when NFC is enabled. A gray dot indicates the setting has not been enabled.
3. When on the **USERS** tab of the **SECURITY** screen, and the **ASSIGNMENTS** tab of the

RECIPES screen, the **NFC** icon  and options will be activated.

The Lasair Pro 310 is available in a non-RF emitting configuration (PMS PN: 101410X2X) which will not be equipped with the hardware or internal firmware that would enable any wireless communication.



This sticker on the exterior of the unit indicates the non-RF model. The **NFC** icon on the GUI will not be enabled on this model.

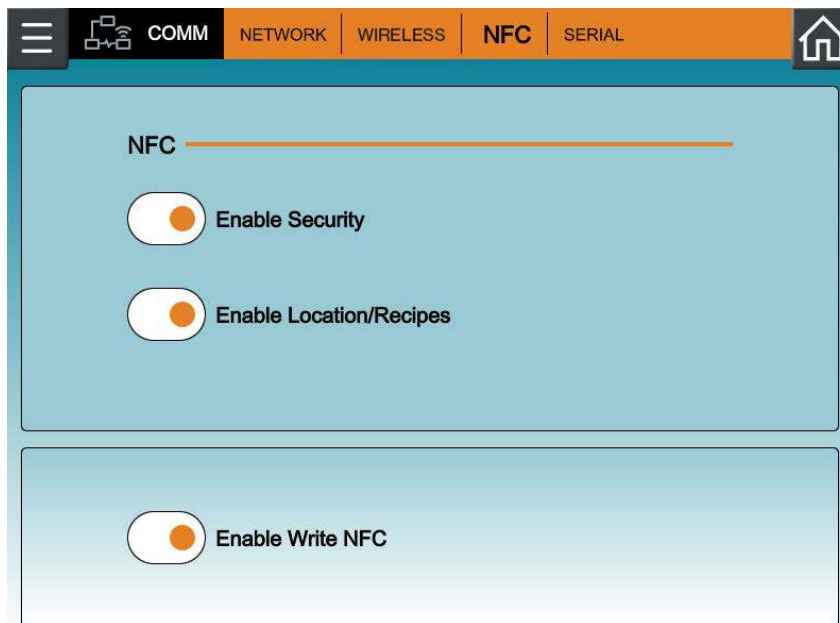


Figure 1-4. NFC Tab

Basic WiFi Setup Procedure

-- NOTICE --

Change the Wi-Fi country code to the appropriate country setting prior to Wi-Fi use.

This explains how to correctly use the Lasair Pro Wi-Fi enabling hardware. The hardware necessary to provide the Wi-Fi consists of a separate microprocessor controlled electronics module inside the Lasair Pro instrument.

This procedure explains the basic process of using the Lasair Pro Wi-Fi module. The Wi-Fi module is preconfigured by Particle Measuring Systems to operate such that parameters are set via the Lasair Pro front panel display.

1. Press , then  (**COMM**).
2. Go to the **WIRELESS** tab and select the WiFi toggle at the top of the screen. The orange dot will appear when the WiFi is enabled. A gray dot indicates the setting has not been enabled.

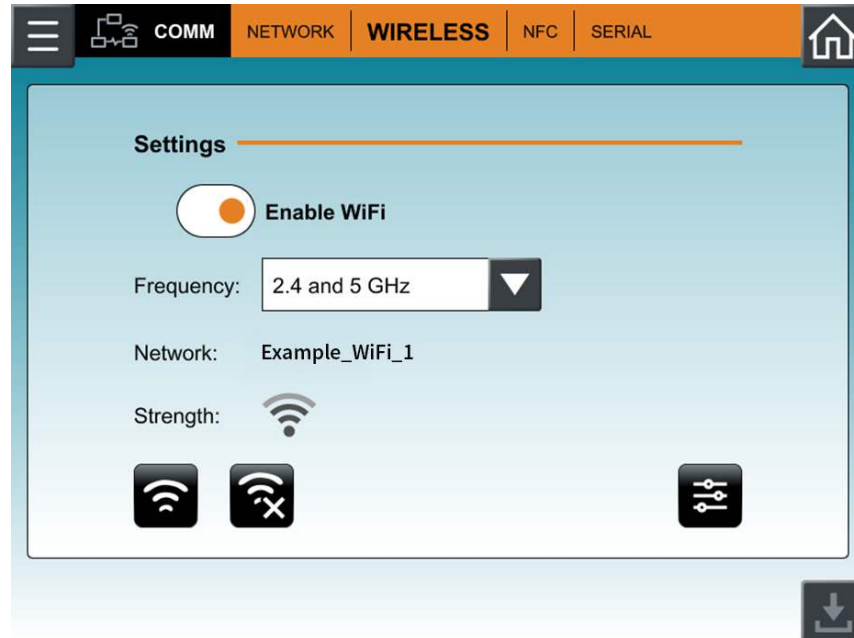


Figure 1-5. Wireless Tab

When you enable or disable the Wifi, you will need to reboot by pushing the re-boot button in the lower right corner of the screen.

3. Select the WiFi icon below Strength
A list of available networks will appear



AVAILABLE NETWORKS

NETWORK	
Example_WiFi_1	
Example_WiFi_2	
Example_WiFi_3	
Example_WiFi_4	
Example_WiFi_5	

Network:

OK

CANCEL

4. Select your network and enter the password as prompted.
The instrument will then be connected to the network of choice

Data Export and Import

The Lasair Pro system and data can be cloned and copied to another Lasair Pro instrument.

CAUTION

Cloning should only be done between the same type of instruments. For example, a model 310 should only be cloned to other 310 instruments. If cloning is attempted for different flowrate units, there will be errors in the cloning process due to product differences.

You can export a clone file or import an existing one. Settings in the clone file include:

- All **SYSTEM** screen parameters
- All **SAMPLE** screen parameters
- All **STATISTICS** screen parameters
- All **SECURITY** screen parameters (including all user data)
- TCP/IP communication parameters
- All **COMM** screen parameters
- IP addresses (selectable with Comm Settings)
- Area, Room, Locations and assignments
- Recipes
- All **IN/OUT** screen parameters
- All **DISPLAY** screen parameters
- All **DATA** screen parameters
- Clone file encryption

1. Press  (**SYSTEM**).

2. Go to the **SETUP** tab.

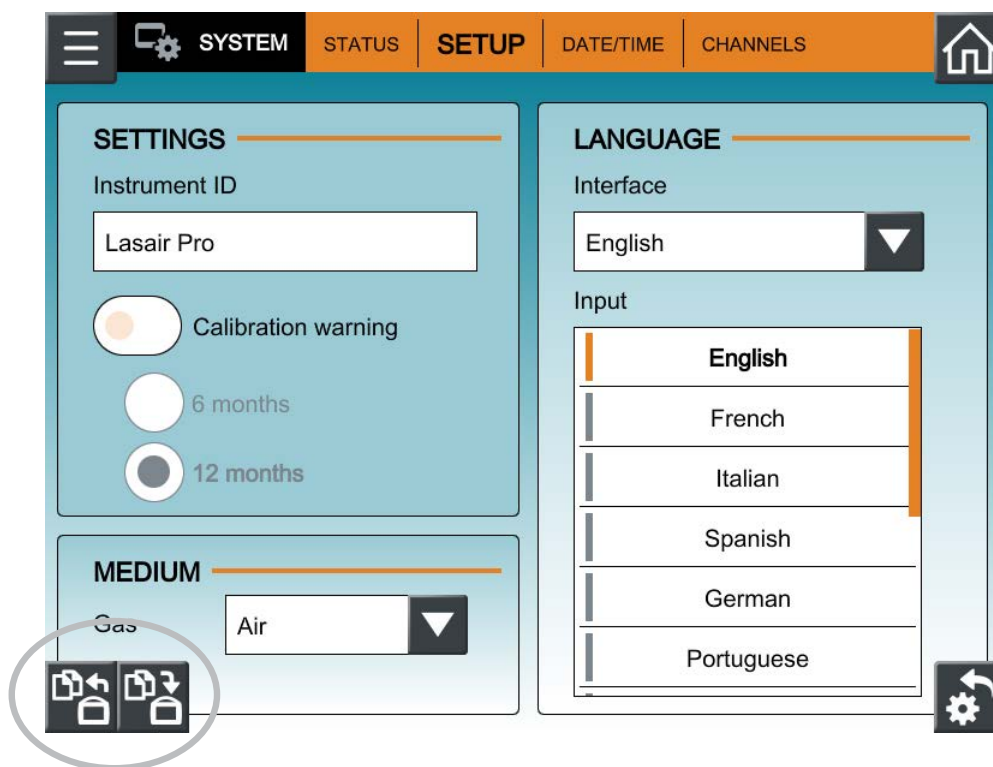


Figure 1-6. Clone Export and Import buttons, SETUP tab, SYSTEM

3. Press either of the circled buttons (descriptions below)

	Clone Export	Choose Clone Export , press inside the File Name field to open the keyboard, or press  to select a file to overwrite. Select the options to be included in the export file and press OK .
	Clone Import	Choose Clone Import , press inside the File Name field to open the keyboard to type the name of the import file, or press  to select a file to import. Select the options to be imported and press OK . The Lasair Pro will logout any users and restart with the imported options. Note that security is automatically disabled when importing security settings.

Scan or click to
Download a Paper
about *Data Integrity*



Chapter 2

Specifications

	MODEL		
	310	350	5100
Channels	Up to 8 configurable channels from 0.3 to 25.0 μm	Up to 8 configurable channels from 0.3 to 25.0 μm	Up to 8 configurable channels from 0.5 to 25.0 μm
	Optional 2-channel pharmaceutical mode available. See CHANNELS Tab on page 12-13.		
Flow Rate	1.0 CFM ± 5% (28.3 LPM)	50 LPM ± 5%	100 LPM ± 5%
Calibration	Meets ISO 21501-4:2018 requirements. Optional ISO 17025 compliance available.		
Maximum Concentration ^a	> 42,924,662 / m ³	> 28,209,736 / m ³	> 21,354,726 / m ³
Counting Efficiency	50% ± 20% for most sensitive threshold. ISO 21501-4:2018 compliant.		
Zero Count	< 7.07 counts/m ³	< 4.00 counts/m ³	< 2.00 counts/m ³
Tubing Length	Maximum 8 meters		
Compressed Gas Compatibility	Air (CDA), argon (Ar), nitrogen (N), and carbon dioxide (CO ₂)		
Data Storage	10,000 complete data sets. Data cannot be edited or altered meeting 21 CFR Part 11 compliance.		
Communication Modes	- Ethernet - USB data downloading - NFC tag for user login and recipe configuration - Units with P/N (10141010X2X) will not have NFC or Wifi enabled		
Table 2-1. Specifications			

	MODEL		
	310	350	5100
Remote Operation	• Real-time download to Facility Net, Pharmaceutical Net Pro, FacilityPro SCADA NG, and FacilityPro SMART NG • USB download • Automatic clock adjustment with NPT server configuration		
Reports	• Encrypted PDF exports • Cleanroom certification reports for ISO, EU GMP, China GMP, and FS209E • Cleanroom monitoring reports		
Digital and Analog Input/Output	• Four (4) 4-20 mA inputs (< 0.5% of Span), and (4) 4-20 mA outputs (< 1.0% Span) • One (1) 5 V pulse output • Status/Alarm Output: 24 VDC, 1 A maximum		
Languages	International keyboard with English, French, German, Italian, Japanese (Kanji), Mandarin Chinese (Traditional or Simplified), Portuguese, Russian		
Display and Printer	• 8.4-inch color SVGA display • P-cap with finger swipe and gesture control • Optional built-in thermal printer with paper cutter compatible with thermal and cleanroom paper		
Audit Trail	21 CFR Part 11 compliant with 30,000 recorded activities		
Security	Up to 100 configurable users with 3 privileges group (Administrator, Supervisor, Operator). Unlimited users can be configured using NFC access cards on applicable models.		
Location	Up to 1,000 dynamic locations, organizable within Area, Room and Location hierarchy. Up to 50 locations configurable with NFC recipe cards on applicable models.		
Recipes	Up to 100 configurable recipes unlimited when using NFC cards		
External Surface	Polycarbonate (PC)		
Table 2-1. Specifications			

	MODEL		
	310	350	5100
Enclosure Cleaning Materials	- Alcohol, 70% or 99.5% - Hydrogen peroxide 6% - Phenol or other phenolics - Quaternary ammonium salts - Hypochlorites/sodium hypochlorite 0.5% detergent - Peracetic acid and hydrogen peroxide combination		
Sample Tubing ID ^b	3/8-inch 8 m max. length	1/2-inch 8 m max. length	3/4-inch 8 m max. length
Sample Output Filtering	Internally filtered to > 99.97% at 0.3 μm		
External AC to DC Power Supply	- Input: 100 – 240 V, 50/60 Hz, 2.5 A - Output: 19 VDC, 7.89 A - AC input voltage fluctuation shall not exceed + 10%. (Requires a grounded electrical supply for safety.)		
Optional Battery	- Rechargeable Lithium Ion battery pack NH2054QE34 - Estimated continuous operation is: 4 hr (single) and 8 hr (dual) for 1 CFM unit 4 hr (single) and 8 hr (dual) for 50 LPM and 6 hr for 100 LPM (dual) This is estimated for operations where the LCD screen is at 50% brightness, the printer is not printing, there is no WiFi connection, NFC is powered but not active, and no tubing is attached.		
Dimensions (H x W x D)	24.6 x 25.7 x 25.6 cm (9.7 x 10.1 x 10.1 in)		
Weight	11.9 lb (5.4 kg) without batteries 14.2 lb (6.4 kg) with two optional batteries		
Operating Environment	- Temperature: 0 – 32 °C (32 - 89.6 °F) - Humidity: 5 – 95% RH non-condensing		
Table 2-1. Specifications			

- a. Less than 10% coincidence loss at maximum recommended concentration.
- b. For pharmaceutical applications, tubing length should equal 2m maximum.

Environmental Conditions

The following environmental conditions apply to the Lasair Pro particle counter:

Operating Temperature Range	0 – 32 °C (32 - 89.6 °F)
Humidity Range	5 – 95% RH non-condensing
Storage and Transportation Temperature	-20 – 50 °C (4 - 122 °F)
Maximum Altitude	6,562 ft (2000 m)
Installation Requirements	• Indoor use only • Pollution degree 2 • Over voltage category I • Ordinary protection (not protected against harmful ingress of moisture) • External AC to DC Power Supply: • Overvoltage Category II • Class I Equipment (Electrical grounding from the main power source to the product input is required for safety.)
Laser Classification	Class 1, complies with US 21 CFR 1040.10 and EN60825-1. Internally, an enclosed Class 3b laser is used per EN60825-1 and IEC60825-1:2014 and operates either with the enclosure cover open or closed.
Table 2-2. Environmental conditions	

Chapter 3

Your System

Recycling

As a global leader in contamination monitoring, Particle Measuring Systems (PMS) has also been actively monitoring and reducing our environmental contamination over the last few years.



We are Strongly Committed to Net Zero

We have set a clear ambition

Our operations:

- Net Zero by 2030 (Scope 1 and 2 emissions)
- Our value chain: Net Zero by 2040 (Scope 3 emissions)

Our science-based targets support this ambition

- The 85% absolute reduction in Scope 1 and 2 emissions by 2030
- The 42% absolute reduction in Scope 3 emissions by 2030

Both targets have been set across the Spectris group and are aligned to a 1.5 degree warming scenario and have been validated by the Science Based Targets initiative.

With your shipment, you receive packaging materials that can be 100% recycled. For up to date, detailed information about recycling the specific materials in your shipment, see our website by scanning the QR below or clicking on [this link](#).



How Lasair Pro Works

The Lasair Pro takes in air at a set flowrate of 28.3, 50, or 100 LPM dependent on the model (310, 350, and 5100, respectively) through the sample inlet to the sample chamber. In this chamber, a laser projects a beam against particles in the sample and causes light to scatter. Scattered light is picked up by the built-in optics collection system and converted to a voltage pulse.

- The amplitude of the voltage pulse corresponds to the size of the particle.
- The number of pulses corresponds to the number of particles.

The incoming particle data is allocated to the appropriate size channel for counting differential and cumulative counts. Once the air is sampled, it is pumped from the sampling chamber to the HEPA-filtered exhaust port.

Standalone or Portable Use

The Lasair Pro particle counter can be used as either a standalone or portable device. As a standalone particle counter, you can position the unit in a permanent sampling location or connect tubing to sample air in a remote location, such as a cleanroom or isolator. As a portable device, you can carry the Lasair Pro from one location to another to sample multiple areas.

Firmware

The internal firmware for collecting, displaying, analyzing, storing, and reporting data is 21 CFR Part 11 compliant. The software stores up to 10,000 samples, 100 sampling recipes and 1,000 locations to reduce labor time and potential errors.

Memory

The Lasair Pro particle counter has the memory capacity to store 10,000 complete data sets, which cannot be edited or altered, meeting 21 CFR Part 11 requirements. Once this memory is full, the instrument automatically erases memory in order to add additional sampling data. The oldest data is erased first.

**Scan or click for a
Quick Demo Video
about Initial Setup**



Communication

Data can be printed from the unit's built-in printer, downloaded from the USB port to a portable storage device (jump drive), transferred to a computer via Ethernet communication, and/or connected to control software.

NFC cards can be used to upload user and recipe data for quick use. This feature is not available on Lasair Pro 310 models that do not have NFC and Wifi capability (1014102X2X).

Control Software

Facility Net and FacilityPro software stores data from the Lasair Pro particle counter and provides additional analysis and reporting options that are 21 CFR Part 11 compliant. For more information on configuring PMS software to work with Lasair Pro particle counters, see the software's user guide.

The graphic features a background image of a laboratory setting with glass vials and equipment. On the left, the Particle Measuring Systems logo is displayed above the text "a spectris company". Below this, a red banner reads "Scan or Click to DOWNLOAD", followed by the title "A Practical Application of Current Guidelines" in a large, bold, black serif font. A QR code is positioned at the bottom left. On the right, a 3D rendering of a handbook is shown, titled "Environmental Monitoring Handbook for Pharmaceutical Manufacturers" with the tagline "Without measurement there is no control" at the bottom.

PARTICLE MEASURING SYSTEMS®
a spectris company

Scan or Click to DOWNLOAD

A Practical Application of Current Guidelines

Environmental Monitoring Handbook for Pharmaceutical Manufacturers

Without measurement there is no control

Touchscreen

The particle counter has a large 8.4-inch color touchscreen that displays intuitive and easy-to-use navigation. Information can also be entered using a USB keyboard. The display can be configured to display information in 1 of 9 languages (see **SETUP Tab** on page 12-2).

The navigation panel allows you to quickly access any screen in the system. To open, press

the  button on any screen. Press the  button to close the panel.



Figure 3-1. Navigation options

HOME Screen

When you first turn on the Lasair Pro particle counter, the **HOME** screen displays. You can

also navigate to this screen any time by pressing  and then  (**HOME**).

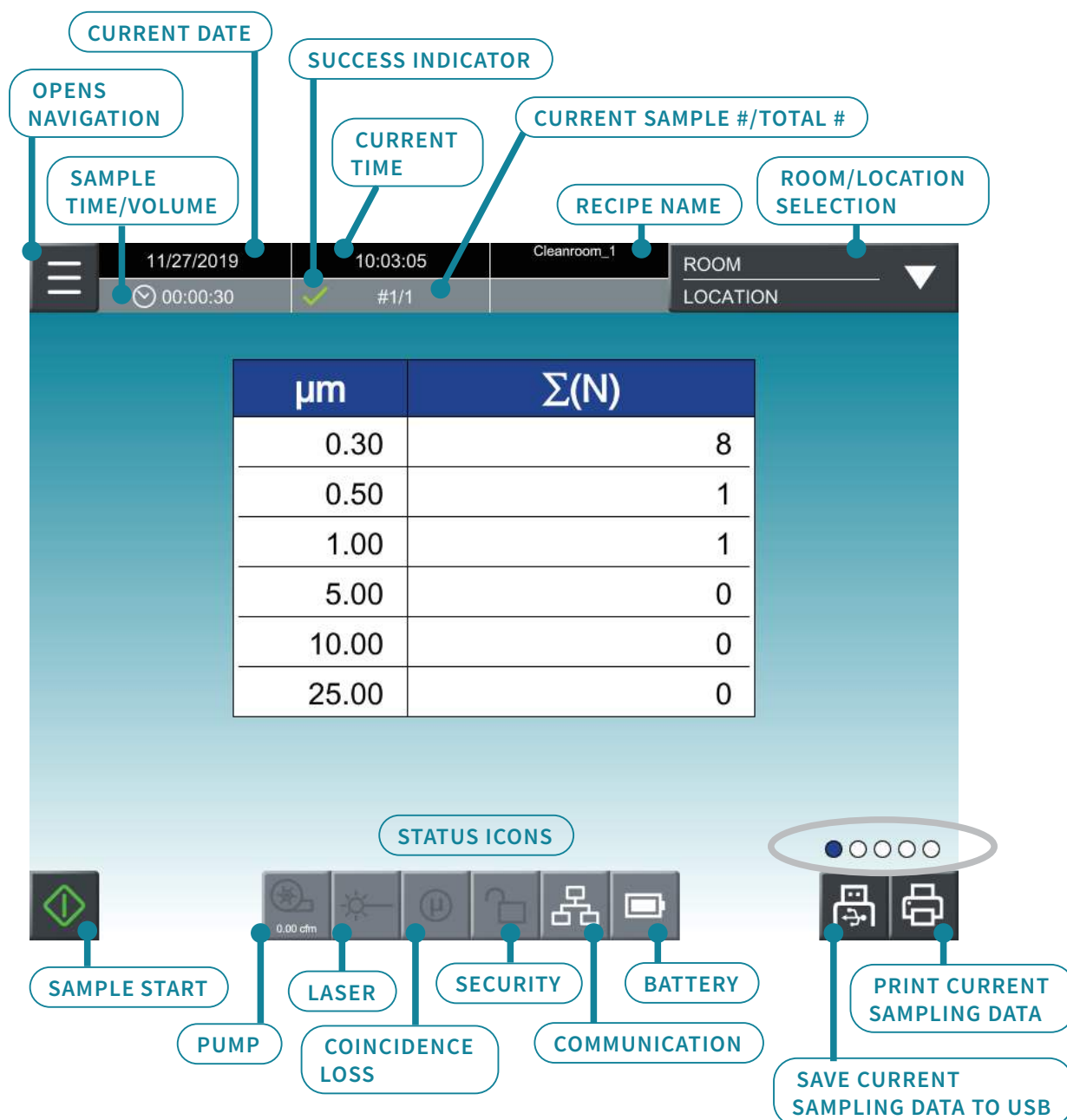


Figure 3-2. Default sampling display (Cumulative Normalized Counts)

Use the **HOME** screen for viewing sampling data in a variety of formats. All data formats can be viewed by swiping across the screen to the left or right. The screen position dots, circled in **Figure 3-2**, indicate which of the five total formats you are viewing.

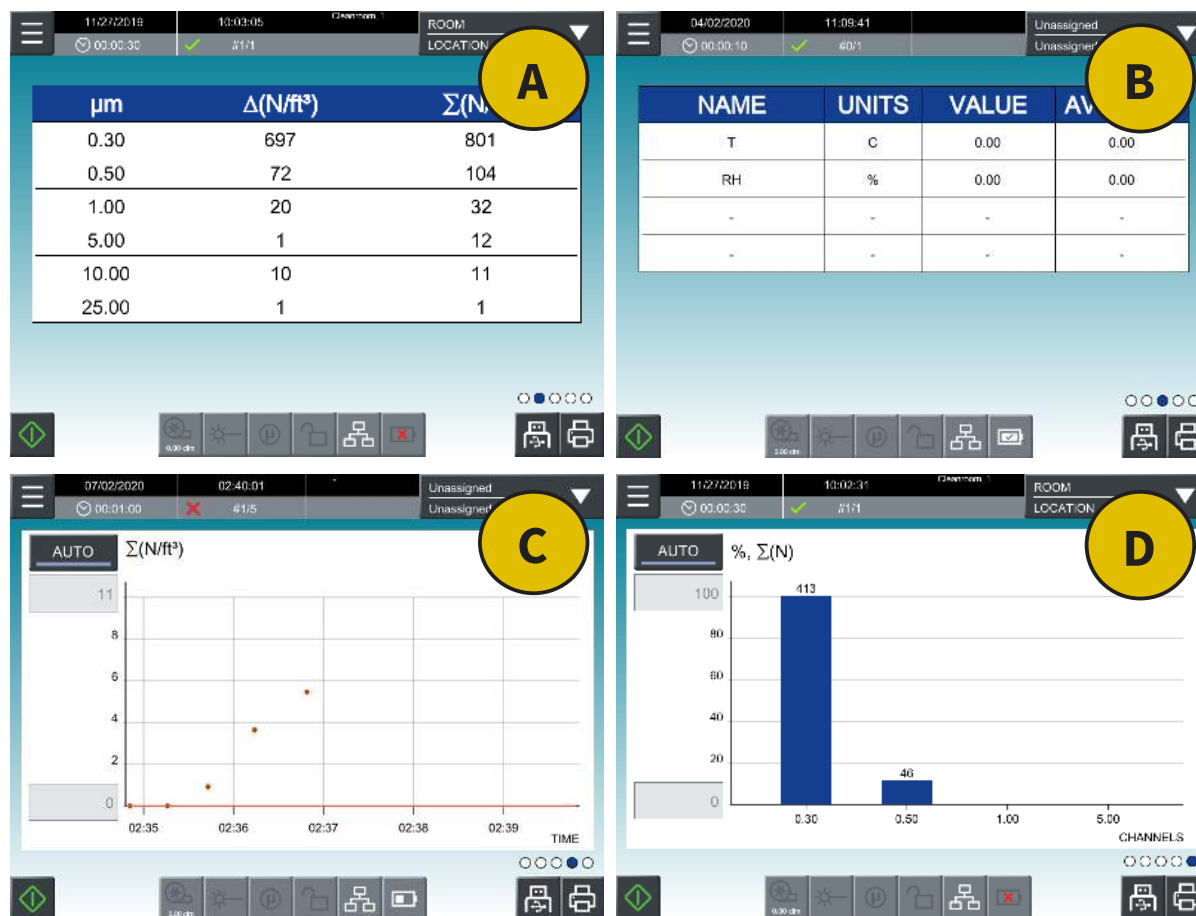


Figure 3-3. Other data formats

In **Figure 3-3**, the following formats will display by swiping left once:

- **A.** Differential and Cumulative Normalized Counts
- **B.** Environmental Data Table
- **C.** Cumulative Normalized Counts Real-Time Graph
- **D.** Cumulative Raw Counts Bar Graph

Differential count (Δ) refers to the number of particles of a specific size that are found in one sample. **Cumulative count (Σ)** refers to the number of particles of a certain size and larger that are found in one sample. **Normalized counts** refer to the total particle data counted in a unit of volume. **Raw counts** refer to the total number of particles counted during sampling and are unitless.

Environment Data Table

Use the **Environment Data Table** on the **HOME** screen to view data collected by any environmental sensors (such as a temperature and relative humidity sensor). The table contains four rows for each available analog channel and the following four columns:

- **Name:** Name set for the channel
- **Units:** Unit name set for the channel
- **Value:** Current calculated value for the channel
- **Average:** Average calculated value for the channel

Sampling Configuration

Use the tabs on the **SAMPLE** screen to set up the parameters that will be used for collecting sample data. These sampling parameters are assigned to specific sampling locations.

- **SETTINGS Tab** on page 5-2
- **ADVANCED Tab** on page 5-6



**Scan or click to Download a Paper
about Choosing the Most Suitable Locations to Sample**

Icons and Buttons of the HOME Screen

The **HOME** screen displays data collected from the current sample. Data remains on the screen until a new sample is started. All data is automatically saved and stored in the Lasair Pro counter's internal memory. You can access previous sampling data by navigating to **DATA** from the navigation panel.

The **HOME** screen is what first appears after instrument startup and is the only screen available if security has been enabled. Every other screen has the **HOME** icon for easy, one-button access. Users can also return to the **HOME** screen with the navigation panel.



Figure 3-4. HOME icon

The full list of **HOME** screen display icons and buttons are listed in **Table 3-1**. Some icons may only appear under certain conditions.

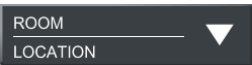
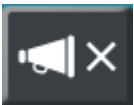
Image	Name	Description
	Start Sample	Starts the sampling process.
	Stop Sample	Stops the sampling process.
	Start Pump	Available when Continuous Pump mode has been enabled. See ADVANCED Tab on page 5-6.
	Stop Pump	Available in Continuous Pump mode after the Start Pump button has been pressed.
	Room and Location List	Selectable list of stored rooms, areas, and locations. Use to associate a location to a particular sample.
	Acknowledge Alarm	Only displays when an alarm has occurred. Press to acknowledge the alarm and set an alarm reason. For more information, see Chapter 7 .
	Beep	Allows the user to select the number of particle counts before an audio cue occurs. Configured in the ADVANCED tab of the SAMPLE screen. Press this button to close the list of particle count options.
	Terminate	Terminates Monitoring Mode and Statistics Mode. - For more information on Monitoring Mode, see Monitoring Mode on page 5-8. - For more information on Statistics Mode, see Chapter 11.

Table 3-1. HOME screen icons and buttons

Image	Name	Description
Lasair Pro Status		
	Pump Status: Ok	Indicates the status of the pump. When pressed, a dialog box gives the following information: • Flowrate (in CFM) • Status (Ok, Unstable, Failure) • Mode (On or Off)
	Pump Status: Unstable	
	Pump Status: Failure	
	Laser	Indicates the status of the laser. When pressed, a dialog box gives the following information: • Status (Ok, Bad) • Mode (On or Off)
	Coincidence Loss	Indicates the coincidence loss (% error) of the current sampling data. This number increases as multiple particles pass through the sensor, resulting in an overall decrease in counts. Ideally, the number is 0. When pressed, a dialog box gives the following information: • Status (Ok, Bad) • Description (< or > 0.10 %)
Table 3-1. HOME screen icons and buttons		

Image	Name	Description
Security		
	Security Enabled, Administrator	Indicates the security of the Lasair Pro counter. When pressed, a dialog box gives the following information: • Status (Enabled, Disabled) • User (Username or Not logged in) • Access level (Administrator, Supervisor, Operator, View Only, N/A)
	Security Enabled, Supervisor	
	Security Enabled, Operator	
	Security Enabled, No Login	
	Security Disabled	
	Comm	Indicates the communication status. • When active (white), the device is connected to FacilityPro or Facility Net. • If the indicator is gray, no connection is present.
Battery		
	Low Battery	The red battery icon will flash when the battery is low and not charging.

Table 3-1. HOME screen icons and buttons

Image	Name	Description
	Discharging/ Not Charging	Indicates the status of the battery. When pressed, a dialog box gives the following information: • Number of installed batteries • Charge level • Remaining time (in hours) • Status (Charging, Not Charging, Discharging)
	Plugged In/ Fully Charged	
	Plugged In/ Charging	
	Battery Not Installed	
External Data Save Options		
	Print	Prints sampling results to thermal printer. A number in the top-right corner indicates the number of items to print in the queue.
	Save to USB	Saves sampling results to a USB key. A number in the top-right corner indicates the number of items to save to USB in the queue.
	Print on Alarm	When the alarm symbol is displayed on the top left of the icon, sampling data will print when an alarm is triggered. See the GENERAL Tab on page 7-2 to configure this setting.
Sampling Status		
	Success Indicator	When displayed, indicates the previous sampling was successful.
	Failure Indicator	When displayed, indicates the previous sampling failed.
Table 3-1. HOME screen icons and buttons		

Image	Name	Description
	Alarm	When displayed, indicates alarms have been enabled in the GENERAL tab of the ALARMS screen. The background of the HOME screen turns red and audio cues may start if configured. Alarms cease after acknowledgement. To configure alarm limits, see Chapter 7.
	Audible Alarm	When displayed, indicates alarms will be audible. See the GENERAL Tab on page 7-2 to configure this setting. Volume can be configured in the DISPLAY tab of the DISPLAY screen.
	Warning	When displayed, indicates warnings have been enabled in the GENERAL tab of the ALARMS screen. Audio cues may start if configured. Warnings cease after acknowledgement. To configure alert limits, see Chapter 7.
	NTP Server Not Connected	When displayed, indicates the NTP server for updating the Lasair Pro's time and date is not connected. See DATE/TIME Tab on page 12-11.
	NTP Server Connected	When displayed, indicates the NTP server for updating the Lasair Pro's time and date is connected. See DATE/TIME Tab on page 12-11.
	NFC Location/Recipes Enabled	When displayed, indicates locations and recipes can be assigned to an NFC card. See Locations and rooms may have more than one recipe associated with them. In this case, when the location (or room) is selected, the operator will have the option of choosing one of the assigned recipes to load and run. on page 9-4.

Table 3-1. HOME screen icons and buttons

Image	Name	Description
	NFC Security Enabled	When displayed, indicates users can be assigned to an NFC card. See Creating NFC Users on page 6-6.
	Sample by Volume Enabled	When displayed, indicates sample will terminate after a specified volume is reached. See SETTINGS Tab on page 5-2.
	Sample by Time Enabled	When displayed, indicates sample will terminate after a specified time is reached. See SETTINGS Tab on page 5-2.
Table 3-1. HOME screen icons and buttons		

Shipkit List

Review the list of items included with your shipment. If any items are missing, contact Particle Measuring Systems Customer Service Center at 1-877-475-3317 or email info@pmeasuring.com.

The list included with your shipment will be specific to your order and Lasair Pro model (310, 350 or 5100).

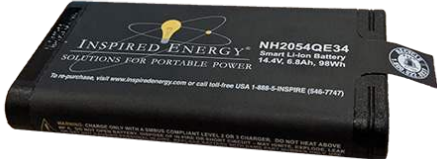
	310	350	5100
Lasair Pro Particle Counter Quantity: 1			
	P/N: 101410-XXXX	P/N: 101420-XXXX	P/N: 101430-XXXX
	Note: X refers to variances in part numbers specific to your order.		
Isokinetic Sampling Probe (ISP) and Plug Quantity: 1 Probe 1 Plug			
	ISP: P/N 1000012579	ISP: P/N 1000012578	ISP: P/N 1000012577
	Plug: P/N 1000001023	Plug: P/N 1000009426	Plug: P/N 1000013174
Lithium Ion Battery P/N 1000025008			
	Quantity: 1	Quantity: 1	Quantity: 2

Table 3-2. Default shipkit list

	310	350	5100
Power Supply Quantity: 1			
	P/N 1000024952		
Power Cord Quantity: 1			
	P/N CMP-X (dependent on country)		
Thermal Printer Paper Quantity: 1			
	P/N 1000024998		
Cleanroom Thermal Printer Paper Quantity: 1			
	P/N 1000024977		
Lasair Pro Quick Guide Quantity: 1			
	P/N 1000026654		
Table 3-2. Default shipkit list			

Accessory List

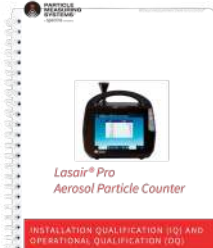
The following is the list of accessories available for the Lasair Pro particle counter. Contact your local sales representative, call 1-877-475-3317, or email info@pmeasuring.com to order.

	310	350	5100
Tripod Adapter Quantity: 1			
	P/N 1000012955	P/N 1000012956	P/N 1000012957
Stainless Steel Isokinetic Sampling Probe Quantity: 1			
	P/N 1000012952	P/N 1000012953	P/N 1000012954
Sample Tubing 10 ft (3.05 m) Quantity: 1			
	P/N MI153	P/N 1000016726	P/N 1000012960 (100 LPM)
Zero-Count Filter Quantity: 1			
	P/N 90104050	P/N 90104052	P/N 90104057
Table 3-3. Accessory list			

	310	350	5100
Handheld ISP Quantity: 1			
	P/N 90101036	P/N 90101037	P/N 90101038
Temperature and Relative Humidity (TRH) Probe Quantity: 1			
	P/N 501050-01		
USB Micro B Serial Service Cable			
	P/N 1000025093		
External Battery Charger Quantity: 1			
	P/N 90101118-10, One Bay, 115 V P/N 90101118-20, One Bay, 230 V		P/N 90101119-10, Four Bay, 115 V P/N 90101119-20, Four Bay, 230 V
Table 3-3. Accessory list			

	310	350	5100
Pelican Wheeled Transport Case Quantity: 1			
	P/N 90101292		
Tabletop Tripod Quantity: 1			
	P/N 1000000979		
316L Stainless Steel Table Stand Quantity: 1			
	P/N 1000023413		
NFC Card Quantity: Dependent on order			
	P/N 1000025099		
Table 3-3. Accessory list			

	310	350	5100
USB Storage Jump Drive and Cap Quantity: Jump Drive: 1 USB Cap: 1			
	Jump Drive P/N 1000026003		USB Cap P/N 1000013021
Connector Kit Quantity: 1			
	P/N 1000024980		
Connector Kit with Crimp Pliers (Optional) Quantity: 1			
	P/N 1000024981		
Crimp Pliers Quantity: 1			
	P/N 1000024982		
Table 3-3. Accessory list			

	310	350	5100
Lasair Pro Validation Manual Quantity: 1			
	P/N 90510015		
Lasair Pro IQOQ Test Protocol			
	P/N 1000026652		
Lasair Pro Operations Manual Quantity: 1			
	P/N 1000025871		
Table 3-3. Accessory list			

Storing Shipping/Packing Materials

After unpacking the instrument, make sure to save and store all the shipping and packing materials for future use. These shipping containers and packing materials are made specifically to protect the Lasair Pro particle counter during initial shipments, as well as future calibration or return servicing shipments.

CAUTION

To protect the instrument, always pack and ship the Lasair Pro particle counter using its original packing materials and shipping container. Failure to do so may void the warranty, and additional charges may be assessed for replacement containers reissued for return shipments.

Chapter 4

Connections

This chapter describes the following types of connections:

- **Power** on page 4-4
- **Analog** on page 4-6
- **Digital In/Out** on page 4-13
- **NFC Cards** on page 4-14
- **Computer Connections** on page 4-15

Back Panel

Pinouts configurable by the user include AUX I/O, 4-20 mA IN, and 4-20 mA OUT.

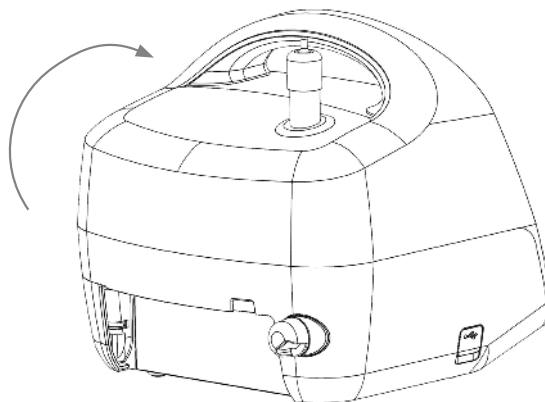
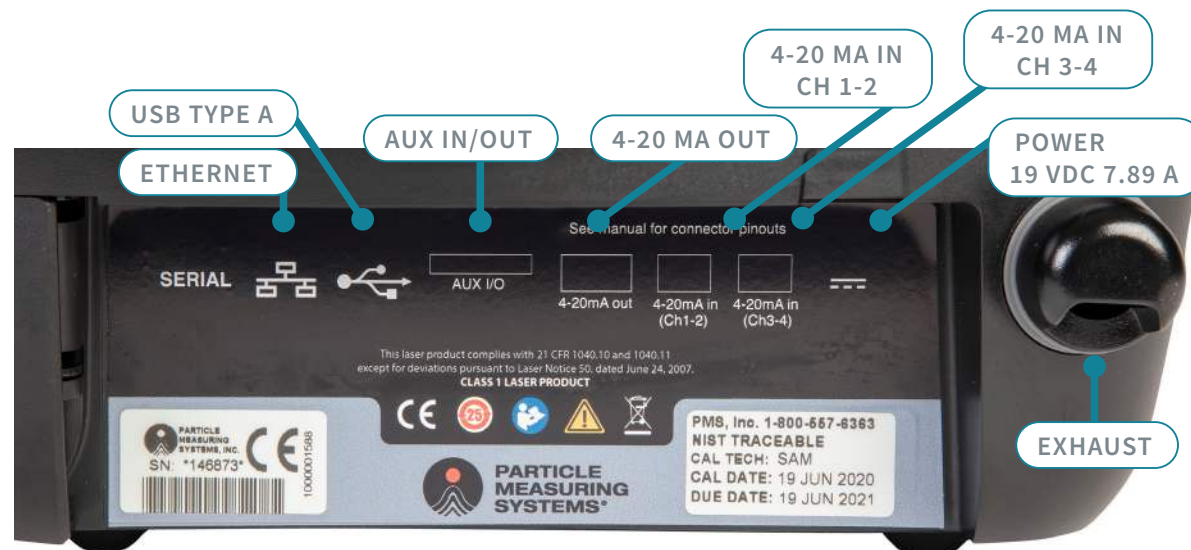


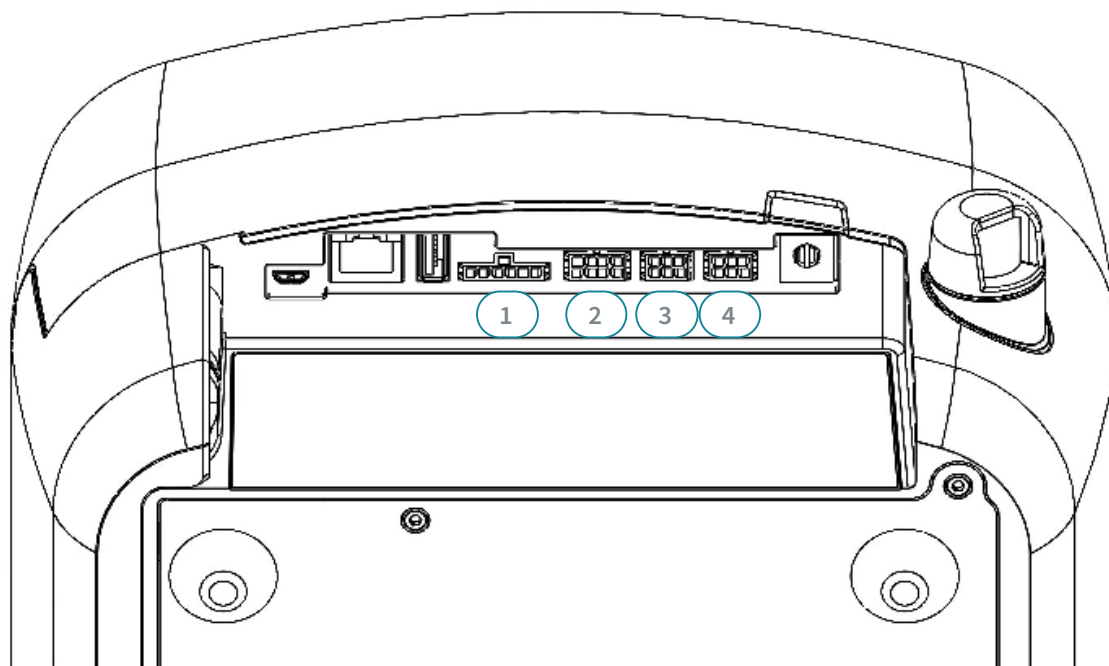
Figure 4-1. Positioning the Lasair Pro to see connections



BACK PANEL

- **(1) Ethernet** – Use to connect to control software (i.e., Facility Net). PMS software stores data, provides additional analysis, and reports results that are 21 CFR Part 11 compliant for one or more Lasair Pro particle counters.
- **(2) USB Type A** – There are two USB ports, one on the side and one on the back panel, for transferring data from the Lasair Pro particle counter to your computer or connecting a USB keyboard.
- **(1) Aux I/O** – Use to connect to external signal equipment and for Lasair Pro start/stop.
- **(4) 4-20 mA OUT** – Use to read particle data on a separate device, such as a Programmable Logic Controller (PLC) or Proportional-Integral-Derivative (PID) controller
- **(4) 4-20 mA IN** – Connect up to four analog environmental sensors using the Lasair Pro particle counter's 4-20 mA input connectors (see the next page).
- **Power** – Use to power the instrument and charge the removable lithium batteries.
- **Exhaust** – Sample stream discharge from instrument.

Lay the Lasair Pro so that its screen is against a flat surface. Pin numbering and description are given below:



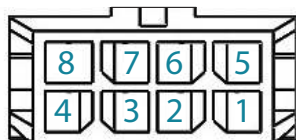
AUX I/O



Pin 6 GND	Pin 5 12V Dry Contact	Pin 4 GND	Pin 3 +5 VDC (PULSE)	Pin 2 +24 VDC GND	Pin 1 +24 VDC
6	5	4	3	2	1

1

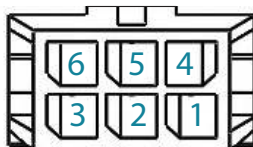
4-20 mA out



Pin 8 GND	Pin 7 GND	Pin 6 GND	Pin 5 GND
Pin 4 CH 4 OUT	Pin 3 CH 3 OUT	Pin 2 CH 2 OUT	Pin 1 CH 1 OUT
8	7	6	5
4	3	2	1

2

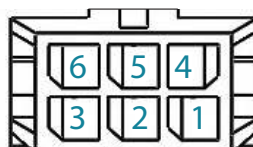
4-20mA in
(Ch1-2)



Pin 6 GND	Pin 5 CH 2 IN	Pin 4 CH 2 POWER
Pin 3 GND	Pin 2 CH 1 IN	Pin 1 CH 1 POWER
6	5	4
3	2	1

3

4-20mA in
(Ch3-4)



Pin 6 GND	Pin 5 CH 4 IN	Pin 4 CH 4 POWER
Pin 3 GND	Pin 2 CH 3 IN	Pin 1 CH 3 POWER
6	5	4
3	2	1

4

Customers may wish to build their own cabling to connect to the Lasair Pro. Each instrument is supplied with a mating connector kit (P/N 1000024980). The proper crimp tool must be used with the connector kit, available as P/N 1000024981.

Power

CAUTION

Fluctuations in the AC Main supply voltage should not exceed +10% of the rated voltage range.

The Lasair Pro is rated at 19 VDC (150 W) and can be operated with the AC to DC power adapter or internal batteries. When using AC, the external power supply requires 100-240 V, 50/60 Hz AC power to produce 19 VDC.

Batteries

Insert one or two lithium battery packs into the particle counter for portable operation. Charge internally before first use.

Optional lithium ion batteries and battery chargers are available from Particle Measuring Systems.

- Lithium Ion Battery – P/N 1000025008
- Battery Charger with one (1) bay, 115 V – P/N 90101118-10
- Battery Charger with one (1) bay, 230 V – P/N 90101118-20
- Battery Charger with four (4) bays, 115 V – P/N 90101119-10
- Battery Charger with four (4) bays, 230 V – P/N 90101119-20

**Scan or click for a
Quick Tutorial Video about
How to Swap Batteries**



For a 1 CFM unit, a single battery runs for approximately four hours, and dual (using two) batteries run for approximately eight hours based on continuous sampling and printing every minute. Battery run and charging times vary with conditions, such as tube length, sample time, and use of the built-in thermal printer. All battery chargers are CE-compliant.

WARNING

Ensure battery packs are not exposed to vaporized hydrogen peroxide (VHP).

AC Power

Before connecting to an AC power source, ensure you have the following items:

Item	Comments
External AC to DC power supply	Standard U.S. Government Energy Information Administration (EIA) power input of 100-240 VDC, 50–60 Hz. Only use the included power supply to prevent damage and assure proper operation.
U.S. power cord with plug	Included with U.S. shipments only.
International power cord (included with international shipments)	The power cord for international shipments comes assembled with a plug configured for your country's voltage and frequency specifications.
Surge protector (recommended)	To protect the unit from any voltage spikes, use a good quality surge protector.
Table 4-1. Items required for AC power source connection	

WARNING

Before you begin, ensure the external AC to DC power supply has been properly grounded.

CAUTION

The main power disconnect is the power cord. Ensure that it is easily accessible. Also remove the lithium batteries (if installed) to remove all power.

CAUTION

This is a LOW POWER DEVICE. Connect ONLY low voltage power accessories to the auxiliary power output to avoid damage to the unit.

Analog

Included in this section:

- **Environmental (Analog) Input** on page 4-6
- **Analog Output** on page 4-10

Environmental (Analog) Input

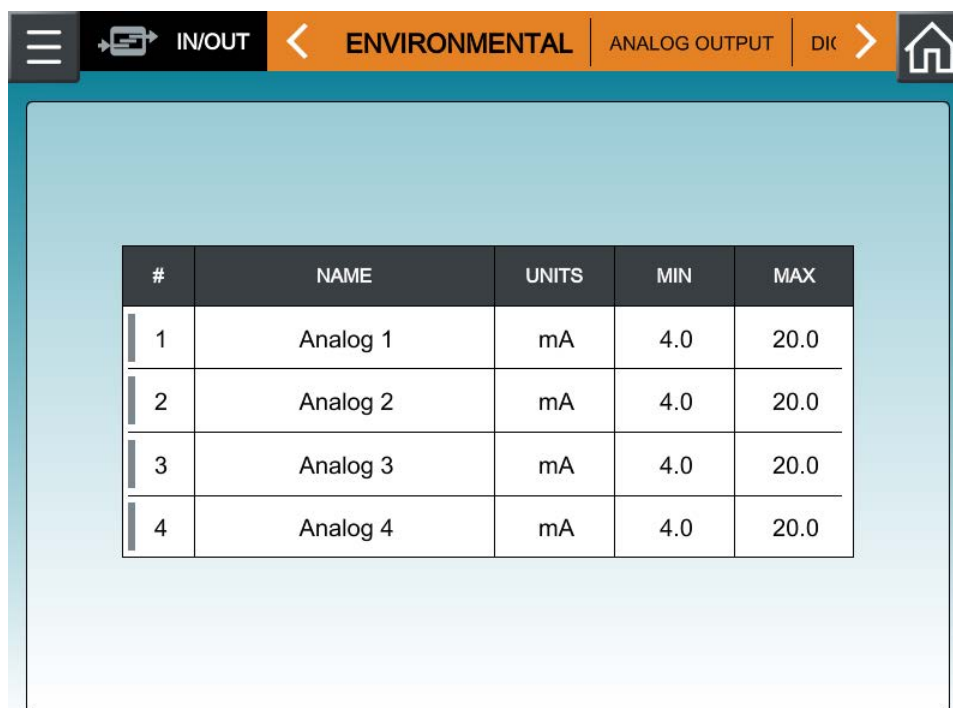
You can connect up to four analog environmental sensors using the Lasair Pro particle counter's 4-20 mA input connectors. These input connectors are located on the back panel of the Lasair Pro counter (see **Back Panel** on page 4-1 for pinout information). Examples of 4-20 mA sensors include:

- Temperature/Relative Humidity (T/RH) sensor (P/N 501050-01)
- Air velocity sensor that provides 4-20 mA OUT
- Differential pressure sensor that provides 4-20 mA OUT

To connect a 4-20 mA sensor:

1. Locate the appropriate 4-20 mA input (see **Back Panel** on page 4-1).
2. Plug the sensor into the connector.
3. Turn on the Lasair Pro counter.

4. Go to  , then  (**IN/OUT**).
5. Ensure you are on the **ENVIRONMENTAL** tab. The font for the current tab you are on will be enlarged and bold.



#	NAME	UNITS	MIN	MAX
1	Analog 1	mA	4.0	20.0
2	Analog 2	mA	4.0	20.0
3	Analog 3	mA	4.0	20.0
4	Analog 4	mA	4.0	20.0

Figure 4-2. ENVIRONMENTAL tab, IN/OUT

6. Each analog input can have a different value of the Scale and Offset values. These values are determined by the range of the sensors that are being used.

#	A selection box to enable or disable the analog input.
NAME	Can be changed to name of the sensor such as Temperature or Humidity.
UNITS	Can be used to identify the units of measure related to the 4-20 mA value, such as degrees C or percent (%) humidity.
MIN	Is the minimum value of the measurement device. For example, if the lowest value of a temperature probe is 32, the value of 32 would be entered into this field.
MAX	Is the maximum value of the measurement device. For example, if the highest value of relative humidity probe is 100%, the value of 100 would be entered into this field.

As an example, we will be setting up a TRH accessory for the Lasair Pro particle counter with the following specifications:

- Temperature range: 32 – 122 °F
- Relative humidity range: 0 – 100%

7. Enable the #1 and #2 rows by pressing inside the appropriate # fields. When enabled, the vertical line beside the number will be blue in color:
8. Press inside the **NAME** field to define the sensor name. For example, “T” for temperature.
9. Press inside the **UNITS** field to define the sensor units. For example, “%” for relative humidity.

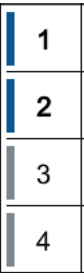


Figure 4-3. Enabling/disabling sensors

NOTE: Press and hold the ‘5’ numeric keyboard key until the “%” sign appears in the text field.

10. Enter the range of measurement for the sensor in the **MIN** and **MAX** fields:
 - Press inside the **MIN** field to enter the lowest value in the range. In this example, the minimum temperature is 32.
 - Press inside the **MAX** field to enter the highest value in the range. In this example, the maximum temperature is 122.
11. Your environmental sensors table should look similar to **Figure 4-4**.

#	NAME	UNITS	MIN	MAX
1	T	F	32.0	122.0
2	RH	%	0.0	100.0
3	Analog 3	mA	4.0	20.0
4	Analog 4	mA	4.0	20.0

Figure 4-4. Example environmental sensor table

12. You can find the data display for your environmental sensors on the **HOME** screen by swiping left twice. When the sensor is operating, the current value and average value will update every second. See **Figure 4-5**.

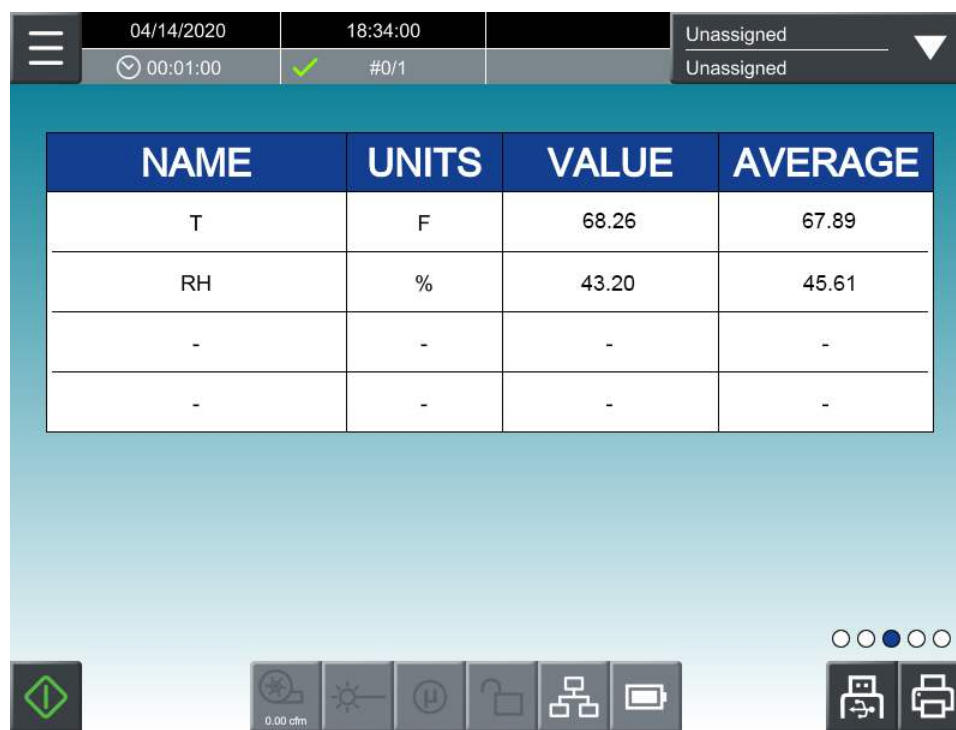


Figure 4-5. Environmental sensor data display, **HOME** screen

NOTE: Analog data cannot be assigned to a location. It is advisable to include location details in the **Name** field if applicable.

Analog Output

The Lasair Pro counter can be enabled to generate a multichannel analog output for reading particle data on a separate device, such as a Programmable Logic Controller (PLC) or Proportional-Integral-Derivative (PID) controller. Analog outputs are generated using particle size channel limits. These limits are set in the **ANALOG OUTPUT** tab of the **IN/OUT** screen.

Enable analog output

DATA

☒ N ☐ N/m³
☐ N/l ☐ N/ft³

☒ Σ ☐ Δ

☐ ~ ☒ ⌋

☒ Linear ☐ Log Min

#	CHANNEL		MAX
1	0.30	▼	10000.0
2	0.30	▼	10000.0
3	0.30	▼	10000.0
4	0.30	▼	10000.0

Figure 4-6. ANALOG OUTPUT tab, IN/OUT

Particle data can be configured with analog output in the following way:

- **Enable analog output:** Enable or disable analog output
- **Raw (N) or Normalized (N/m³, N/ft³, N/l) data:** Sets the units for the data.
- **Cumulative (Σ) or differential (Δ) data:** Sets the type of data to trigger the analog output. Cumulative refers to the sum of all particle counts of one size and larger in a sample. Differential refers to particle counts of a certain size in a sample.
- **Wave (~) or Step (⌋):** Sets how the output will be updated. The Wave option sets the output to update once per second throughout the sample. The Step option sets the output to update at the end of the sample.
- **Linear or Log:** Sets the 4-20mA output to be generated as a linear or logarithmic value. See **Lasair Pro Analog 4-20 mA Output Log Mode** on page 4-12.

- **Min:** Sets the minimum x-axis value of the log graphical display.
- **CHANNEL:** Press the dropdown arrow to select the particle size to be used for analog output generation. Channel units are set in the **CHANNELS** tab of the **SYSTEM** screen.
- **MAX:** Press inside the field to define the maximum value for the particle size channel pertaining to 20 mA. The minimum number of counts (pertaining to the 4 mA signal) is assumed to be 0.

Status Output

The status output channel can be used in either a simplified mode (i.e., good/bad) or in a more complex fashion, which allows you to discriminate between various errors. **Table 4-2** shows the various output status parameters and their associated value. In order to do a status check, verify the status channel reads more than 18 mA.

Status Parameter	Current (mA)
4-20mA Outputs Enabled	+3.00
Data Collection is On	+0.75
Blower/Flow is OK	+1.50
Laser is OK	+3.00
Alarms are Off	+6.00
Everything OK	18.25 (Total)
Table 4-2. 4-20 mA Analog Output Status Channel	

More complex status testing will require an algorithm similar to the following:

1. If current < 7 mA, 4-20 mA system is off. Otherwise...
2. Test value_float = (current – 7 mA) / 0.75 mA
3. Test value_bits = Test value_float rounded to nearest integer.
4. Interpret Test value_bits as hexadecimal integer and interpret bits.
5. Data Collection On = 0x01
6. Blower/Flow is OK = 0x02
7. Laser is OK = 0x04
8. Alarms are Off = 0x08

Lasair Pro Analog 4-20 mA Output Log Mode

The Lasair Pro allows scaling of 4-20 mA output data in a log format rather than a linear format. This is useful for encoding values with high dynamic ranges of particle counts as it provides an equal number of discrete values per decade. This improves resolution at lower count values and especially helps maximum output values of greater than 50,000. The resolution of the 16-bit converter is unable to discriminate between 0 and 1 count above this value. If overall system accuracy is also taken into account, a lower level than 50,000 is the more practical limit for linear scaling.

The log setting uses a global minimum particle count value. Particle counts below the minimum value will be clipped. The limits of this parameter are 0.001 to 100.0.

NOTE: Set the minimum value to less than 1 (e.g., 0.1) in order to differentiate between 0 and 1 particles. For example, when sending raw particle counts, if the minimum is set to 1, then if 0 particle counts are received, the system will output 1 count. This is an inherent limitation of logarithmic conversions.

Each channel has a maximum value output. The global minimum and channel-based maximum are used to calculate the output. The two equations in this section show the conversion used from mA to particle counts and back.

Particle counts are scaled to a normalized value, if that output option is selected, before the conversion.

Equation 1: Particle counts to mA conversion

$$mA_{out} = \left(\frac{\log_{10} \frac{particleCounts}{min}}{\log_{10} \frac{max}{min}} \right) * 16 mA + 4 mA$$

Equation 2: mA to particle counts conversion

$$particleCounts = min * 10^{\left(\frac{mA_{out} - 4mA}{16mA} * \log_{10} \frac{max}{min} \right)}$$

Digital In/Out

The Lasair Pro counter can be enabled for output for use with light tower and alarm devices. Alarms must be configured first (see **Chapter 7**).

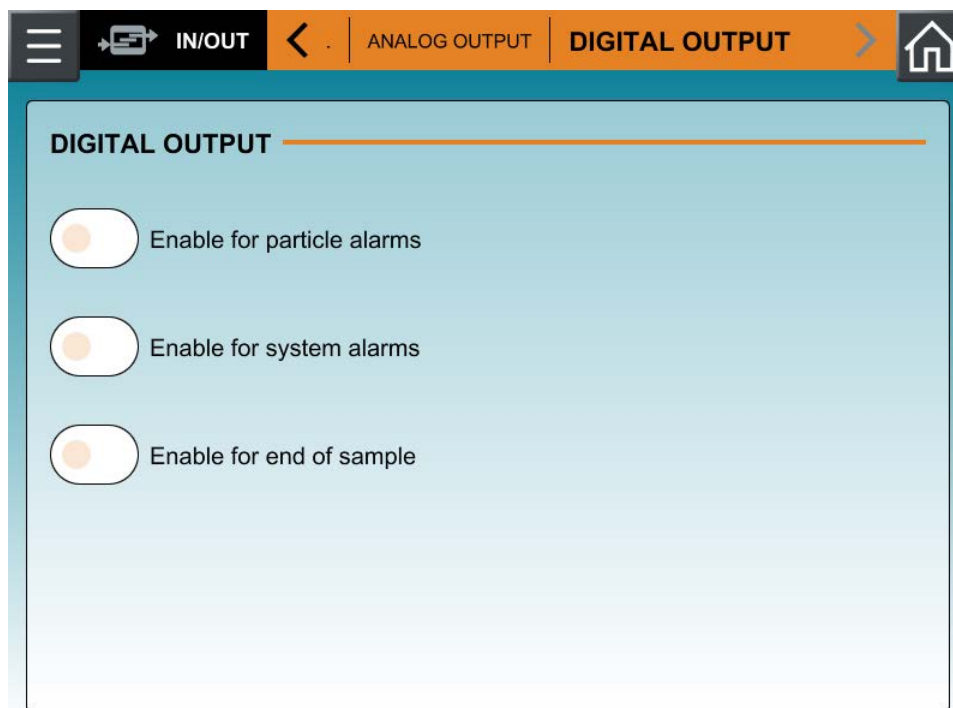


Figure 4-7. DIGITAL OUTPUT tab, IN/OUT

Digital output can be configured in the following way:

- **Enable for particle alarms:** Enables digital output signals to be sent for every particle alarm that occurs on the Lasair Pro counter during sampling.
- **Enable for system alarms:** Enables digital output signals to be sent for every system alarm that occurs on the Lasair Pro counter (e.g., calibration alarms).
- **Enable for end sample:** Enables digital output signals to be sent when sampling is ended (automatically or manually).

NFC Cards

Near Field Communication (NFC) allows the Lasair Pro counter to read and write information stored on a portable card. The card can contain:

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Setup & Program NFC Cards*



- User data to facilitate logging into the particle counter without entering the same information into the touchscreen. See **Creating NFC Users** on page 6-6.
- Recipe and location data to automatically populate sampling options on the touchscreen. See **Locations and rooms may have more than one recipe associated with them. In this case, when the location (or room) is selected, the operator will have the option of choosing one of the assigned recipes to load and run.** on page 9-4.

Note: This feature is not available on Lasair Pro 310 models that do not have NFC and Wifi capability (101410-2X2X).

To enable NFC communications, press  , then  (**COMM**).

On the **NFC** tab, you will have the option to enable the NFC capabilities of the Lasair Pro counter. In **Figure 4-8**, all are enabled.

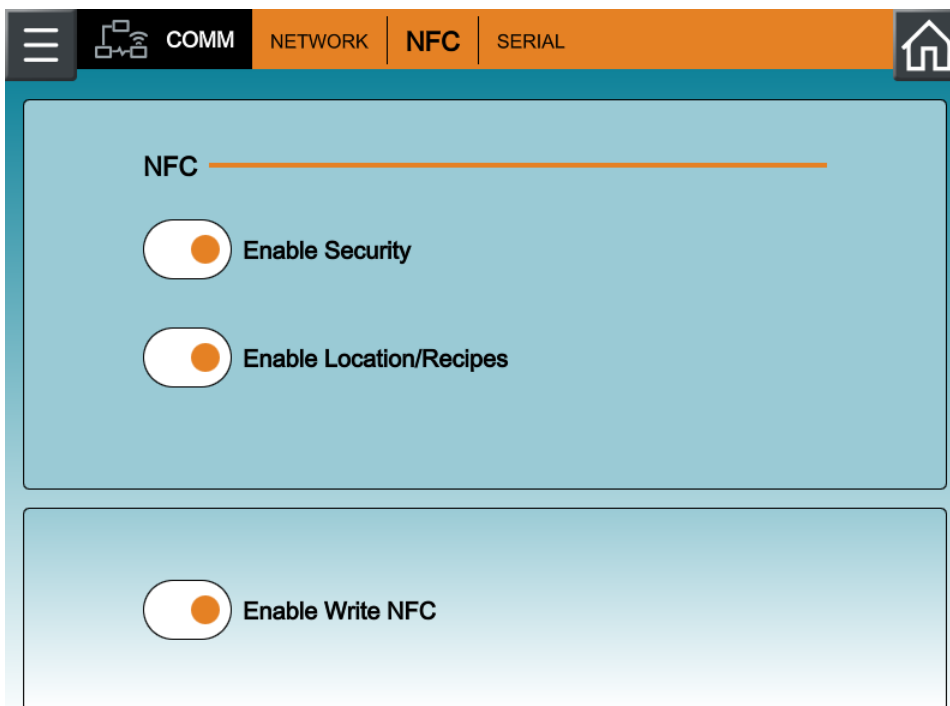


Figure 4-8. NFC tab, COMM

Computer Connections

This section includes information for computer communications with the Lasair Pro particle counter. Although the Lasair Pro is a standalone instrument with its own built-in firmware, you can also control the instrument with optional software.

The Lasair Pro particle counter has the memory capacity to store 10,000 complete data sets, which cannot be edited or altered (thereby meeting 21 CFR 11 compliance). Once this memory is full, the instrument automatically erases memory in order to add additional sampling data. The oldest data is erased first.

Connecting the Lasair Pro particle counter to a computer provides the capability for increased memory capacity and long term data storage. Additional software also provides the added ability to analyze the data.

You can optionally connect the particle counter to a computer using control software for long term memory storage, as well as data analysis. If connecting the Lasair Pro to a computer directly or indirectly, you will need one of the following:

- **Straight-through Ethernet cable:** Use when connecting indirectly to a computer through a hub or other device on an Ethernet network.
- **USB Micro B serial cable(P/N 1000025093):** Use for connecting the Lasair Pro counter directly to a PC with terminal emulation. \

WARNING

The end user of this product is responsible for ensuring that physical and logical measures are in place that limit physical access to the product to authorized users, devices, and services; limit network access to the product to authorized users, devices, and services; and limit exposure of communicated data to authorized users, devices, and services.

Control Software and Data Interface

There are two (2) types of options for communicating with a computer from the Lasair Pro particle counter, including:

- PMS Software and Communication Protocols
- Third Party Control Software

PMS Software and Communication Protocols

Particle Measuring Systems offers various control/data management software and communication protocol solutions.

The following data management and facility monitoring software systems have been customized to work specifically work with PMS instrumentation:

PMS Data Management and Instrument Control

- **DataAnalyst** – This software stores data from a Lasair Pro particle counter and provides additional analysis and reporting options that are 21 CFR Part 11 compliant. This application will support connecting to multiple Lasair Pro particle counters, store the data from each instrument, and then allow for analysis of the raw data in tabular and graphical formats. DataAnalyst has the capability of generating reports, as recreating room certification reports to meet ISO, EU GMP, China GMP, and FS209E standards. For more information on configuring DataAnalyst to work with Lasair Pro particle counters, see the DataAnalyst User's Manual. Note that Lasair Pro requires firmware version 1.1.011 or later and DataAnalyst Version.

NOTE: Anywhere DataAnalyst is later mentioned in this manual, Facility Net or Pharmaceutical Net also apply.

- **Facility Net or FacilityPro** – These control software systems (optional purchases from Particle Measuring Systems, Inc.) control the Lasair Pro particle counter, as well as store and analyze data to provide a comprehensive view of the environmental and process monitoring conditions of a facility. You can collect, display, analyze, store, and report data collected from the Lasair Pro particle counter.

Communication Protocol

Use PMS TCP/IP protocol to transmit data between the Lasair Pro particle counter to DataAnalyst or Facility Net via an Ethernet network. For more information, see the following section.

Configuring Communications

After you have set up and configured the communication protocol to connect the particle counter to a computer, you must also configure communications on the Lasair Pro particle counter.

Configuring Network Outage Buffer

The communications protocol used for FacilityPro and FacilityNet has a disconnect buffer. The buffer allows recovering data after a network or computer outage. By default, this buffer is set to 60 samples. If sampling is done on one minute intervals, then data will be recovered for up to one hour after communications have recovered. It is possible to adjust the size of this buffer via the serial interface on the instrument. Use the set buffer xxx command to change the buffer size if desired. You must reboot the instrument after making this change for it to take effect.

It is possible to set the buffer between 0 and 10,000. Do not set the buffer larger than necessary, or it may cause network delays as the instrument tries to download a large number of samples after a reconnect.

Third Party Control Software

You can also export data collected with the Lasair Pro particle counter to your Facility Management System (FMS) using third-party software:

- **USB Port** – There are two USB ports, one on the front and two on the back panel, for transferring data from the Lasair Pro particle counter to your computer via USB mass storage device. PMS USB storage drive – P/N 1000026003

Network Configuration

Particle Measuring Systems instruments must be properly configured for Ethernet communications in order to work. There are multiple numeric parameters required to properly configure an instrument and a small error in one or more of these parameters can result in no communications, or worse—sporadic communications.

All instruments support the common IPv4 standard. Valid addresses are in the range of 0.0.0.0 to 255.255.255.255. The number 255 corresponds to the special value of 0xFF in hexadecimal. Numbers 256 or larger are not valid. Each number in the dot sequence is sometimes called an octet.

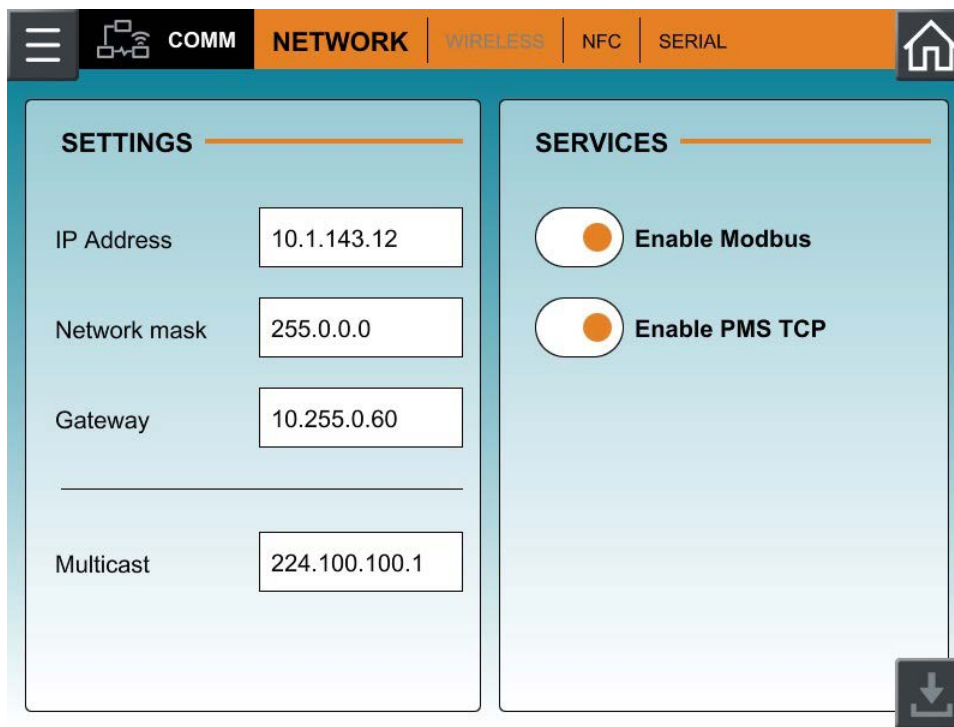


Figure 4-9. NETWORK tab, COMM

The **NETWORK** tab of the **COMM** screen allows for the following configurations:

- **IP Address**
- **Network Mask**
- **Gateway Address**
- **Multicast Address**
- **Enable Modbus**
- **Enable PMS TCP**

NOTE: The Wireless Tab is currently not active/accessible because WiFi is not active at this time

IP Address

The Internet Protocol (IP) address consists of two portions:

- a network portion
- a location portion

In the analogy of a telephone number, there is an area code and a phone number. Unlike a telephone number, the network (or area code) portion of an IP address can be set to different numbers of digits. It is not a fixed size like an area code. The location portion is the rest of the number – everything that is not part of the network portion. The definition of what is network and what is location is done by the network mask, described below.

Although there are a great many numbers in the range of 0.0.0.0 to 255.255.255.255, in almost all circumstances instruments are placed on a segregated private network that uses a greatly reduced set of numbers. The valid ranges are shown in the following table.

Address Class	Start	End
A (24 Bit Range)	10.0.0.0	10.255.255.255
B (20 Bit Range)	172.16.0.0	172.31.255.255
C (16 Bit Range)	192.168.0.0	192.168.255.255

CAUTION

Only the IP addresses listed in the table above are valid for use with the Lasair Pro. IP addresses are restricted to private network addresses only. Public IP addresses are not valid.

Network Mask

The network mask is used to discern the network portion of the IP address from the location portion, allowing the instrument to communicate outside of its local network. From a telephone number analogy, it segregates the area code from the phone number. It is easy to set the mask incorrectly, and when it is incorrect, it can result in sporadic communication problems. For example, in Facility Net an instrument can be seen as available via a Multicast probe, but trying to control the instrument causes a communications error.

The mask is actually a 32 bit binary number consisting of some number of ones followed by enough zeros to make 32 bits. The length of the ones depends on the network Address Class (i.e., area code size) as well as sub-netting (i.e., something done by IT). The following table shows the default network mask for each address class.

Address Class	Default Network Mask
A (24 Bit Range) (e.g., 10.X.X.X)	255.0.0.0
B (20 Bit Range) (e.g., 172.16.X.X)	255.240.0.0
C (16 Bit Range) (e.g., 192.168.X.X)	255.255.0.0

When a Particle Measuring Systems instrument is set to default parameter or factory defaults, the network mask is set to 255.0.0.0. This corresponds with the 10.X.X.X address which is also set. Enter as **aaa.bbb.ccc.ddd**. Each 3-digit series is a value of 0–255.

For large systems, IT personnel will dictate a network mask value, and the value may be different from what is shown in the table. Make sure the network mask is set as specified by IT. All PCs, routers and instruments on a network must use exactly the same network mask, or communication problems will arise.

Gateway Address

The gateway address is a special address used to allow communications outside of the local network. In the telephone analogy, it allows placing long distance calls. In many (if not most) situations, a gateway address is not required.

The default gateway address set when restoring defaults to a Particle Measuring Systems instrument is 10.255.0.60. Enter as **aaa.bbb.ccc.ddd**, where each 3-digit series is a value of 0–255. This address should be set to whatever is required by IT.

Multicast Address

The multicast address is used by Facility Net and Pharmaceutical Net to query all instruments attached to a local network. The valid multicast address range is defined as 224.0.0.0 to 239.255.255.255. From a practical standpoint addresses in the 224.0.X.X range should not be used as many of them are reserved for other communications.

Particle Measuring Systems assigns a factory default multicast address of 224.100.100.1 to all instruments. This address generally does not need to be changed, but alternates may be entered in the form of **aaa.bbb.ccc.ddd**, where each 3-digit series is a value of 0–255. The exception is when sensors are integrated into a large network. In this situation, IT may recommend an alternative multicast address to avoid network conflicts.

Enable PMS TCP

Enables the PMS TCP/IP protocol that attaches the instrument to PMS control software such as Facility Pro and Facility Net. Disabling this function prevents the use of these applications.

MAC Address

All Ethernet devices have a MAC (Media Access Control) address. This address may be thought of as an Ethernet serial number. It is unique for all devices. If an instrument needs to be replaced with a different instrument for either calibration or service, the service technician will duplicate the old instrument's IP address into the new instrument. However, the MAC address of the new instrument will be unique.

In Particle Measuring Systems instruments the MAC address is set during production. The value is permanently stored in non-volatile memory on the main processor circuit board. (The MAC address will change if the main circuit board is replaced.) The MAC address may be displayed via terminal emulation (i.e., USB Micro B service interface) by using the status command.

Routers and switches keep track of which MAC address is attached where. For that reason, it is important for the instrument to tell a router or switch who is attached. For all Particle Measuring Systems instruments, this is done at least once when the instrument boots. In some newer instruments, the MAC address is announced to the switch or router every time a network connection is detected. Without this mechanism, it would be possible for routers to operate for an extended period of time without recognizing which MAC address is mapped to which IP address.

Saving Network Settings

After making changes to the IP Address, Network Mask, Gateway Address or Multicast

Address, press



to save settings. The Lasair Pro will reboot with the new settings

after confirmation.

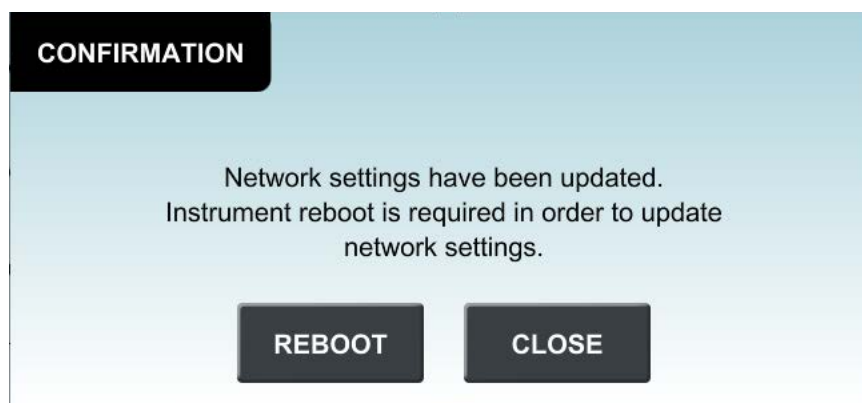


Figure 4-10. Confirm network settings

Instrument to Laptop Ethernet Setup

There are two ways to establish a direct Ethernet link between a laptop (or other PC) and a Particle Measuring Systems instrument. The first way is to modify the PC Ethernet settings to work with the existing instrument settings. The second way is to modify the instrument settings to work with the existing PC settings. Since PCs are typically configured for DHCP, this method is less obvious. However, for certain applications (such as demos or testing) this method may be advantageous.

Cabling between a laptop and instrument can often be done with a standard Cat 6 Ethernet cable. Older computers and older instrument designs may require an Ethernet cross-over cable to communicate properly. This is available from Particle Measuring Systems as P/N 1000011477. Newer computers use a mechanism called Auto-MDIX to do the cross-over within the computer or instrument automatically.

Method 1: Modifying the IP Settings on a PC

This method allows using the existing instrument address. At the end of the communications session, the laptop will contain an address that will prevent normal communications to the corporate network. The procedure must be undone after the session.

1. Retrieve the network address parameters from the instrument. Use one of the following methods:
 - a. Use terminal emulation software such as **PuTTY** or **HyperTerminal**, the USB Micro B serial service interface, and the “sta” command.
 - b. From the **HOME** screen of the Lasair Pro, navigate to the **NETWORK** tab of the **COMM** screen. Note that parameters can be changed on this tab.
2. Determine a compatible network address and mask to set the PC. For example, an instrument has address **10.12.43.217** and mask value **255.255.0.0**. The PC must use exactly the same mask value (i.e., 255.255.0.0). The address can be selected as any valid address so long as the network portion is kept the same. Therefore, **10.12.43.216** would be acceptable, and **10.12.0.1** could also be used.
3. Configure the PC to talk at the selected address:
 - a. Navigate to the **Ethernet** or **Local Area Connection Properties** window.
 - i. In Windows 10, use the following navigation:



NOTE: If you don't see "Ethernet" as a network option, choose "LAN" or "Local Area Connection".

NOTE: Do not select anything with the word "Wireless" or the word "Virtual".

ii. You should see a window similar to the following:

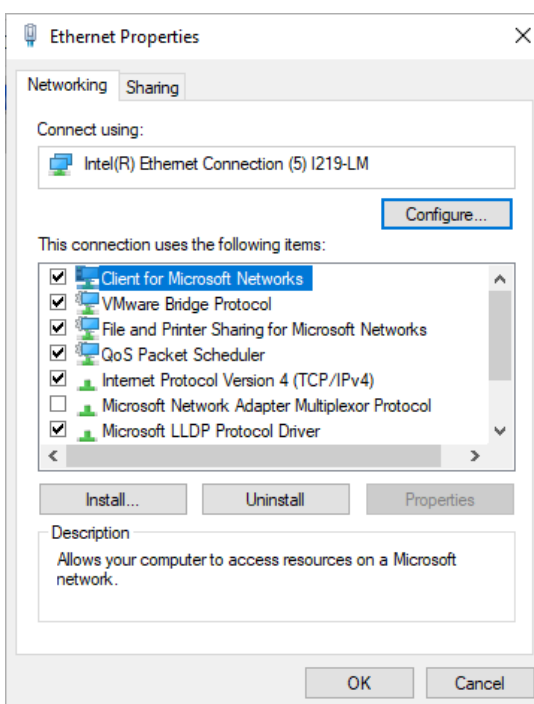


Figure 4-11. Ethernet/LAN Properties window

- b. Select Internet Protocol Version 4 (TCP/IPv4), and click **Properties**.
- c. Record the existing properties, including IP address and Subnet mask. These settings will need to be restored later.
- d. Change the IP address and Subnet mask as described in Step 2. The Default gateway and DNS server values should be left blank.

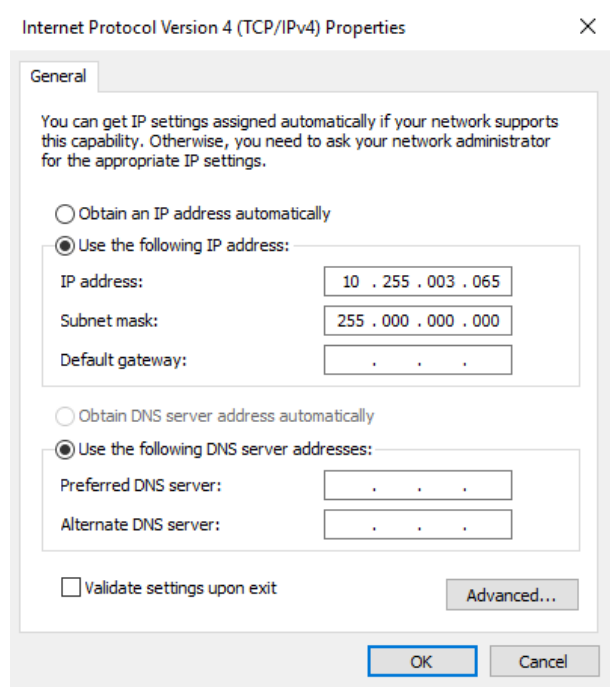


Figure 4-12. Adjusted Internet protocol properties

- e. Click the **OK** button to close the window. Click **OK** again to exit LAN configuration.

Method 2: Modifying Network Settings with Serial Commands

This method takes advantage of a Microsoft Windows feature called Automatic Private IP Addressing or APIPA. APIPA allows a PC to automatically assign itself an IP address even when no DHCP server is present to provide an address to the PC. Translated this means that by assigning the right address to an instrument, it will talk one to one with a Windows machine without setting an address on the Windows machine. The address range of 169.254.0.1 through 169.254.255.254 is reserved for APIPA.

- 1. Connect the Lasair Pro counter to a PC using a USB Micro B serial cable. Windows 10 should automatically load the appropriate driver for proper communication. If not, download the driver from here: <https://ftdichip.com/drivers/>.
- 2. On the PC, open your terminal emulation software (**PuTTY** or **HyperTerminal**).
- 3. Set the instrument addresses as follows:

IP address	169.254.0.1	Use command “set ip”
Mask	255.255.0.0	Use command “set mask”
Gateway	0.0.0.0 (or blank)	Use command “set gate”

- 4. After setting the addresses, use the **write** command to save the addresses. The instrument will reboot and apply the new address settings.

Chapter 5

Sampling Options

Default settings for sampling can be changed and applied to the next sample run. This chapter describes the general configuration options, with the following chapters contributing to operation, data display and collection:

- **Security** on page 6-1
- **Alarms** on page 7-1
- **Locations** on page 8-1
- **Recipes** on page 9-1
- **Display, Data and Reports** on page 10-1
- **Statistics** on page 11-1
- **System Configuration** on page 12-1



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Without measurement there is no control

SETTINGS Tab

Press  and then  (**SAMPLE**). You should now see the **SETTINGS** tab.

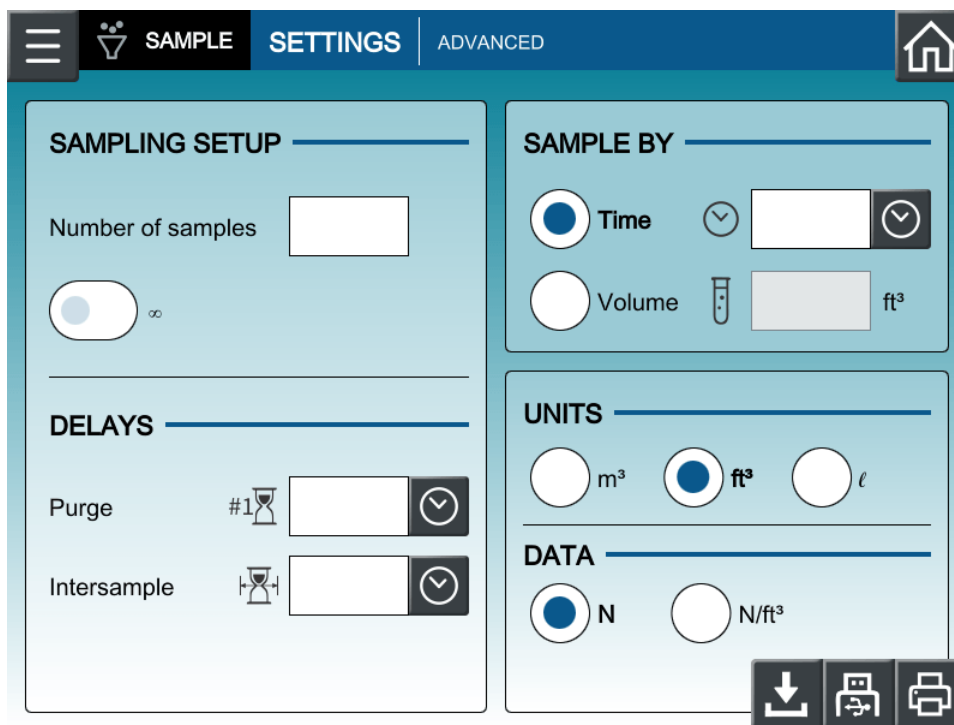


Figure 5-1. Sampling configuration settings

Sampling Setup

The user can configure a set number of samples or enable continuous sampling (∞).

- **Number of samples:** The Lasair Pro will perform the number of samples indicated here without the user needing to press the **Start** or **Stop** button on the **HOME** screen.
- **Continuous sampling (∞):** Sampling will continue with the set configuration until the user presses the **Stop** button on the **HOME** screen. For a full list of **HOME** screen buttons, see **Icons and Buttons of the HOME Screen** on page 3-7.

Delays

Time in the format of HH:MM:SS can be added at the start or between samples.

- **Purge:** Initial delay before the start of sampling.
- **Intersample:** Delay between samples if **Number of samples** is greater than one.

Sample By

Sampling can be configured to stop after a certain duration of time or after a certain volume of sampling medium (e.g., air) has been sampled.

- **Time:** If selected, the Lasair Pro will sample for a set period of time. Press inside the field to adjust the sample time. The format is HH:MM:SS.
- **Volume:** If selected, the Lasair Pro will sample a set volume of sampling medium. Press inside this field to adjust the sample volume. The unit of volume can be changed just below this area of the screen.

Units

Normalized particle counts can have the following volume units:

- Cubic meters (**m³**)
- Cubic feet (**ft³**)
- Liters (**L**)

Data

Particle counts can be displayed as raw or normalized counts:

- **Raw (N):** Purely a numeric value of the particles counted by the sensor with no associated volume.
- **Normalized (N/m³ or N/ft³ or N/L):** The number of particles counted by the sensor within a unit of volume.

Buttons

Image	Name	Description
	Save as Recipe	Opens the keyboard to name the recipe configuration. For more information on recipes, see Chapter 9 .
	Save to USB	Saves the Sampling Setup Report as a PDF to the USB key. This button is only activated when a USB key is inserted. Saved information includes: • Sampling Plan Data (Sample Time or Volume, Number of Samples, Units, Delays, Group Report Mode, Continuous Pump, Beep, Autoprint, USB Report) • Global Alarm Settings (Master, Beep, Autoprint) • Particle Alarm Settings • Environmental Alarm Settings • Trend Alarm Settings
	Print	Prints the Monitoring Setup Report to the thermal printer.
Table 5-1. SETTINGS tab, SAMPLE		

Example Sampling Setup Report



**PARTICLE
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21 CFR 11 Compliant 

Sampling Setup Report

Instrument ID:	Lasair Pro
Serial Number:	XXXXX
Calibrated:	11/7/2019

Batch ID:
Operator:
Recipe:

Sampling Plan Data

Number of Samples:	5
Time:	00:01:00
Delays:	
Purge:	00:00:10
Intersample:	00:00:00
Sample Units:	#/ft ³
Data Units:	Nuff ³
Sampling Start:	Standard
Number of Locations:	1
Options:	
Group Repeat Mode:	No
Continuous Pump:	No
Beep:	No
Print Averages:	Yes
Print Report:	Yes
Save USB Report:	Yes

Global Alarm Settings

Enable Alarms:	Yes
Enable Warnings:	No
Enable System Alarms:	Yes
Enable Alarm Reasons:	No
Enable Audible Alarms:	No
Print Report:	No
Save USB Report:	No

Figure 5-2. Example Sampling Setup Report (page 1)

The Sampling Setup Report summarizes the current user configuration of the following:

- **SETTINGS** and **ADVANCED** tab of the **SAMPLE** screen
- **GENERAL**, **PARTICLES**, **ENVIRONMENTAL**, and **TREND** tab of the **ALARMS** screen (see **Chapter 7**)

ADVANCED Tab

Press **ADVANCED** at the top of the screen to access this tab.

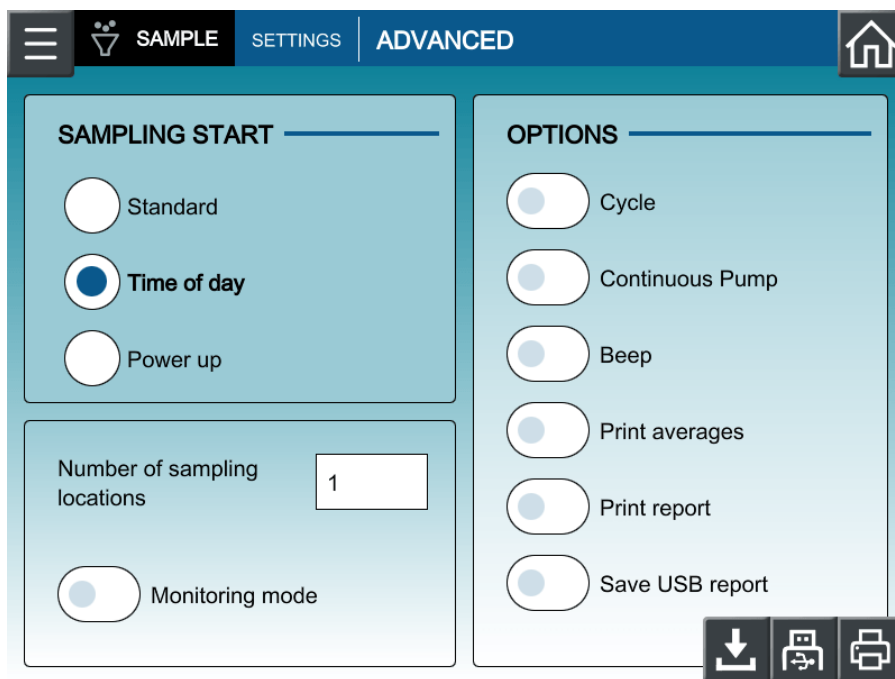


Figure 5-3. Advanced sampling settings

Sampling Start

The following choices determine how sampling will start on the Lasair Pro counter:

- **Standard:** Sampling start is determined with the **HOME** screen.
- **Time of day:** Sampling will automatically start based on the user-configured time. The time is set on the **HOME** screen. This setting will be disabled in Monitoring Mode or Statistics Mode.
- **Power up:** Sampling automatically starts after the Lasair Pro counter has been turned on. The sampling configuration is whatever was used prior to shutdown.

-- NOTICE --

Note that NFC users will be unable to log into the Lasair Pro if the **Power up** selection is chosen. Ensure a non-NFC user is enabled for logging in.

Additionally, this feature is not available on Lasair Pro 310 models that do not have NFC and Wifi capability (101410-2X2X).

Options

The following options can be enabled or disabled:

- **Cycle:** Enables the continuous collection of a finite number of samples without the user needing to press the **Start** button on the **HOME** screen after each sampling. The number of samples is set on the **SETTINGS** tab (**Number of samples**).
- **Continuous Pump:** Keeps the pump active outside of sampling operation.
- **Beep:** Enables the user to determine how many particles counted in a sample will trigger an audio cue. The pop-up in **Figure 5-4** appears on the **HOME** screen when enabled.

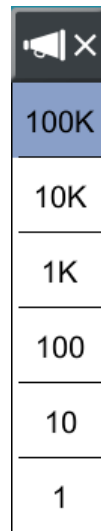


Figure 5-4. Particle count values to trigger an audio cue

- **Print averages:** Automatically includes average particle counts for each configured channel size in the printed report, the USB report, or both. If particle counts are given as raw data, the print averages feature will include both normalized and raw average counts.
- **Print report:** Automatically prints Final Sample Report using the thermal printer (if available).
- **Save USB report:** Automatically saves Final Sample Report to a PDF report. An example is shown in **Figure 5-5**. See **Final Sample Report Example** on page 10-11 for more details.



Final Sample Report



Instrument ID: Lasair Pro
 Serial Number: XXXXX
 Calibrated: 11/7/2019

Batch ID: -
 Operator: -
 Area: Area X
 Room: Room X
 Location: Location X
 Recipe:

Started: 03/31/2020 13:57:07
 Finished: 03/31/2020 13:57:17
 Sample: 81
 Sample status: VALID

Particle Data

μm	ΔN	ΣN
0.30	6,679	8,751
0.50	1,371	2,072
1.00	675	701
5.00	20	26
10.00	6	6
25.00	0	0

Volume: 0.0047 m³ Flow: 0.03 m³/min
 Duration: 00:00:10

Environmental Data

		Avg	Min	Max
Analog 1	mA	4.00	4.00	20.00
Analog 2	mA	4.00	4.00	20.00

Alarm: Alarm Tittle
 AlarmReason: Alarm Reason

Figure 5-5. Final Sample Report example

Monitoring Mode

Monitoring mode uses preconfigured sampling plans for locations. When enabled, changes to sampling plans and their associated locations are restricted until the monitoring plan has been completed or canceled. This mode works best when sampling plans are saved as recipes and assigned to locations. The **HOME** screen displays maximum and average counts, and lists the particles broken down by size and location.

When Monitoring Mode is activated, or when a recipe is running in Monitoring Mode, sampling data is always normalized.

Monitoring Mode Activation

To activate **Monitoring Mode**:

1. Deselect continuous sampling on the **SETTINGS** tab of the **SAMPLE** screen.
2. On the **ADVANCED** tab of the **SAMPLE** screen, press inside the **Number of sampling locations** field and increase the number to 2 or greater.

NOTE: The user can use previously created locations or virtual locations for their monitoring plan. These locations will appear in the particle count averages list on the **HOME** screen.

3. The **Monitoring Mode** slider will now be activated. Press for **Switch Mode** options.

SWITCH MODE

Area: (Unassigned) ▼

Location(s) required: 2

Room: (Unassigned) ▼

Location(s) selected: 0

- #1
- #2
- #3
- #4
- #5

☐ Add virtual

OK CANCEL

Figure 5-6. Switch Mode window

4. In the **Switch Mode** window, you must select the number of locations equal to those set in step 2. This can be done in two ways:

- a. Use the dropdown arrows for **Area** and **Room** to adjust the **Location(s) selected** area, and press on any of the locations listed to select. Selected locations will have an adjacent blue vertical bar. Previously made assignments will affect the locations listing. See **Checking Assignments** on page 8-5.
 - b. You may also enable the **Add virtual** slider, which creates temporary locations to be used only for the sampling to be performed after enabling **Monitoring Mode**. These locations are labeled with the "Virtual loc #XXX" format, and are not stored by the system for later use.
5. When you have made a selection equal to the **Number of sampling locations**, you will be able to press **OK**.
 6. You will be automatically taken to the **HOME** screen, which will display differently while **Monitoring Mode** is activated.
 7. Check the selected location in the top right corner. If you would like to change the selected location, open the dropdown and double-press on the desired location.
 8. Press  to start sampling.

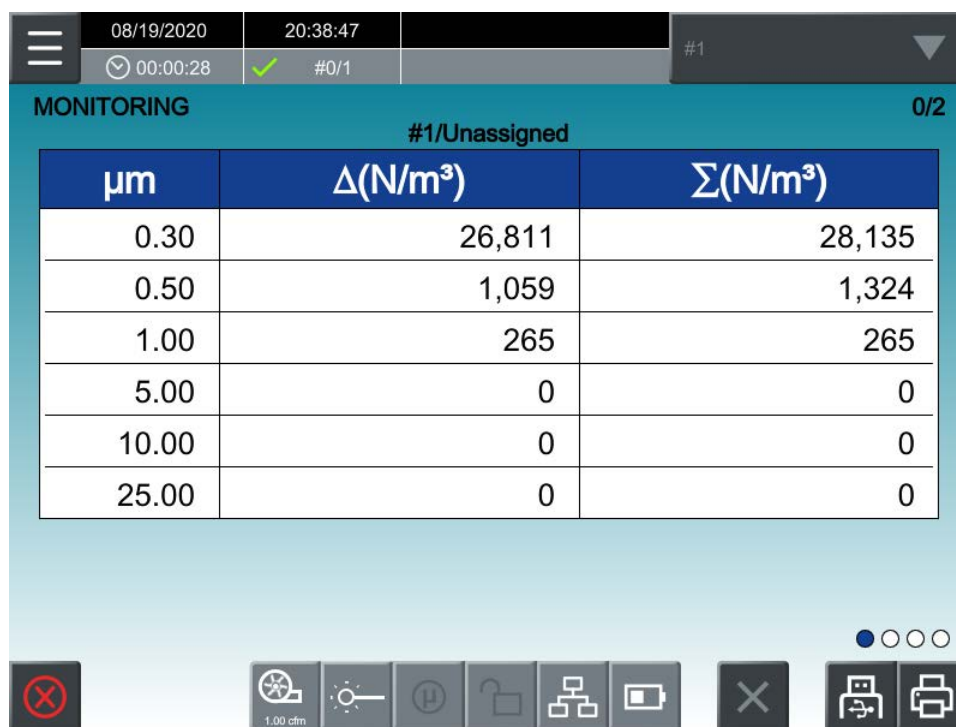


Figure 5-7. HOME screen, Monitoring Mode

9. You can take multiple samples at each location as many times as desired. The maximum and average counts can be viewed by swiping from right to left once across the screen. Counts will always be normalized.



µm	MAX	AVERAGE
0.30	15,221	15,221
0.50	706	706
1.00	141	141
5.00	0	0
10.00	0	0
25.00	0	0

Figure 5-8. Maximum and average counts

10. You can also view average values for each location by swiping from left to right once more across the screen.

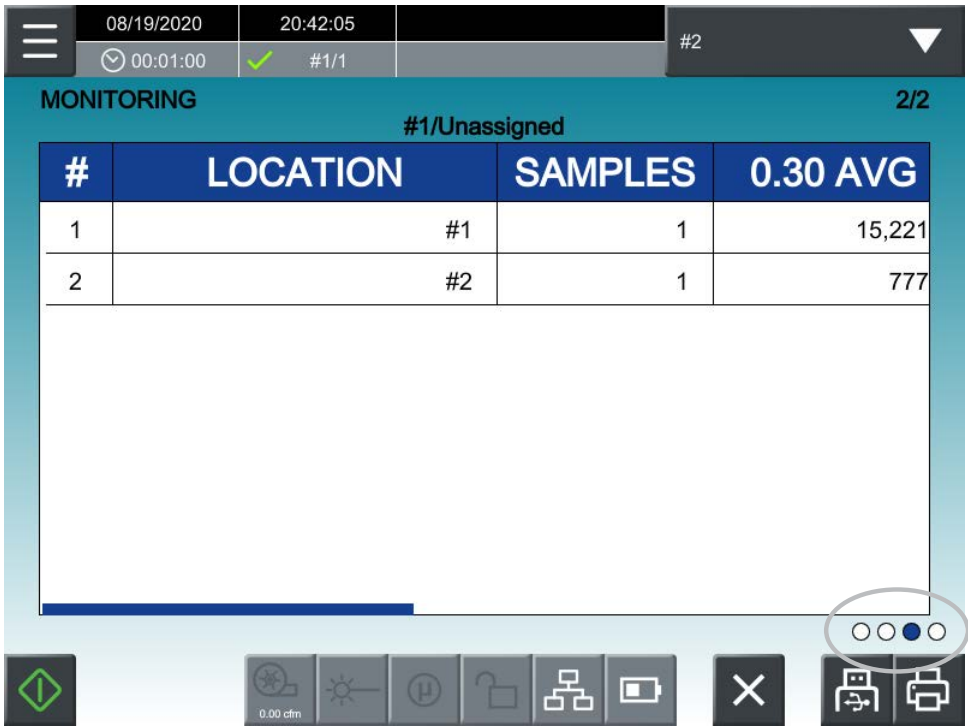


Figure 5-9. Average counts for each location

11. After each sample has completed, you will see the following message. Press **OK** to confirm.

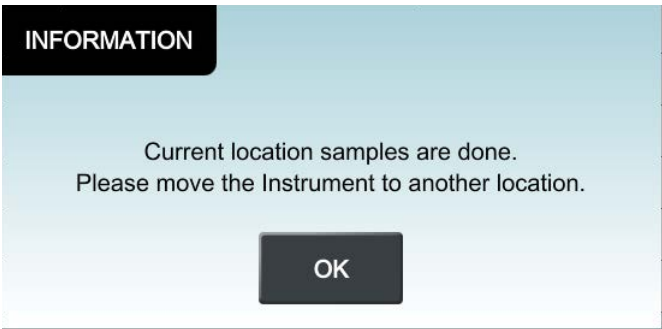


Figure 5-10. Sampling is complete at the selected location

12. After samples have been collected at all locations you will see the following message. Press **OK** to confirm.

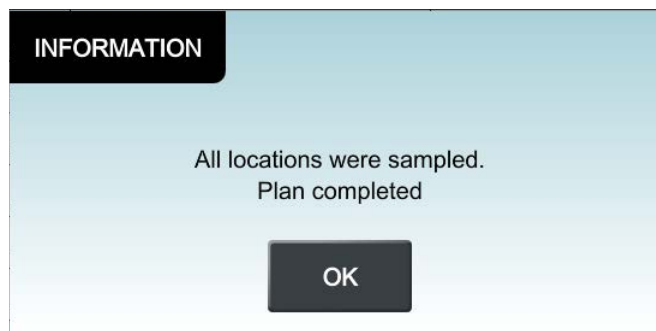
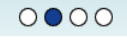


Figure 5-11. Monitoring Mode sampling completed

13. You may continue to take as many samples at each location as desired.
14. After completing your sampling plan, navigate to the second display of the **HOME** screen () and press  (**Print to USB**) or  (**Print to Thermal Printer**) to generate your Cleanroom Monitoring Report. See **Figure 5-13** for an example report. Monitoring Mode data is always normalized.
15. Press  to terminate **Monitoring Mode**. After confirmation, the **HOME** screen will adjust back to the default display.

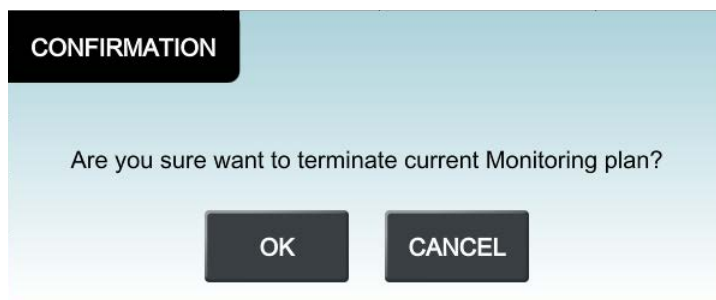


Figure 5-12. Confirmation window to terminate Monitoring Mode

Example Cleanroom Monitoring Report

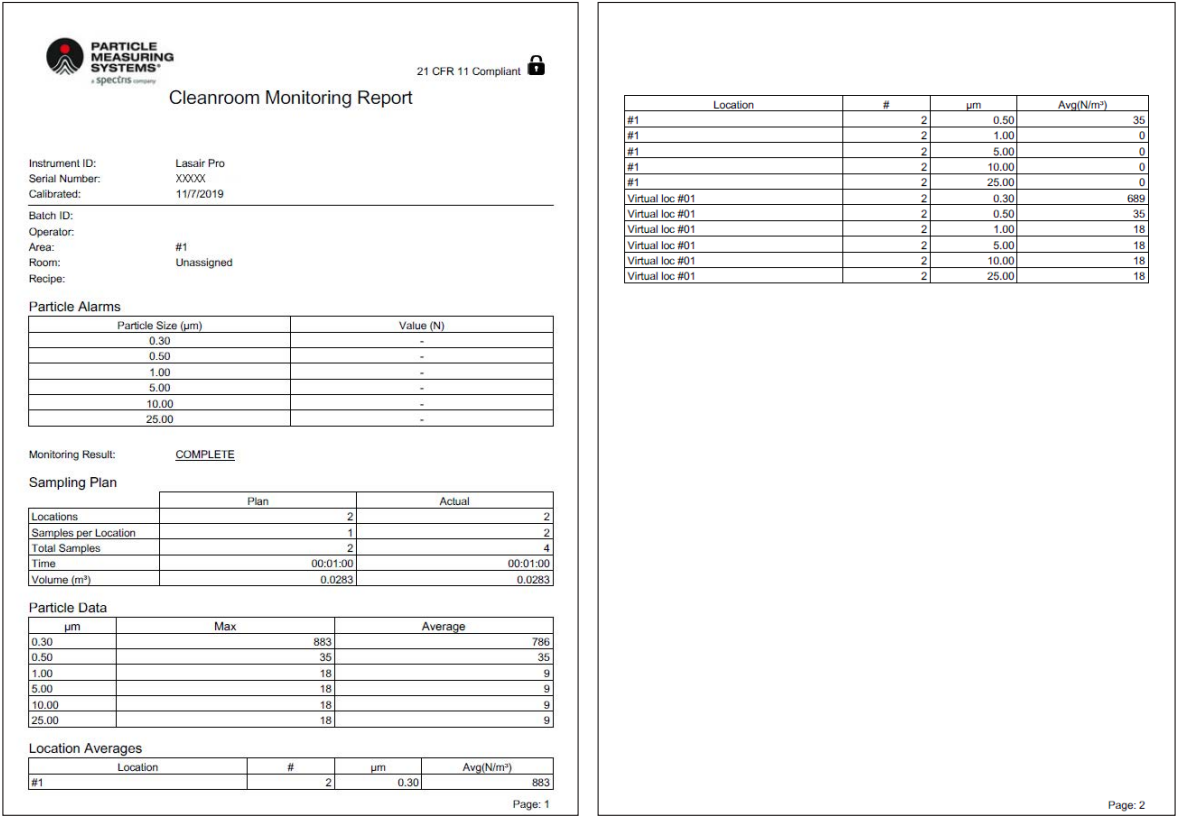


Figure 5-13. Cleanroom Monitoring Report example

NOTE: If you generate a Cleanroom Monitoring Report before all sampling locations have completed, you will see a general estimation ("0+") in the Samples per Location field on the report. Generate the report after all sampling has completed to ensure the field's specificity.

Sampling Accessories

Sample Probes

A standard isokinetic sampling probe (ISP), constructed out of Ultem® 1000, is included with the particle counter that can be mounted directly onto the instrument's sample inlet. Or, to extend the reach of the sample probe, sample tubing can be added.

Optional Probes

The following isokinetic sampling probes (ISPs) are available and are dependent on the unit's configuration.

- ISP, stainless steel (1 CFM) – P/N 1000012952 (optional)
- ISP, stainless steel (50 LPM) – P/N 1000012953 (optional)
- ISP, stainless steel (100 LPM) – P/N 1000012954 (optional)
- ISP, Ultem 1000 (1 CFM) – P/N 1000012579 (standard)
- ISP, Ultem 1000 (50 LPM) – P/N 1000012578 (standard)
- ISP, Ultem 1000 (100 LPM) – P/N 1000012577 (standard)

Positioning Accessories

For more precise positioning, the following accessories are available from Particle Measuring Systems:

Tripods

- 316L Stainless Steel Table Stand – P/N 1000023413
- Table tripod – P/N 1000000979 (Not for use with the Lasair Pro 5100 unit)

Wall/Hand/Tripod Adapters

A wall/hand/tripod adapter, specific to the particle counter model, is included and shipped with each Lasair Pro particle counter. Additional adapters are available for purchase, if needed:

- Wall/hand/tripod adapter (1 CFM) – P/N 1000012955
- Wall/hand/tripod adapter (50 LPM) – P/N 1000012956
- Wall/hand adapter (100 LPM) – P/N 1000012957

Zero Count Filters

- Zero count filter (1 CFM) – P/N 90104050
- Zero count filter (50 LPM) – P/N 90104052
- Zero count filter (100 LPM) – P/N 90104057

Thermal Paper

- Standard thermal paper – P/N 1000024998
- Cleanroom thermal paper – P/N 1000024977

For users who desire to use the Isokinetic Sampling Probe (ISP) remotely with a handheld accessory, there is the option of using a handheld isokinetic probe attachment (HHIPA). The HHIPA is ideally designed for filter scanner applications where the standard ISP is not suitable. The HHIPA meets the requirements of ISO 14644-3, Section B.6.2.4, “Determination of Probe Size”, and can be used for filter scanning applications.

HHIPA Accessory

Flowrate

The HHIPA probe is available in three different flowrate configurations, depending on the flowrate of your Lasair Pro particle counter. Those flowrates are:

- 28.3 LPM (1.0 CFM)
- 50 LPM
- 100 LPM

Depending on the flowrate of the Lasair Pro Particle Counter, the size and the shape of the HHIPA horn are slightly different as well as the size of the barb fitting and tubing ID.

Tubing

All units are supplied with the same ergonomic handle, a barb fitting to attach tubing and 10 feet of tubing to connect to the Lasair Pro Particle Counter. Each of the probes is supplied with 10 feet (3 meters) of tubing, but it can be replaced with tubing up to the maximum length allowed for the instrument (8 meters). The user should take into account particle transport losses when using longer lengths of tubing and should minimize the length of tubing between the HHIPA and the particle counter whenever possible.



Figure 5-14. Hand-held Isokinetic Probe Attachment (HHIPA)

Application

Tubing is connected to the barb fitting located on the rear of the HHIPA. The other end of the tubing connects to the Lasair Pro Particle Counter's sample inlet.

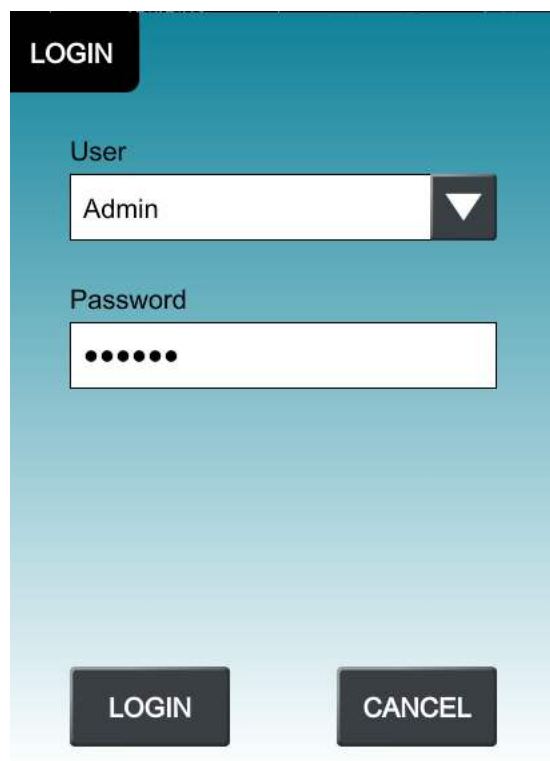
For filter scanning applications it is most common to utilize the audio beep function of the Lasair Pro Particle Counter. This feature allows the user to scan a filter without looking at the screen of the Lasair Pro, and to hear an audio sound when particles are detected. Go to the **DISPLAY** tab of the **DISPLAY** screen for volume adjustment, and ensure audible alarms are enabled (see **GENERAL Tab** in **Chapter 7**).

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Chapter 6

Security

The Lasair Pro particle counter is shipped without security enabled, allowing first-time users to access all screens and settings. Access can be made limited by creating users and enabling security. Once enabled, there are four tiers of accessibility: administrator, supervisor, operator, and no login.



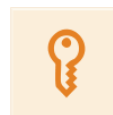
The screenshot shows a 'LOGIN' window with a teal background. At the top left, the word 'LOGIN' is in white on a black background. Below it, there are two input fields: 'User' and 'Password'. The 'User' field contains the text 'Admin' and has a dropdown arrow on the right. The 'Password' field contains six dots. At the bottom, there are two buttons: 'LOGIN' and 'CANCEL'.

Figure 6-1. LOGIN window

To configure security settings, press



and then



(**SECURITY**).

Security Overview

See the following sections for information on individual **SECURITY** tabs:

- **Settings Tab** on page 6-10
- **Users Tab** on page 6-12
- **Audit Tab** on page 6-15
- **Audit Data Tab** on page 6-16

Scan or click for a
Quick Demo Video
about User Setup



Username

The Lasair Pro can manage and internally store up to 100 customizable usernames. Usernames can be a minimum of 3 characters, with a maximum of 32 characters in length. Each username must be unique. Once set, usernames cannot be changed.

Password

Passwords must be at least 4 characters and no more than 16 characters in length. The Lasair Pro stores passwords in an encrypted form, and does not store unencrypted passwords to prevent users or Particle Measuring Systems from displaying or exporting unencrypted passwords.

Depending on configuration settings chosen by the administrator, passwords may have an expiration and be chosen by the user. They may also be required to have a minimum length longer than 6 characters.

Access Levels

The Lasair Pro allows users to be associated with different access levels. Once security is enabled, **No Login** will be the default access level.

Name	Description
No Login	This access level supports viewing the HOME screen and logging in.
Operator	This access level supports operating basic instrument function on a day-to-day basis.
Supervisor	This access level supports modifying some instrument settings at a management level.
Administrator	This access level supports all instrument capabilities.
Table 6-1. Access levels	

NOTE: Permissions are the same for NFC access levels. For example, Administrator and Administrator NFC have the same permissions.

A summary of the accessible instrument screen/menu for each access level is provided in **Table 6-2**.

Screen	No Login	Operator	Supervisor	Administrator
SAMPLE				
SAMPLE	X	☐	✓	✓
ALARMS	X	X	✓	✓
LOCATIONS	X	X	✓	✓
STATISTICS	X	☐	✓	✓
RECIPES	X	☐	✓	✓
SETUP				
DISPLAY	X	☐	✓	✓
SYSTEM	X	☐	☐	✓
SECURITY	X	X	☐	✓
COMM	X	X	✓	✓
IN/OUT	X	X	✓	✓
OTHER				
DATA	X	☐	☐	✓
DIAGNOSTICS	X	X	✓	✓
LOGIN	✓	✓	✓	✓
HOME	☐	✓	✓	✓
✓ Full Access ☐ Limited Access X No Access				
Table 6-2. Screen accessibility by access level				

The user's access level is selected when the user is created. Like the username, it cannot be changed at a later time. The only user data that can be changed is the password.

Activate/Deactivate Users

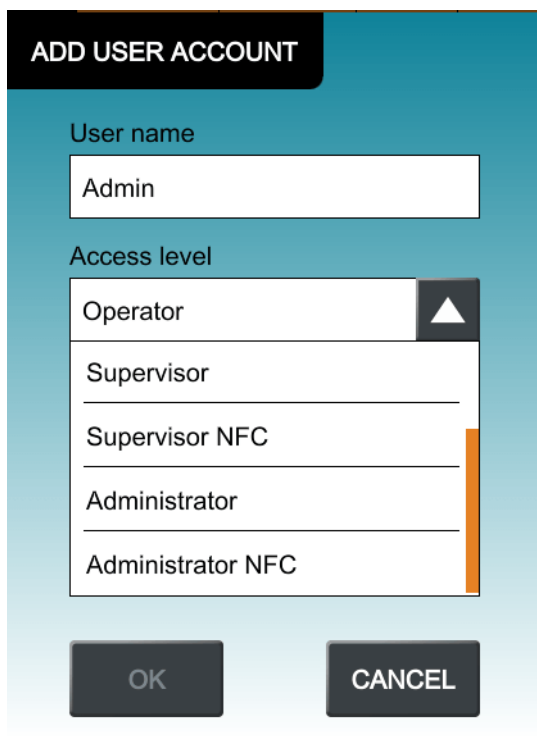
User accounts can be activated and deactivated from the **USERS** tab by administrators. This is done by touching the ON/OFF column for a specific user. Orange indicates the user is enabled, while gray indicates it is disabled.

NOTE: When security is enabled, the Lasair Pro prevents the disable of the Administrator account currently logged into the instrument.

NOTE: When security is enabled, the Lasair Pro prevents an administrator from disabling their own account. In order to disable the current administrative account, security must be disabled or another administrative user must log in to the instrument.

Enabling Security

1. Go to the **USERS** tab and press .
2. Select **Administrator** from the **Access level** dropdown.
3. Press inside the **User name**, **Password**, and **Confirm Password** fields to open the keyboard screen and enter your chosen credentials.
4. Press **OK** to create the new user.



ADD USER ACCOUNT

User name
Admin

Access level
Operator
Supervisor
Supervisor NFC
Administrator
Administrator NFC

OK CANCEL

Figure 6-2. Access levels for a new user

5. You should now see the new user listed beneath the column headers. Select the portion of the row under the **ON/OFF** column to activate the user. The vertical line beside the row number will be orange when activated (See the Figure to the Right)
6. Go to the **SETTINGS** tab and press the **Enable security** slider.
7. Select the Administrator user from the **User** dropdown on the **VERIFY USER** window.
8. Enter the Administrator password and press **OK**.
9. The indicator dot will change from gray to orange when enabled. The administrator user will automatically be logged out.

ON/OFF	
	1
	2
	3
	4
	5

Figure 6-3. ON/OFF column

NOTE: On the **HOME** screen, press the  button to view status, username, and access level information. See **Security** on page 3-10 for more details.

Login and Logout

1. Press , then  (**LOGIN**).
2. Select your username from the **User** dropdown, and enter the user's password.
3. To log out of this user, press , then  (**LOGOUT**).

Disabling Security

Security can only be disabled by an administrator.

1. Log in to an administrator account.
2. Press , then  (**SECURITY**).
3. Go to the **SETTINGS** tab and press the **Enable Security** slider. The orange indicator will fade in color and move to the left side before the **HOME** screen automatically appears.

Editing a User

If security is enabled, the logged-in user will only be able to change their own password, not their Access level. Security must be disabled first and the user de-activated before the Access level can be changed.

1. Log in as the user with the password to be edited. If security has yet to be enabled, skip this step.

2. Go to the **USERS** tab and press .

3. If desired, change the Access level from the dropdown menu.
4. If desired, enter the new password twice (once to confirm).
5. The previously set Access level and password will be erased.

Deleting Users

While logged in as an administrator, any other user can be deleted. If security is not enabled, any user, including administrators, can be deleted.

1. On the **USERS** tab, select the user to be deleted and press .
2. You will be prompted for confirmation. Press **OK**.

3. If you want to delete all users, press . Press **OK** for confirmation.

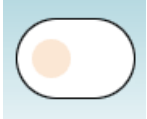
Creating NFC Users

Specialized NFC cards can be programmed with user data for touch-free login to the Lasair Pro particle counter.

Note: This feature is not available on Lasair Pro 310 models that do not have NFC and Wifi capability (1014102X2X).

1. Press , then  (**COMM**).

2. Go to the **NFC** tab and press the **Enable Security** and **Enable Write NFC** indicators.

A light orange dot  indicates the setting has not been enabled.

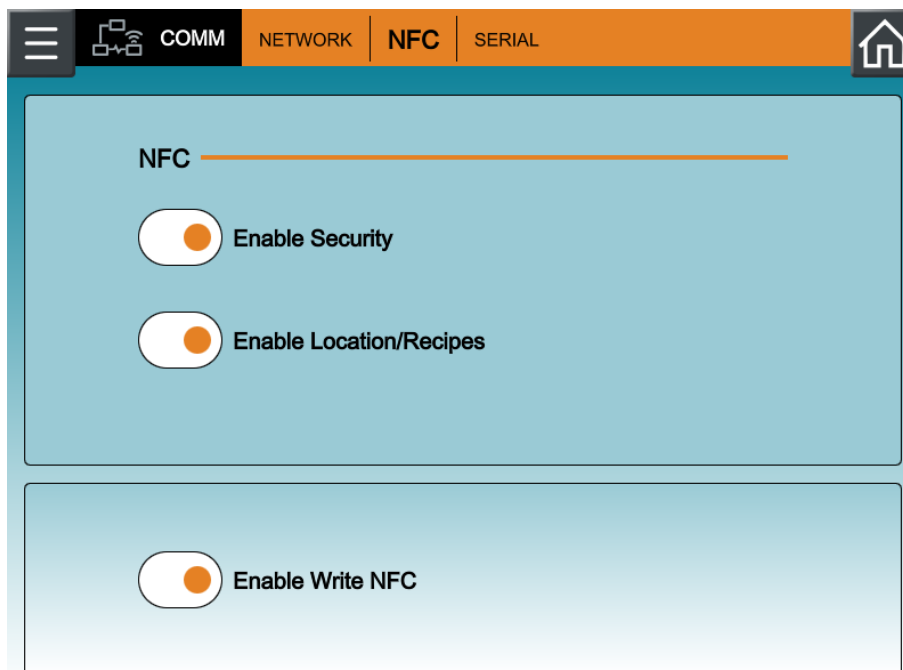
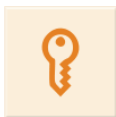


Figure 6-4. NFC tab, COMM

3. Press  and then  (**SECURITY**).
4. Go to the **USERS** tab and press .
5. Select any type of NFC user (Operator NFC, Supervisor NFC, or Administrator NFC) from the **Access level** dropdown. Your username will generate automatically.
6. Press inside the **Password** and **Confirm password** fields to open the keyboard and enter your password.
7. Press **OK** to create the new NFC user.
8. You should now see the new user listed beneath the column headers. Select the portion of the row under the **ON/OFF** column to activate the NFC user. The vertical line beside the row number will be orange when activated (see **Figure 6-3** on page 6-5).

9. Press  to open the **Create NFC User Card** window.
10. Select the recently created NFC user from the **User** dropdown.
11. Press inside the **NFC operator name** field and enter your personalized username.
12. Press **Write**.
13. Press your NFC card to the NFC card reader located on the right side of the Lasair Pro counter.



Figure 6-5. Internal NFC card reader location

14. Wait as the user is written to the NFC card. Continue to hold the card in place.

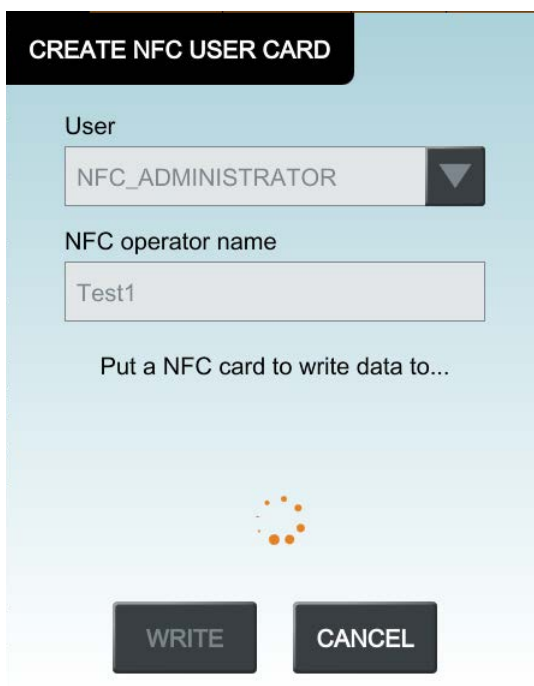


Figure 6-6. Orange circular waiting animation

15. Once complete, the message **NFC USER card is successfully written** will appear in green. The NFC user can now use this specific card to log into the Lasair Pro counter without using the keyboard.

NOTE: If user information has already been written to the NFC card, the older data will be automatically overwritten. Only one user can be written to an NFC card.

-- NOTICE --

Note that NFC users will be unable to log into the Lasair Pro if the **Power up** sampling start selection is chosen (see **Sampling Start** on page 5-6). Ensure a non-NFC user is enabled for logging in.

Scan or click for a
Quick Tutorial Video to
Setup & Program NFC Cards



Settings Tab

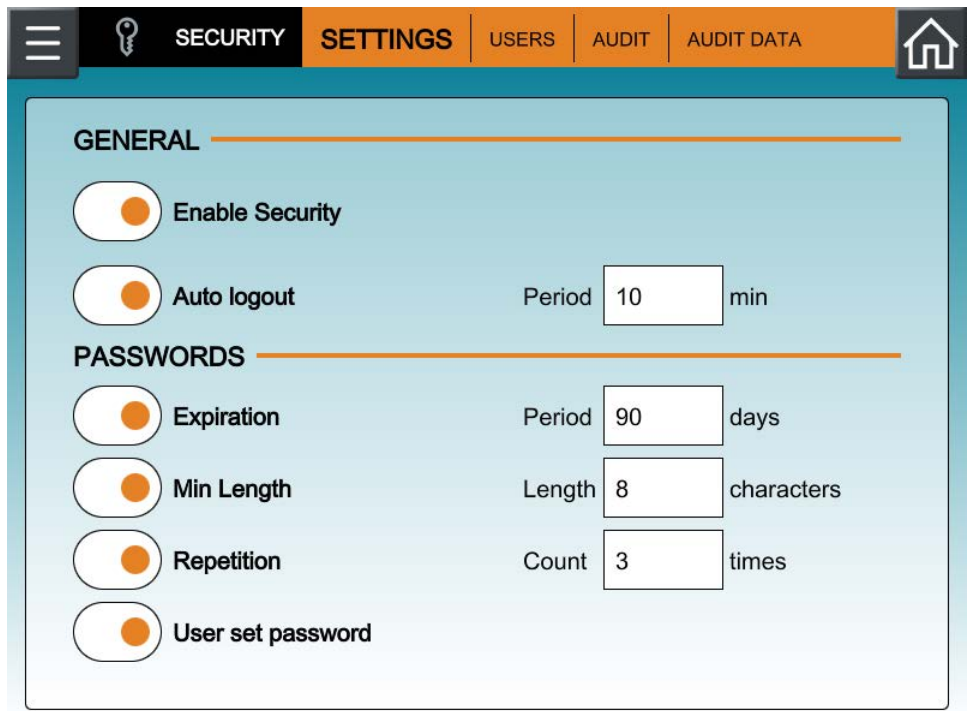


Figure 6-7. SETTINGS tab, SECURITY

The **SETTINGS** tab allows an administrator to enable or disable security, enable or disable the auto-logout feature, and configure password settings.

All settings are described in **Table 6-3** on page 6-11.

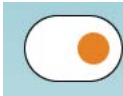
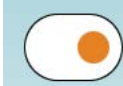
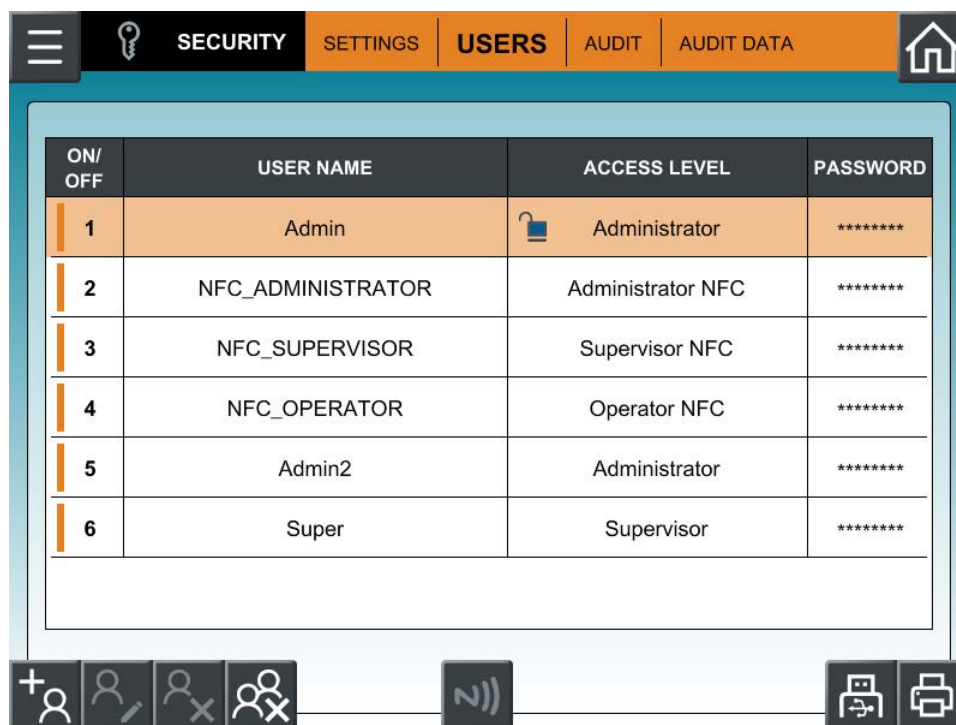
Image	Name	Description
GENERAL		
 Enable Security	Enable Security	Enables all security features. Security cannot be enabled if there is no administrator account has been enabled.
 Auto logout	Auto Logout	Enables the Lasair Pro counter to automatically log the user out at the end of a specified time period.
Period 10 min	Auto Logout Period (min)	Sets the minutes before the auto-logout feature is activated.
PASSWORDS		
 Expiration	Expiration	Activates password expiration after a set number of days.
Period 90 days	Period before Expiration (days)	Sets the number of days before passwords expire. Counts down after the password is set.
 Min Length	Min Length	Activates a minimum password length.
Length 8 characters	Minimum Password Length (characters)	Sets the minimum number of password characters.
 Repetition	Repetition	Activates the option to use repeat passwords.
Count 3 times	Different Passwords Before Reuse (number)	Sets the amount of passwords before the same password can be reused again.
 User set password	User set password	When activated, this setting allows the user to set their own password. When deactivated, passwords are created by the administrator.

Table 6-3. SETTINGS tab, SECURITY

Users Tab



ON/OFF	USER NAME	ACCESS LEVEL	PASSWORD
1	Admin	Administrator	*****
2	NFC_ADMINISTRATOR	Administrator NFC	*****
3	NFC_SUPERVISOR	Supervisor NFC	*****
4	NFC_OPERATOR	Operator NFC	*****
5	Admin2	Administrator	*****
6	Super	Supervisor	*****

Figure 6-8. List of users

The primary feature of this tab is a table with all entered users. A lock icon appears next to the logged-in administrator inside the Access Level column. The table has the following columns:

- **ON/OFF:** Allows the administrator to enable or disable specific users of the Lasair Pro.
- **USER NAME:** Allows the administrator to edit the user name.
Each user name is unique. When adding or editing a username, the firmware will prevent duplicate entries.
- **ACCESS LEVEL:** Allows the administrator to edit the user's access level.
- **PASSWORD:** Allows the administrator to modify a user password.

All buttons are described in **Table 6-4** on page 6-13.

**Scan or click for a
Quick Demo Video
about User Setup**



Image	Name	Description
	Add	Allows for the entry of a new user. The Administrator user can add up to 100 users to be saved on the Lasair Pro.
	Modify	The user name, password, and access level can be modified after user creation. After selecting a user from the list, press this button to edit.
	Delete	Users can be deleted at any time by an administrator, or by the current user if security is not enabled. Select the user to be deleted and press this button to delete.
	Delete All	Allows for the deletion of a user. To delete a specific user, first press anywhere inside the specific row and press the “delete” button. NOTE: When security is enabled, the instrument prevents the removal of the Administrator account currently logged into the instrument.
	Write to NFC Card	Opens the Create NFC User Card window. Only active when an NFC user has been created. Note: This feature is not available on Lasair Pro 310 models that do not have NFC and Wifi capability (1014102X2X).
	Print	The print buttons allow the Administrator to print the User Setup Report to either thermal printer or the USB key. The Print to USB button is only activated when a USB key is inserted.
	Print to USB	The report lists usernames with their access level and enable status.

Table 6-4. **USERS** tab, **SECURITY**

Example User Setup Report

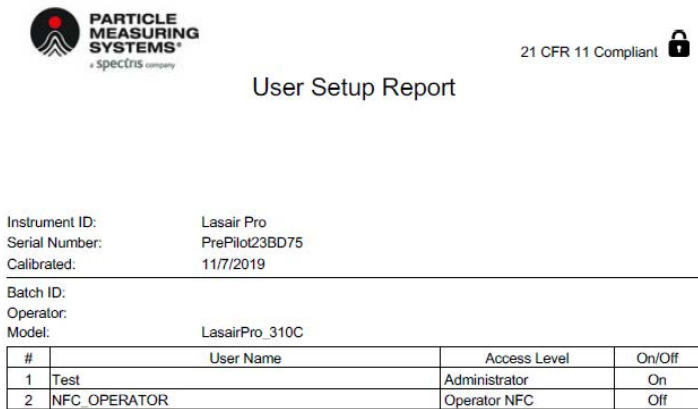


Figure 6-9. Example User Setup Report

To generate your User Setup Report:

The report will list all current users. If no users are created, the report will generate an empty table.

1.

Press  and then  (**SECURITY**).
2.

Go to the **USERS** tab and press .
3.

Press  or , depending on where you want the report to print.
4.

When you see a small number in the top-right corner of the print icon chosen, the report is queuing. Do not remove the USB key at this time.



NOTE: Security does not need to be enabled to generate a report.

Audit Tab

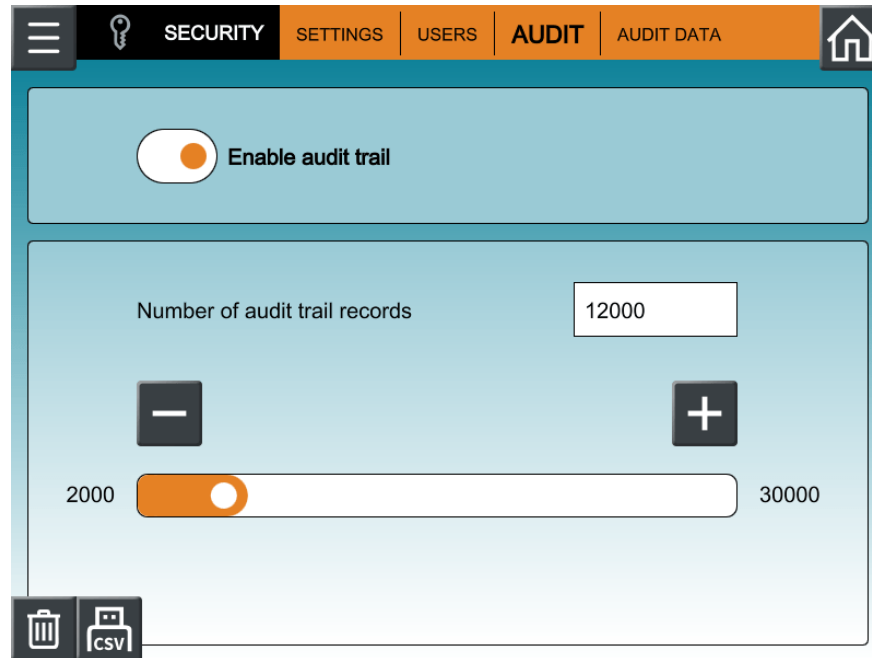


Figure 6-10. Audit trail settings

The Lasair Pro will gather all user activity into an audit trail, organizing by type and date/time. To enable the audit trail functionality, toggle the **Enable audit trail** button so that the orange indicator dot is on the right.

**Scan or click for a
Quick Demo Video of
the Audit Trial Function**



The audit trail is recorded and stored using the Lasair Pro counter's internal memory. The number of entries before auto-deletion can be set between 2000 and 30000. When changing the number of audit trail records stored by the instrument, reboot the instrument immediately after the change is made to properly enable the new setting.

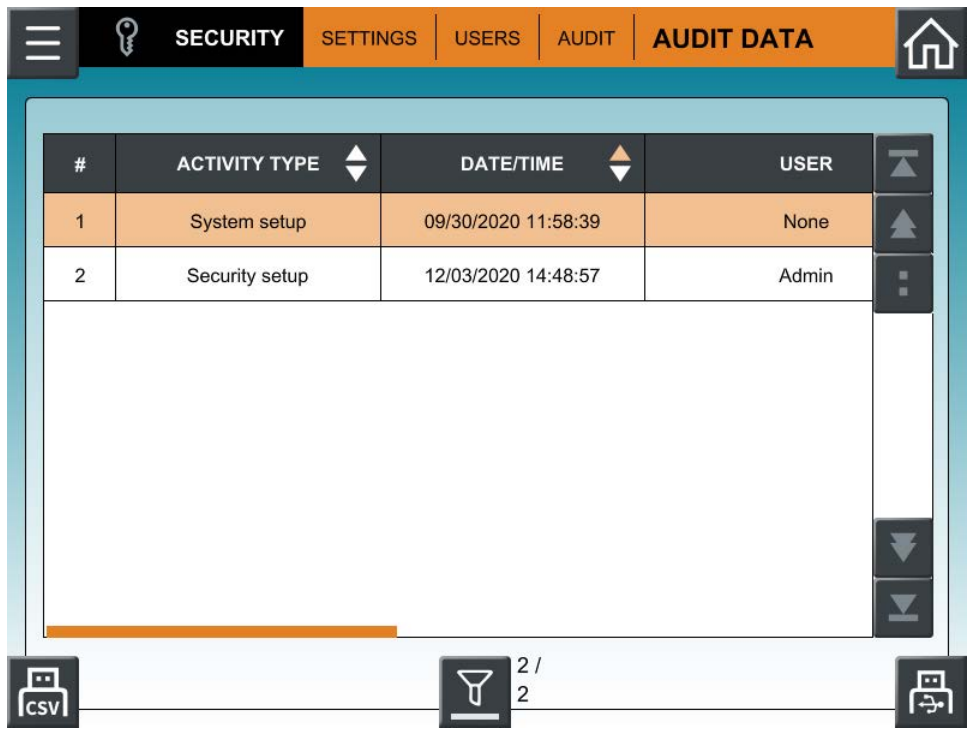
NOTE: When the serial commands are used, they are not logged or tracked in the audit trail.

NOTE: Information contained in the USB export includes instrument identifiers.

Image	Name	Description
	USB Export to CSV File	When a USB key is inserted, pressing this button exports the current Audit Data listing (shown in Figure 6-11) to a CSV file or XML file on the inserted USB key.
	Delete Current Audit Trail	Press this button to clear all current audit trail records from the Lasair Pro.

Table 6-5. AUDIT tab, SECURITY

Audit Data Tab



#	ACTIVITY TYPE	DATE/TIME	USER
1	System setup	09/30/2020 11:58:39	None
2	Security setup	12/03/2020 14:48:57	Admin

Figure 6-11. Audit Data listing

The Audit Data tab lists the activities of configured users, grouped by the location of activity (Security, Recipe, Sampling, Data, etc). Default sorting is by date/time, with earliest shown first.

NOTE: The CSV and XML exports generated on the **AUDIT** and **AUDIT DATA** tabs are identical.

Image	Name	Description
	USB Export to CSV File	When a USB key is inserted, pressing this button exports the current Audit Data listing (shown in Figure 6-11) to a CSV file or XML file on the inserted USB key.
	Filter Options	Press this button to open a window with list filter options for Operator, Date/Time, and Activity Type.
	USB Export	When a USB key is inserted, pressing this button exports the current Audit Trail list to the inserted USB. The file type is PDF.

Table 6-6. AUDIT DATA tab, SECURITY

Example Audit Report

**PARTICLE
MEASURING
SYSTEMS[®]**
a specTris company

21 CFR 11 Compliant

Audit Trail Report

Instrument ID: Lasair Pro
Serial Number: XXXXX
Calibrated: 11/7/2019

Batch ID:
Operator: Admin
Model: LasairPro_310C

1	Main Screen	03/09/2020 12:46:40	Super
UserEnable 0 0 0 0 Adm Super			
2	Main Screen	03/09/2020 12:46:41	Super
UserEnable 1 0 0 0 Adm Super			
3	Diagnostics	03/09/2020 12:47:29	Super
ChangeParameters stat_stat_standard_unit Previous New			
4	Diagnostics	03/09/2020 12:47:30	Super
ChangeParameters stat_stat_standard Previous New			
5	Diagnostics	03/09/2020 12:47:30	Super
ChangeParameters stat_stat_class Previous New			
6	Alarm Setup	03/09/2020 12:47:31	Super
ChangeParameters stat_channel_mask Previous New			
7	Diagnostics	03/09/2020 12:47:31	Super
ChangeParameters stat_stat_loc_samples Previous New			
8	Diagnostics	03/09/2020 12:47:32	Super
ChangeParameters stat_stat_sample_volume Previous New			
9	Diagnostics	03/09/2020 12:47:35	Super
ChangeParameters stat_stat_flow Previous New			
10	Diagnostics	03/09/2020 12:47:36	Super
ChangeParameters stat_stat_standard Previous New			
11	Diagnostics	03/09/2020 12:47:36	Super
ChangeParameters stat_stat_class Previous New			
12	Alarm Setup	03/09/2020 12:47:37	Super
ChangeParameters stat_channel_mask Previous New			

Figure 6-12. Audit Trail Report example

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Chapter 7

Alarms

Alarm limits can be set for all available particle and environmental channels. One particle alarm may be set for up to four particle size channels—and each particle alarm may be individually enabled or disabled.

Use the following tabs to configure alarm settings:

- **GENERAL Tab** on page 7-2
- **PARTICLES Tab** on page 7-3
- **ENVIRONMENTAL Tab** on page 7-5
- **TREND Tab** on page 7-6
- **REASONS Tab** on page 7-8

Navigation

Press  and then  (**ALARMS**). You should now see the **GENERAL** tab.

GENERAL Tab

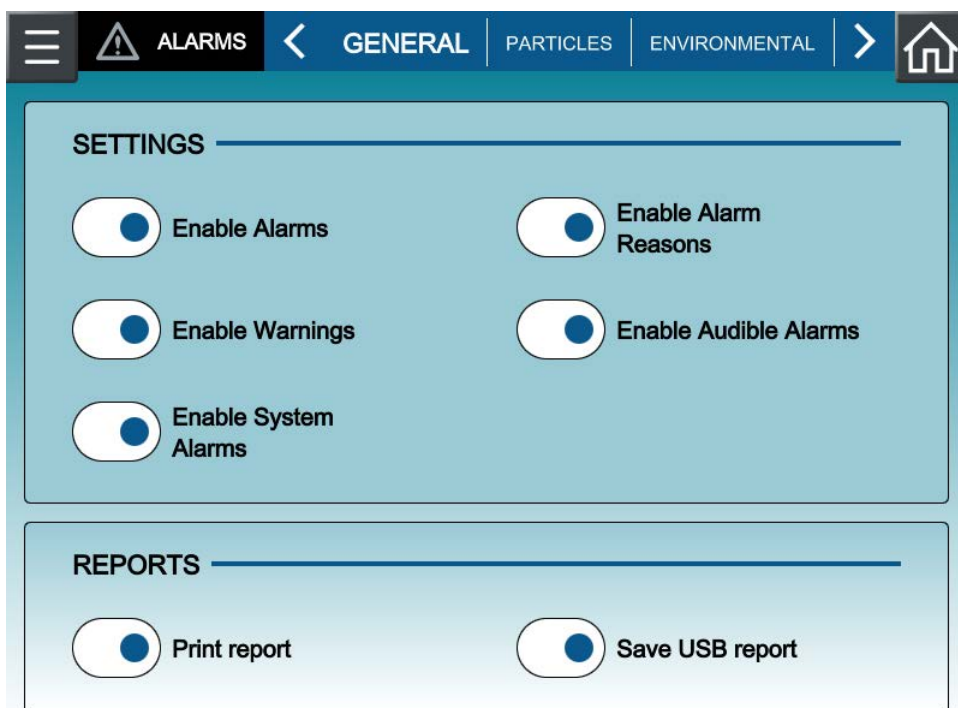


Figure 7-1. GENERAL tab, ALARMS

The **GENERAL** tab allows the user to enable or disable the following options:

- **Enable Alarms:** Enables all alarms (particle, environmental, and trend). When the button is disabled, all alarms and alarm settings are disabled. Alarms are triggered after warning limits are reached.
- **Enable Warnings:** Enables all particle warnings. When the button is disabled, all warnings and warning settings are disabled. Warnings are triggered prior to alarms.
- **Enable System Alarms:** Enables Pump, Laser, Coincidence alarms during sampling.
- **Enable Alarm Reasons:** Enables the alarm reason feature. The user may predefine up to 32 alarm reasons, 32 characters in length, and assign an alarm reason to a sample if the sample contains a particle, environmental or trend alarm.
- **Enable Audible Alarms:** Enables or disables an audible buzzer when alarm occurs.
- **Print report on Alarm:** Enables printing of the sampling report on alarm to the thermal printer.
- **Save USB report:** Enables printing on alarm to an attached USB key.

NOTE: These errors are always shown on the status bar on the main screen and flagged in sample data. Enabling System Alarms also provides alarm indication on these items.

PARTICLES Tab

μm	WARNING, N	μm	ALARM, N
0.30	3000.00	0.30	5000.00
0.50	1000.00	0.50	1500.00
1.00	500.00	1.00	1000.00
5.00	0.00	5.00	0.00
10.00	0.00	10.00	0.00
25.00	0.00	25.00	0.00

DATA —

☒ Σ

☐ Δ

Figure 7-2. PARTICLES tab, ALARMS

Use the **PARTICLES** tab to adjust the following:

- Enable/disable the particle alarm for each channel
- Set the particle warning and alarm limit for each channel. Warnings will trigger prior to alarms.
- Select either cumulative (Σ) or differential (Δ) count for triggering all particle channel alarm

The table on this tab defines alarms for each available particle size channel. The left side lists particle warnings, and the right side lists particle alarms.

Size Column (μm)

The size column displays the channel's particle size. The header indicates the units of each particle size in micrometers (μm). Units can be changed to nanometers (nm) in the **CHANNELS** tab of the **SYSTEM** screen.

Triggering Value Column (WARNING, Units)

The second column of each half is the triggering value column. The triggering value column displays the triggering value of the channel. This is also the value at which the channel will activate a particle alarm for the sample.

The unit of measure for the triggering value depends on the configuration of the **SETTINGS** tab of the **SAMPLE** screen. It can be one of the following:

- N
- N/ft³
- N/m³
- N/ℓ

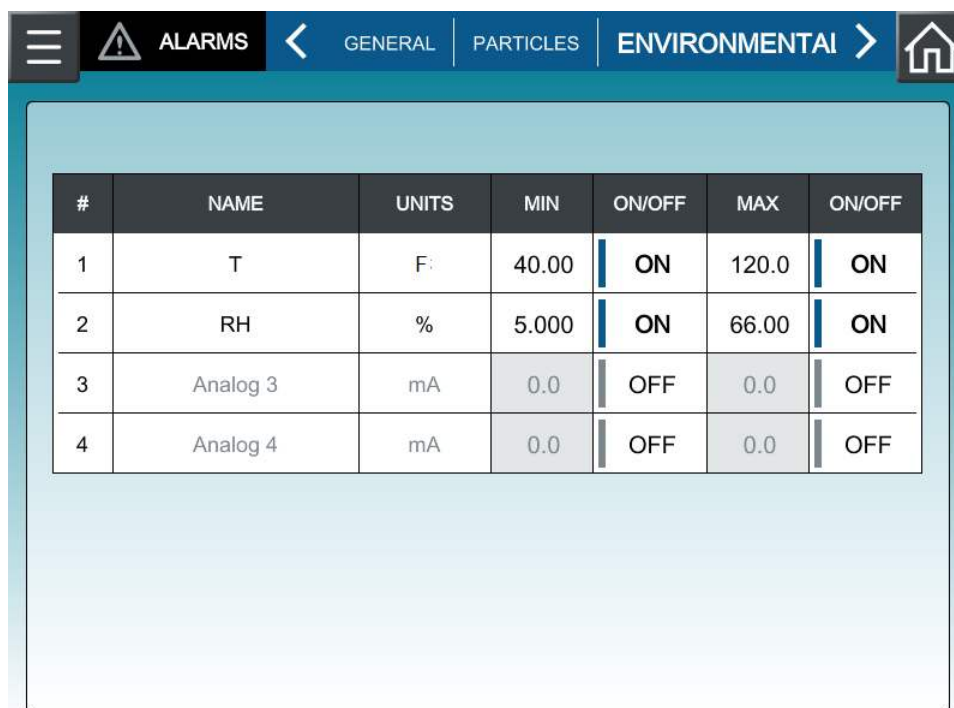
DATA

The first and third column are used to enable or disable warnings and alarms. Press inside the cell to turn the alarm on for the respective particle size. When the checkbox is not selected the respective particle alarm is turned off.

Image	Name	Description
	Cumulative Count Option	When enabled, particle counts will be triggered when the cumulative count reaches the warning or alarm limit set. Cumulative counts are the number of particle counts of a certain size and larger in one sample. The cumulative count values set for particle alarms and warnings will trigger even when the HOME screen is configured to display differential counts.
	Differential Count Option	When enabled, particle counts will be triggered when the differential count reaches the warning or alarm limit set. Differential counts are the number of particle counts of a certain size in one sample. The differential count values set for particle alarms and warnings will trigger even when the HOME screen is configured to display cumulative counts.
Table 7-1. DATA, PARTICLES tab		

ENVIRONMENTAL Tab

Environmental (or analog) channel alarms are configured on the **ENVIRONMENTAL** tab of the **IN/OUT** screen (see **Environmental (Analog) Input** on page 4-6). The same analog channels displayed in the **ENVIRONMENTAL** tab of the **ALARMS** screen are also displayed on the **HOME** screen by swiping left.



#	NAME	UNITS	MIN	ON/OFF	MAX	ON/OFF
1	T	F	40.00	ON	120.0	ON
2	RH	%	5.000	ON	66.00	ON
3	Analog 3	mA	0.0	OFF	0.0	OFF
4	Analog 4	mA	0.0	OFF	0.0	OFF

Figure 7-3. ENVIRONMENTAL tab, ALARMS

The **ENVIRONMENTAL** tab displays all analog channel alarms in tabular format. Changes are made on the **ENVIRONMENTAL** tab of the **IN/OUT** screen. Going by column, the user is able to:

- **NAME:** Change the default display name of the analog channel (Analog 1, Analog 2, etc.) to a user-defined name. There is a 16-character limit.
- **UNITS:** Set the units of the analog channel. There is a 10-character limit.
- **MIN:** Set the minimum values for alarm triggering. Values at or below the minimum value will trigger the alarm. Four digit places are required.
- **MAX:** Set the maximum values for alarm triggering. Values at or above the maximum value will also trigger the alarm. Four digit places are required.
- **ON/OFF:** Enable or disable any analog channel alarm.

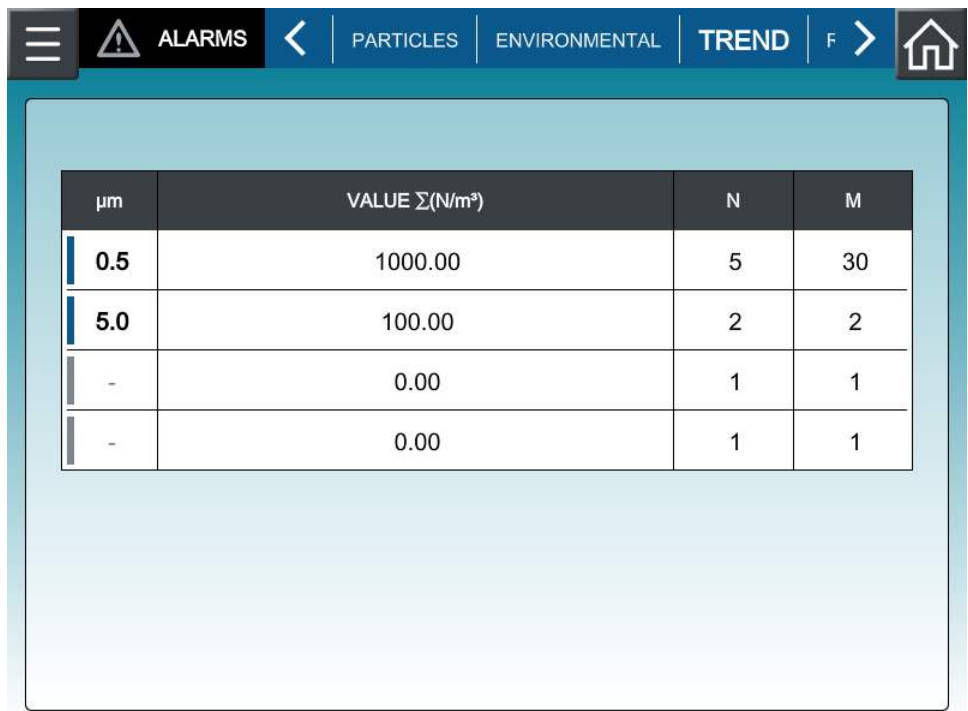
Recipes and Environmental Alarms

Recipes may contain environmental alarm settings, but they do not contain environmental sensor scale and offset setting parameters. When a recipe is loaded, the environmental sensor name and units text name are compared between the Lasair Pro instrument settings and the recipe. If they do not match, then environmental alarm settings from the recipe are not loaded.

TREND Tab

The **TREND** tab allows the user to define trend alarms for a specific channel size. The triggering value of the alarm is displayed on the trend graph (see **GRAPH Tab** on page 10-17). When the alarm for a channel is set, it will display as a horizontal line on the graph with the color of the channel it belongs to. The y-axis position of the line will correspond to the alarm limit value. When the trend alarm condition is reached, the particle counter will trigger a sample alarm.

NOTE: Channels listed on the **TREND** tab are configured in the **TREND** tab of the **DISPLAY** screen. See **TREND Tab** on page 10-4.



µm	VALUE Σ(N/m³)	N	M
0.5	1000.00	5	30
5.0	100.00	2	2
-	0.00	1	1
-	0.00	1	1

Figure 7-4. TREND tab, ALARMS

The **TREND** tab displays the trend alarms for all configured particle channels in tabular format. Going by column, the user is able to:

- **µm:** Enable or disable any trend alarm.
- **VALUE:** Change the triggering value of the trend alarm. The units displayed here, for example, $\Sigma(N/ft^3)$, are set in the **SETTINGS** tab of the **SAMPLE** screen.
- **N:** Set the number of samples (1 to 35) to exceed the set **VALUE** before alarm is triggered. **N** is also known as Triggered Sample Count. This number should be less than or equal to the **M** value.
- **M:** Set the number of samples (1 to 35) to elapse before the alarm is triggered. **M** is also known as the Last Number of Samples. This number should be greater than or equal to the **N** value. See below for examples of alarm triggering (On/Off) based on **N** and **M** numbers when **VALUE** is set to 1000:

Sample #		1	2	3	4	5	6	7
Particle Counts		900	1100	1100	1100	900	900	1100
N	M							
1	1	Off	On	On	On	Off	Off	On
1	3	Off	On	On	On	On	On	On
2	3	Off	Off	On	On	On	Off	Off
3	3	Off	Off	Off	On	Off	Off	Off

REASONS Tab

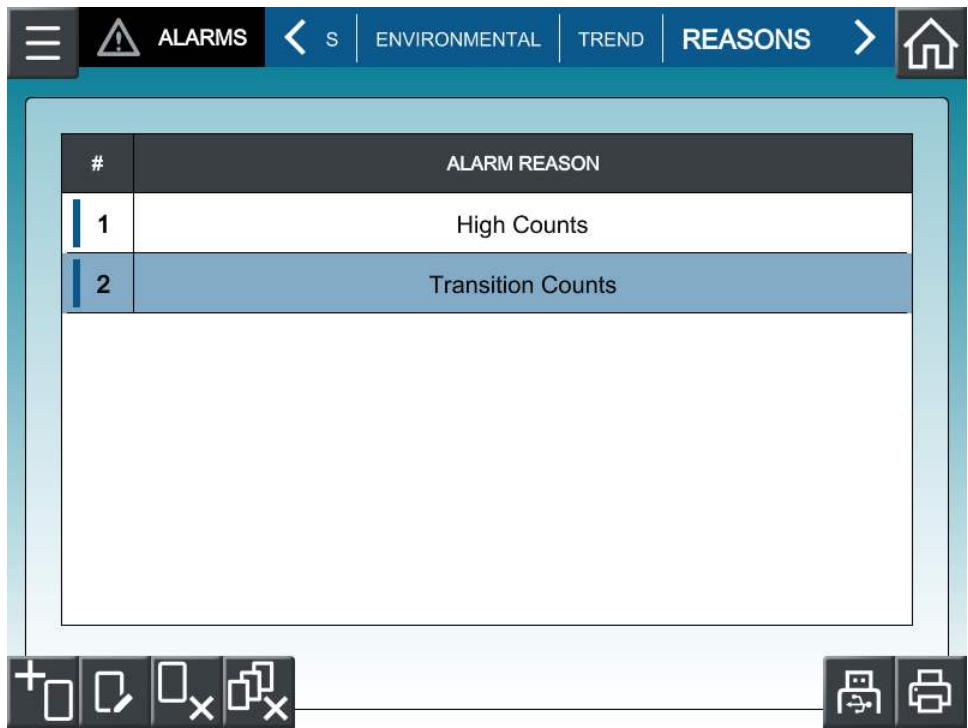


Figure 7-5. REASONS tab, ALARMS

The **REASONS** tab allows the user to define pre-set alarm reasons to select for alarm acknowledgement of particle or environmental alarms. Alarm reasons can be created, deleted, modified, enabled, and disabled. All alarm reasons are automatically enabled after creation. Users may define up to 30 different alarm reasons, and each alarm reason may be up to 32 characters in length.

Image	Name	Description
	Add Reason	Opens the keyboard to define a new alarm reason.
	Edit Reason	When an alarm reason is selected from the list, opens the keyboard to allow the reason to be edited.

Table 7-2. REASONS tab, ALARMS

	Delete Selected Alarm Reason	Deletes the selected alarm reason from the Lasair Pro. A confirmation window appears before the reason is deleted.
	Delete All Alarm Reasons	Deletes all alarm reasons from the list.
	Save to USB	Creates the Alarm Reasons Report on the inserted USB key. The report contains the list of current alarm reasons saved to the Lasair Pro. This button is only activated when a USB key is inserted.
	Print	Prints the current list of alarm reasons to the thermal printer.
Table 7-2. REASONS tab, ALARMS		

NOTE: The Lasair Pro particle counter automatically adjusts alarm settings according to the changes you made in the sample settings so that the proportions will remain constant.

NOTE: When changing between **All channels** mode and **Pharmaceuticals** mode (see **CHANNELS Tab** on page 12-13), the alarm settings will not transfer properly. Alarm settings will need to be reestablished when changing between modes.

NOTE: Alarm Activation: Once an alarm indication occurs on the display during operation, the alarm will remain active until it is acknowledged by the user.

Assigning Alarm Reasons

If a sample contains a particle or analog warning or alarm and the **Enable Alarms Reasons** option is active (see **GENERAL Tab** on page 7-2), the **Alarm Acknowledgement** button appears on the **HOME** screen.

If a warning limit has been reached, the font color for the channel(s) affected will change from black to yellow. If an alarm limit has been reached, the font color for the channel(s) will change from black or yellow (depending on if a warning limit was set) to red. The background of the **HOME** screen will also change from blue to red when either a warning or alarm limit has been reached.



Figure 7-6. Warning/Alarm Acknowledgement button (circled) on the **HOME** screen

In **Figure 7-6**, both an alarm and warning have been triggered for the sample's raw (N) particle counts. The 0.30 μm size channel was set to trigger an alarm at 5,000 counts, and the 0.50 μm size channel was set trigger a warning at 1,000 counts. All alarms and warnings are acknowledged by pressing the **Alarm Acknowledgement** button (circled in **Figure 7-6**) and confirming the **Alarm Acknowledgement** window.

The screenshot shows the 'ALARM ACKNOWLEDGMENT' window. At the top right, it says 'Remaining Samples: 1'. Below this, a status bar indicates '1 / 2 (Alarms: 1, Warnings: 1)'. The main section displays 'Particle alarm' details: 'Date/time: 05/25/2021 06:42:56', 'Channel: 0.30 µm', 'Limit: 5,000.00 (N)', and 'Value: 5,267.00 (N)'. To the right of these details is a right-pointing arrow. Below the details is a 'Reason' dropdown menu with the text 'Specify reason...' and a downward arrow. Underneath the dropdown is a toggle switch labeled 'Apply to all remaining samples', which is currently turned off. At the bottom are two buttons: 'OK' and 'CANCEL'.

Figure 7-7. Particle Alarm information

The screenshot shows the 'ALARM ACKNOWLEDGMENT' window. At the top right, it says 'Remaining Samples: 1'. Below this, a status bar indicates '2 / 2 (Alarms: 1, Warnings: 1)'. The main section displays 'Particle warning' details: 'Date/time: 05/25/2021 06:42:58', 'Channel: 0.50 µm', 'Limit: 1,000.00 (N)', and 'Value: 1,005.00 (N)'. To the left of these details is a left-pointing arrow. Below the details is a 'Reason' dropdown menu with the text 'Testing production' and a downward arrow. Underneath the dropdown is a toggle switch labeled 'Apply to all remaining samples', which is currently turned off. At the bottom are two buttons: 'OK' and 'CANCEL'.

Figure 7-8. Particle Warning information

The **Alarm Acknowledgement** window allows the user to view alarm details and either define an alarm reason to apply to the sampling data, or select an alarm reason defined in the **REASONS Tab** to apply to the sampling data. An alarm reason can be selected for a single alarm or for all remaining alarms in the queue.

NOTE: When acknowledging alarms, the option **Apply to all remaining samples** only applies that alarm acknowledgement to samples that have already been taken. It does not apply to any samples in progress, or that have not been started.

NOTE: Only enabled alarm reasons will be shown in the drop-down list.

The following details are displayed in the **Alarm Acknowledgement** window:

- Number of warnings and alarms in the queue
- Sample date/time
- Warning or alarm type (Particle, Environmental, or Trend)
- Warning or alarm limit (these are user-configured values)
- Warning or alarm channel (the size channel that caused the alarm)
- Data value (the value of the particle count that caused the alarm)

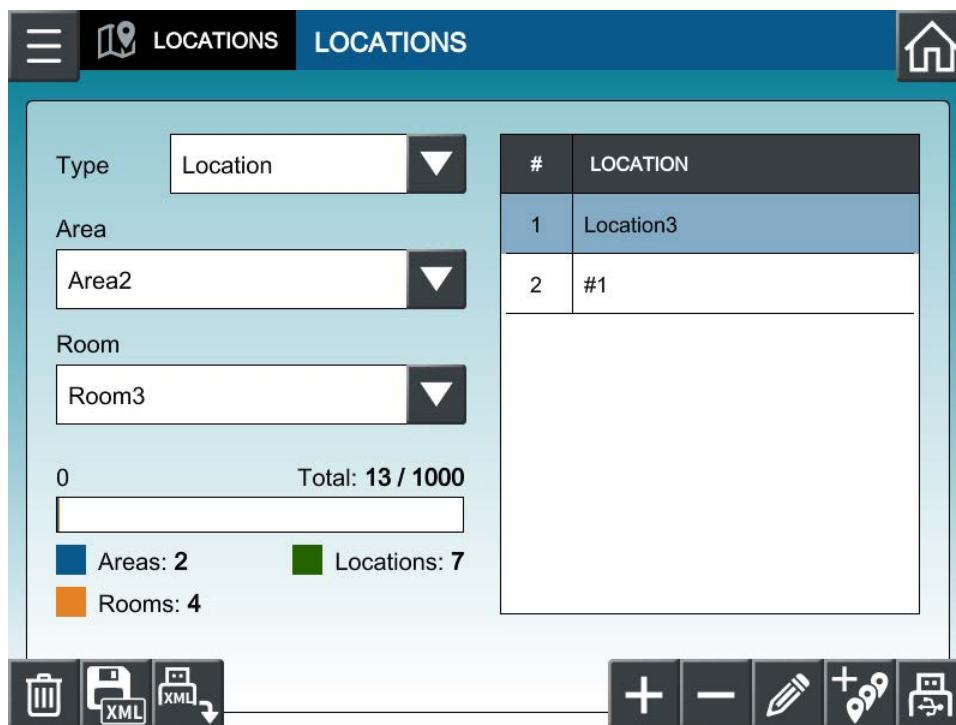
Once the alarm reason has been selected and the user has pressed the **OK** button, the user will be prompted to confirm the selection.

If the device is powered down during the alarm acknowledgement phase, all samples with particle or analog alarms that have not yet been assigned an alarm reason will be assigned the non-customizable alarm reason “No reason provided.”

Chapter 8

Locations

If you are moving the instrument to different sampling points, the Lasair Pro particle counter lets you categorize and name these points in **LOCATIONS**.



#	LOCATION
1	Location3
2	#1

Figure 8-1. Locations configuration for recipes

Areas, rooms, and locations can be added individually or generated automatically with numbering between 1 and 100. You can store up to 1000 locations, rooms, and areas combined.



**Scan or click to Download a Paper
about Choosing the Most Suitable Locations to Sample**

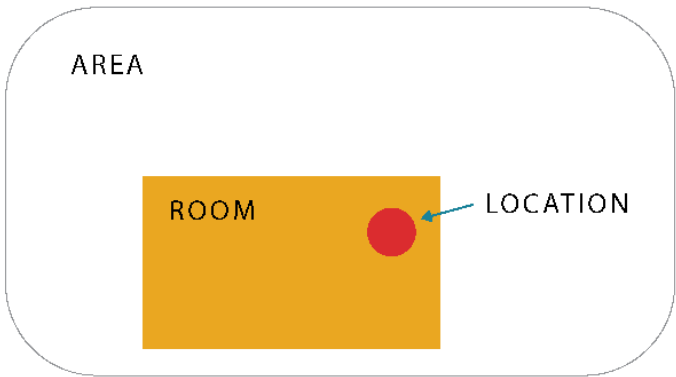


Figure 8-2. Hierarchy of areas, rooms, and locations

You are free to add only the items you need. For example, you may choose to only use locations to refer to your critical sampling points, forgoing the use of rooms and areas.

Areas, rooms, and locations are selectable from the **HOME** screen once created, and sampling data will be labeled with location data whether it is assigned or unassigned.



Figure 8-3. Sampling data (left), and the **HOME** screen (right)

Adding a New Area, Room, and Location

If you plan to use the Lasair Pro for multiple sampling points, you can add these locations and organize them ahead of time to ensure sampling data is appropriately labeled.

1. Go to  >  (**LOCATIONS**).
2. Press  .

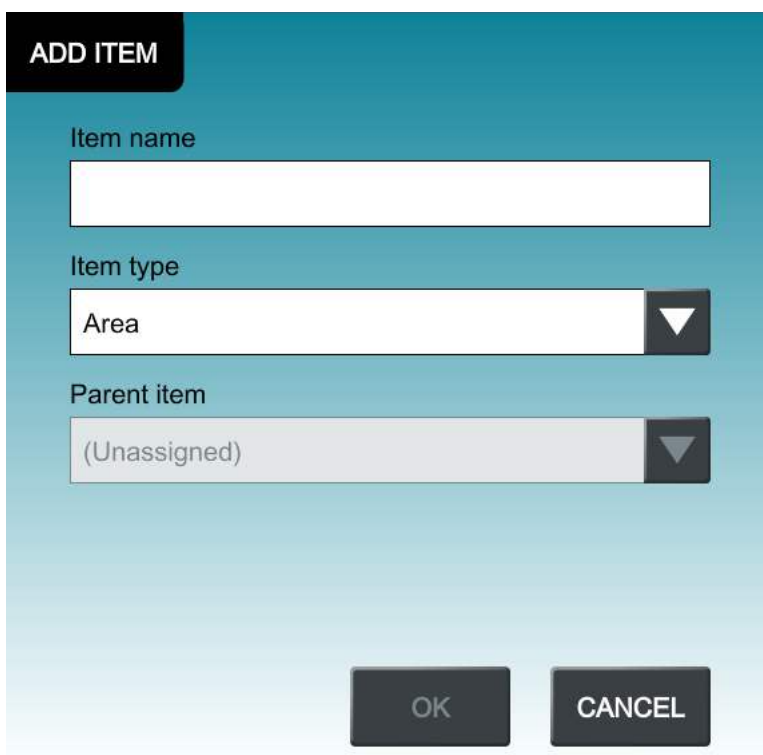


Figure 8-4. Add Item window

3. If using the full hierarchy, it is best to create areas, rooms, and locations in that order. Select **Area** as the Item type and press the **Item name** field to open the keyboard.
4. Press **OK** to confirm the Item name, then **OK** again to add the item.

5. Press  again, and select **Room** as the **Item type**.
6. From the **Parent item** dropdown, select your previously created **Area** to assign the area to the room.
7. Press **OK** to confirm your selection.
8. Press  again, and select **Location** as the **Item type**.
9. From the **Parent item** dropdown, select your previously created **Room** to assign the location to the room.

NOTE: Note the **Parent item** will include both the room and its associated area.

Adding Multiple Areas, Rooms, and Locations

1. Go to  >  (**LOCATIONS**).
2. In the **Type** dropdown, select the option you intend to multiply. For the quickest assignment, first select the largest Parent item you wish to use: Area > Room > Location.

NOTE: If you do not intend to assign locations to rooms, or rooms to areas, skip to step 3 and finish with step 5. Choose Location from the Type dropdown.

3. Press .

4. In the **Auto Fill** dialog, press inside the fields to configure the entry with the keyboard:
 - a. The **Base name** is the text applied to each entry.
 - b. The **Number** determines how many entries will be generated.
5. Press **OK**.
6. Choose the next largest option from the **Type** dropdown. If you selected Area in step 2, you should now select Room. If you selected Room in step 2, select Location.
7. Depending on your choice in step 6, you will have the option to select from the Area dropdown only, or both the Area and Room dropdown. Choose the entry you intend to assign to your multiple Room or Location entries.

NOTE: Here, the **(Unassigned)** option indicates you have not created any entries of that type.

8. Press .

9. In the **Auto Fill** dialog, press inside the fields to configure the entry with the keyboard, as done in step 4. Press **OK**.
10. If you are using the full hierarchy, perform steps 6 -7 to create assigned Locations.

Checking Assignments

1. You can check assignments by using the Type, Area, and Room dropdown arrows on the **LOCATIONS** screen.
2. From the **Area** and/or **Room** dropdown, select any combination to populate the **Type** listing with the existing assignments.

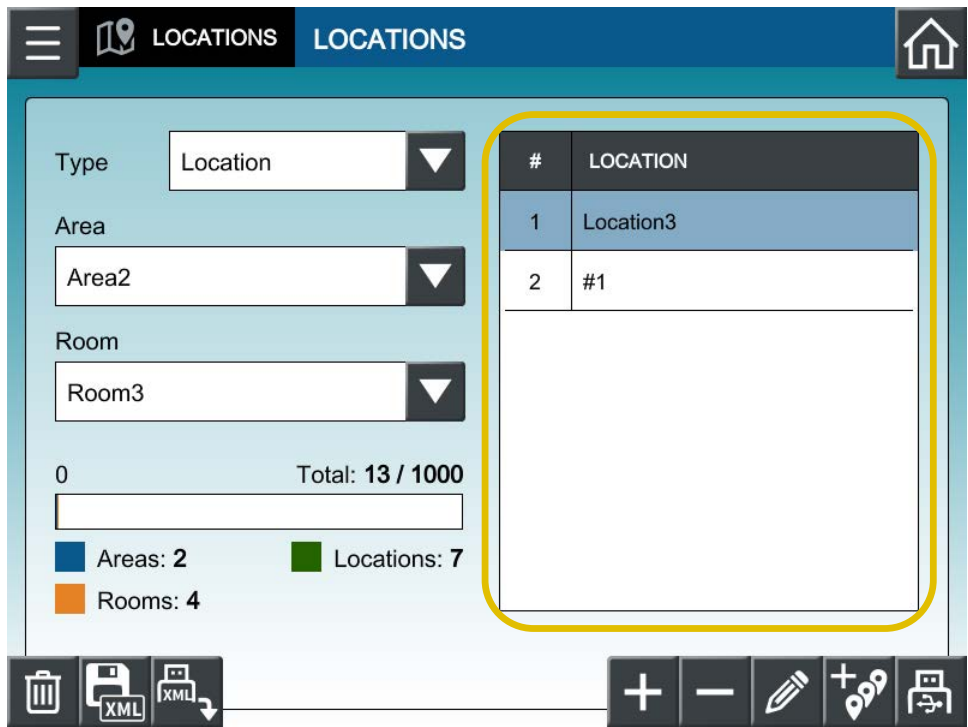


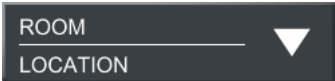
Figure 8-5. Type listing circled

3. You can also print a summary with either the  or  buttons.

NOTE: Selecting an Area and/or Room with the dropdown arrows automatically populates those fields after using the  button.

NOTE: When using the  button for adding multiple locations and/or rooms within a hierarchy, select the Parent items (Area and/or Room) using the dropdown arrows for automatic assignment.

Assigning a Location to a New Sample

1. On the **HOME** screen, select  .
2. The top button,  , displays the **Area** and **Room** listing. The bottom button,  , displays the **Room** and **Location** listing.



AREA	ROOM
(Unassigned)	(Unassigned)
Area1	Room1

Figure 8-6. Area and Room assignment list

3. Double tap the **Room** or **Location** selection to complete. The **HOME** screen will now display your choice of **Room** and **Location** to associate with sampling data.

If a recipe (see **Chapter 9** on page 9-1), is assigned to a room or location, selecting that room or location by double tapping, will pop-up a dialog to load and activate the recipe.

Deletion and Recovery

1. Go to  >  (**LOCATIONS**).
2. Press  to delete all location and assignment data. Recipes will become unassigned by default after this action.

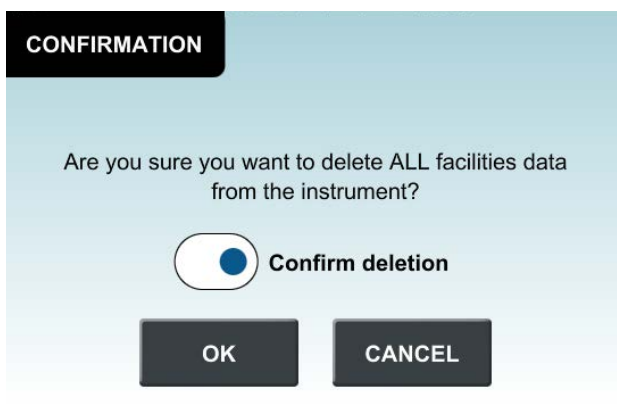


Figure 8-7. Delete all location facility data

3. After confirming deletion by pressing **OK**, you will have the option to recover data until the Lasair Pro instrument is restarted.
4. To recover location data, press . Press OK in the confirmation window to complete the data recovery.

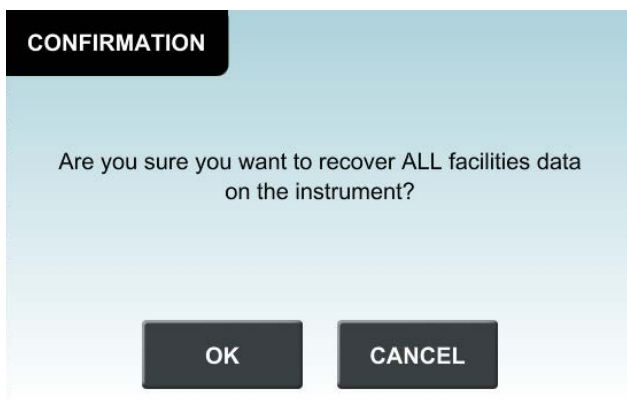


Figure 8-8. Recover all location facility data

Buttons

The following table lists the buttons of the **LOCATIONS** screen.

Image	Name	Description
	Edit Item	Allows the modification of the selected entry.
	Add Item	Enables the entry of a new area, room, or location.
	Remove Selected	Removes selected area, room or location data. A confirmation window appears.
	Delete All Facilities	Deletes all saved area, room, location, and hierarchy data. A confirmation window appears after pressing.
	Recover Location Data	Only appears after pressing the Delete All Location Data button and confirming. Allows the user to revert the change after confirmation.
	Export Facilities	Saves all area, room, location, and hierarchy data in an XML file. This button is only activated when a USB key is inserted.
	Import Facilities	Loads location settings from a USB. This button is only activated when a USB key is inserted.
	Auto Fill	Automatically numbers new locations from 1 to N, where N is selected by the user and may be up to 100.
	Save to USB	Saves the Location Hierarchy Report to the USB as a PDF file. This button is only activated when a USB key is inserted.
Table 8-1. Buttons of the LOCATIONS screen		

Example Location Hierarchy Report

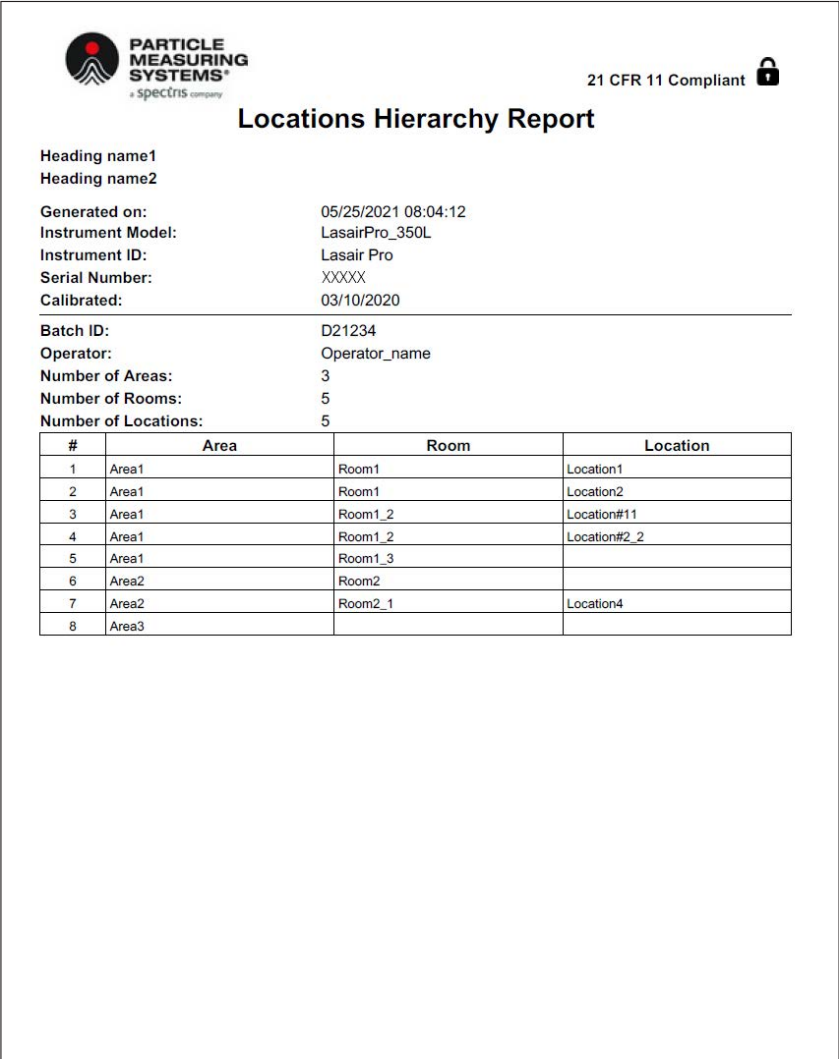


Figure 8-9. Example Location Hierarchy Report

The Location Hierarchy Report displays areas, rooms, locations and their assignments configured in the **LOCATIONS** tab of the **LOCATIONS** screen.

Chapter 9

Recipes

A recipe is a set of sampling or statistical parameters which can be saved and recalled by name or by location. Recipes not only save time and effort, but they can add a quality control measure to ensure consistency between locations and among employees. Up to 100 recipes can be stored on the Lasair Pro.

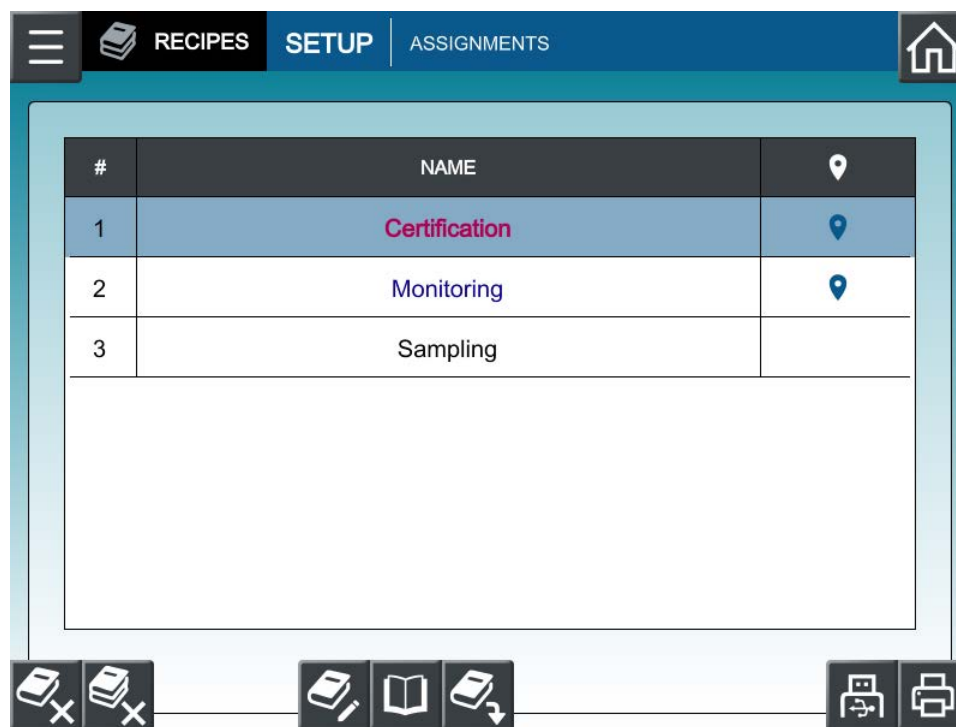


Figure 9-1. SETUP tab, RECIPES

NOTE: The text color of the recipes refers to its type: **Certification** (Magenta), **Monitoring** (Blue), and **Sampling** (Black). These categories are based on the type of report generated.

Creating a New Recipe

Recipes save the current configurations found in **SAMPLE**, **ALARMS**, **LOCATIONS**, and **STATISTICS**.

1. After configuring sampling settings, navigate to  >  (**SAMPLE**).

2. Press  to open the keyboard to name the new recipe. Recipe names can include up to 16 characters.

3. You can now find your recipe and load it at any time if settings change from



Viewing Recipe Settings

You can view all configuration parameters associated with a specific recipe from the **SETUP** tab of **RECIPES**.

1. Go to  >  (**RECIPES**).
2. Select the recipe you would like to view.
3. Press  to open **RECIPE DETAILS**.

See **Figure 9-2** to the right

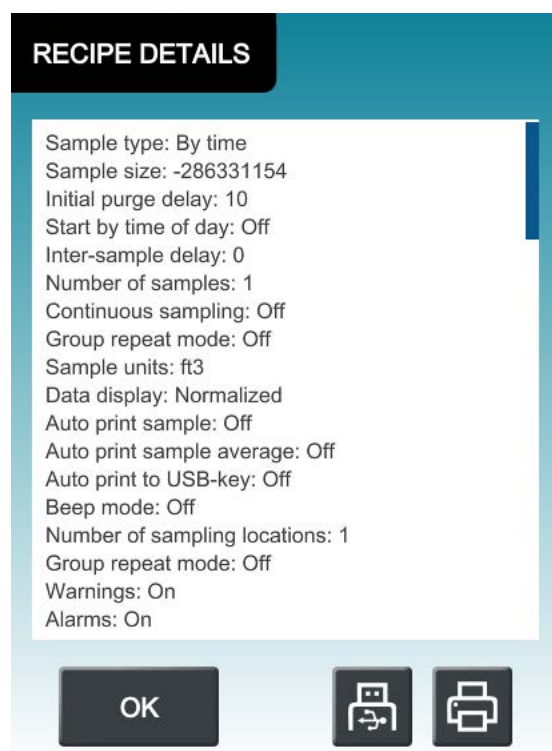


Figure 9-2. RECIPE DETAILS window

4. Press  to save the recipe to a USB. Press  to print the recipe using the thermal printer.
5. Press **OK** when finished.

Scan or click for a
Quick Tutorial Video about
How to Create a Recipe



Assigning a Location to a Recipe

Recipes may be assigned to rooms and locations to facilitate setting the correct sampling.

Scan or click for a
Quick Tutorial Video about
Creating Recipe Locations



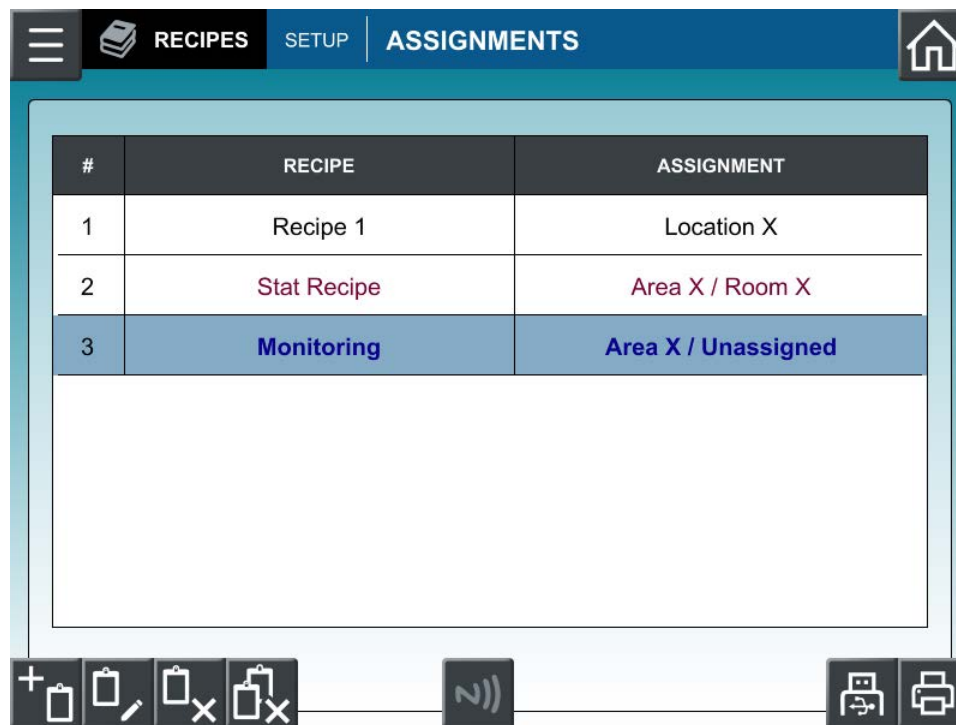
1. From  (**RECIPES**), select the **ASSIGNMENTS** tab.
2. Press  and choose the recipe, area and room from the dropdown menus.
3. Select the Location from the adjacent list. If you want the location to be virtual, select **Add virtual**.

The Location list is generated based on the area and room selection. See **Adding a New Area, Room, and Location** on page 8-3 for more information.

Note that there is some variation in what Recipes can be assigned to what locations.

- **Sampling Recipes** are assigned to individual locations.
- **Monitoring and Statistics Recipes** are assigned to a room with one or more locations (or virtual locations) within them.

4. Select **OK** when finished.



#	RECIPE	ASSIGNMENT
1	Recipe 1	Location X
2	Stat Recipe	Area X / Room X
3	Monitoring	Area X / Unassigned

Figure 9-3. ASSIGNMENTS tab, RECIPES

5. After returning to the **SETUP** tab, you will see  beside the recipe with an assigned location (as seen in **Figure 9-1. SETUP tab, RECIPES** on page 9-1)

Locations and rooms may have more than one recipe associated with them. In this case, when the location (or room) is selected, the operator will have the option of choosing one of the assigned recipes to load and run.

Selecting a location that has a sampling recipe attached on the main screen drop down menu (i.e. double clicking on the room) will allow selecting and loading the recipe.

Creating NFC Recipes

Recipes can be stored to an NFC card so the user can easily switch between recipes configured for different areas, rooms, and locations. A maximum of 50 locations can be used with one NFC recipe card.

1. Press , then  (**COMM**).
2. Go to the **NFC** tab and press the **Enable Location/Recipes** and **Enable Write NFC** indicators. A gray dot indicates the setting has not been enabled.

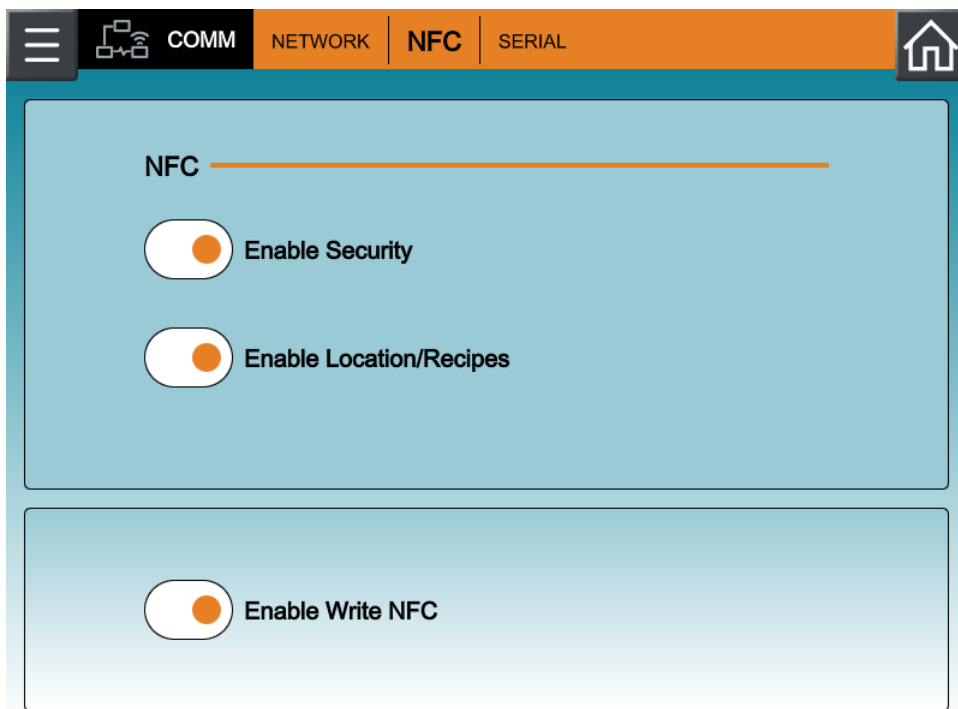


Figure 9-4. NFC tab, COMM

3. After configuring sampling settings found in **SAMPLE**, **ALARMS**, **LOCATIONS**, and **STATISTICS**, navigate to  >  (**SAMPLE**).
4. Press  to open the keyboard to name the new recipe.
5. Press  and then  (**RECIPES**).
6. On the **ASSIGNMENTS** tab, you should see a list of your created recipes and their area, room, and location assignments. If you have not assigned the recipe to an area, room, and location, do so now. See **Assigning a Location to a Recipe** on page 9-3 for more information.
7. Press  to open the **Create NFC Recipe Card** window.
8. Press inside the **NFC recipe name** field and enter the recipe name of the NFC recipe recently created.
9. Press **Write**.
10. Press your NFC card to the NFC card reader located on the right side of the Lasair Pro counter.



Figure 9-5. Internal NFC card reader location

11. Wait as the recipe is written to the NFC card. Continue to hold the card in place.
12. Once complete, the message **NFC RECIPE card is successfully written** will appear in green. The NFC user can now use this specific card to sync the recipe configuration with the Lasair Pro counter without using the keyboard.

NOTE: If user information has already been written to the NFC card, the older data will be automatically overwritten. Only one recipe can be written to an NFC card.

SETUP Tab Buttons

Use the **SETUP** tab to add, modify, and delete recipes from the Lasair Pro counter.

Scan or click for a
Quick Tutorial Video to
Setup & Program NFC Cards



Image	Name	Description
	Delete Recipe	Erases the selected recipe from the Lasair Pro counter’s internal memory.
	Delete All Recipes	Erases all recipes from the Lasair Pro counter. A warning/confirmation prompt is displayed before the recipes are erased.
	Modify Recipe Name	Select the recipe from the list and press this button to edit recipe name.
	View Recipe	Press to view all recipe parameters.
	Load	Loads selected recipe into current settings. You may still make adjustments to settings after a specific recipe is loaded.
	Print	Prints the selected recipe to the Lasair Pro thermal printer

Table 9-1. Buttons of the **SETUP** tab, **RECIPES**

Image	Name	Description
	Save to USB	Saves the highlighted recipe to the attached USB key. There are three types of recipe reports: Certification, Monitoring, and Sampling. The button is enabled only when the USB is attached. Certification: This report lists the current settings found on the STANDARDS and SETUP tabs of the STATISTICS screen. Monitoring: Generates when Number of sampling locations is greater than 1 (Monitoring Mode is selectable). Sampling: This report lists the current settings found on the STANDARDS and SETUP tabs of the SAMPLE screen. Both Monitoring and Sampling recipe reports list the current settings found on the SETTINGS and ADVANCED tab of the SAMPLE screen, in addition to GENERAL, PARTICLES, ENVIRONMENTAL, and TREND tabs of the ALARMS screen.
	Return to Home	Press to return to the HOME screen.

Table 9-1. Buttons of the **SETUP** tab, **RECIPES**

ASSIGNMENTS Tab Buttons

Use the **ASSIGNMENTS** tab to associate a recipe to an area, room, location, or all three.

Image	Name	Description
	Add Assignment	Opens a configuration window to assign a specific recipe to any combination of area, room, and location. Virtual locations can also be assigned.
	Modify Assignment	Modifies the selected assignment.
	Save to NFC	Writes assignment to the NFC card.

Table 9-2. Buttons of the **ASSIGNMENTS** tab, **RECIPES**

Image	Name	Description
	Delete Assignment	Deletes the association between the selected location and recipe.
	Delete All Assignments	Erases the assignment between all locations and recipes.

Table 9-2. Buttons of the **ASSIGNMENTS** tab, **RECIPES**

Recipe Importing and Exporting

Lasair Pro recipes can be imported and exported to other Lasair Pro counters. See **Clone Export and Import** on page 12-8. Be aware of the following:

- Moving a recipe between instruments with different flowrates may result in unexpected sample times or sample volumes. The Lasair Pro can sample by time or by volume, and this information is recorded in a sample recipe.
 - For example, if a one minute sample recipe is exported from a 310 model and imported to a 5100, then the sample volume on the 5100 will be 100 liters rather than 1 ft³, in order to keep the time the same.
- Moving a recipe between instruments with different channel sizes may result in missing alarms.
- For example, a recipe created on a 310 model with an alarm of 1000 counts @ 0.3 µm will be unable to export that alarm setting properly to a 5100, where there is no 0.3 µm channel.
- Moving a statistics recipe between instruments with different channel sizes may result in some adjustments to the statistics if the channel size is not supported in the new instrument.
- Recipes may contain environmental alarm settings, but they do not contain environmental sensor scale and offset setting parameters. When a recipe is imported, the environmental sensor name and units text name are compared between the Lasair Pro instrument settings and the recipe. If they do not match, then environmental alarm settings from the recipe are not imported.

Recipe Details

You can view the details of saved recipes on the **SETUP** tab of the **RECIPES** screen by

pressing



. A typical recipe includes the following details:

- Sample type (volume or time)
- Sample size (volume or time)
- Initial purge delay (in seconds)
- Start by time of day (On/Off)
- Inter-sample delay (in seconds)
- Number of samples
- Continuous sampling (On/Off)
- Group repeat mode (On/Off)
- Sample units (ft³, m³, or l)
- Data display (Raw or Normalized)
- Auto print sample (On/Off)
- Auto print sample average (for two or more samples)
- Auto print to USB-key (On/Off)
- Beep mode (On/Off)
- Number of sampling locations
- Warnings (On/Off)
- Alarms (On/Off)
- Alarm buzzer (On/Off)
- **For Each Particle Size:**
 - Particle alarm type (Cumulative/Differential)
 - Particle channel
 - Alarm setting
 - Alarm (On/Off)
 - Warning setting
 - Warning (On/Off)
- **For Each Analog Channel:**
 - Environmental channel
 - Min alarm setting
 - Max alarm setting
 - Min alarm (On/Off)
 - Max alarm (On/Off)

Statistics Recipe Details

Statistics recipes are found in the same list as normal recipes. Statistics recipes are saved on the **SETUP** tab of the **STATISTICS** screen. See **SETUP Tab** on page 11-9. The following is the list of all parameters saved for a statistics recipe:

- Channels configuration (List of channels included in statistics plan)
- Instrument type (Lasair Pro model)
- Start type (Standard, Time of Day, Power Up)
- Statistics standard (ISO-14644-1 2015, EU GMP, China GMP, FS-209E, or AVERAGE)
- Class (not applicable for AVERAGE mode)
- Purge delay (seconds)
- Inter-sample delay (seconds)
- Auto-Track mode (On/Off)
- Confirm sample mode (On/Off)
- Units (ft³, m³, or l)
- Particle channel
- Flow (Laminar and Turbulent)
- Room state (Static or Dynamic)
- Room area
- Room area units
- Number of locations (to sample)
- Sample Volume
- Number of samples (per location)

Statistics recipe data not saved:

- Statistics User Name
- Sampling Setup Screen Parameters – The number of samples is automatically set when statistics are enabled, except for average mode. In average mode, the current sample count is used.
- Alarm settings – Default alarms are disabled during statistics.

Chapter 10

Display, Data and Reports

The tabs of the **DISPLAY** screen allow the user to adjust screen and sound parameters, configure channel settings, set graphical displays, and insert report data. Tabs under the **DATA** screen allow the user to view previous sampling data in a variety of formats.

You can view sample data in a number of ways on the **HOME** and **DATA** screens, in addition to reports. Tables and graphs change based on your selections made to the parameters described in this chapter:

Tabs of the **DISPLAY** screen:

- **DISPLAY Tab** on page 10-2
- **TREND Tab** on page 10-4
- **HISTOGRAM Tab** on page 10-7
- **REPORTS Tab** on page 10-9

Tabs of the **DATA** screen:

- **TABLE Tab** on page 10-16
- **GRAPH Tab** on page 10-17

DISPLAY Tab

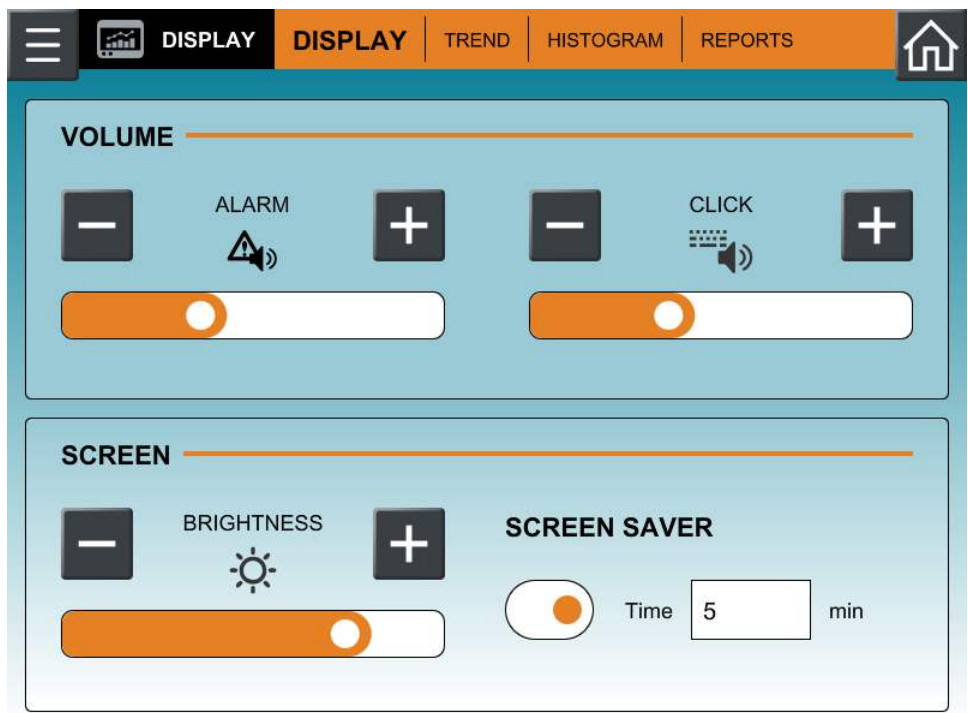
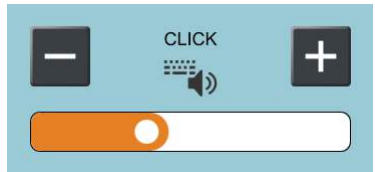


Figure 10-1. DISPLAY tab, DISPLAY

Use the Options tab to adjust the display brightness, screen saver, alarm signal volume, and click button volume. **Table 10-1** describes all settings on this tab.

Image	Name	Description
	Brightness	Use the minus and plus buttons to decrease and increase the brightness of the LCD display. NOTE: This setting affects battery life.

Table 10-1. DISPLAY tab, DISPLAY

Image	Name	Description
	Screen Saver	Enables the screen saver feature. Press the Time (min) field to access the keyboard for entering the number of minutes (1 - 60) of inactivity required before the screen saver is activated. - The screen saver option saves the device power by turning off the backlight, while the device continues working. - Touch any area of the screen to reactivate.
	Volume: Alarm	Use the minus and plus buttons to decrease and increase the volume of the alarm signal. For Lasair Pro units with the optional Alarm Siren, the volume bar is from 0 - 3 levels.
	Volume: Click	Use the minus and plus buttons to decrease and increase the volume of the beep generated with each click. As you decrease or increase the volume, an orange bar (0 - 3) indicates the amount of volume.
Table 10-1. DISPLAY tab, DISPLAY		

TREND Tab

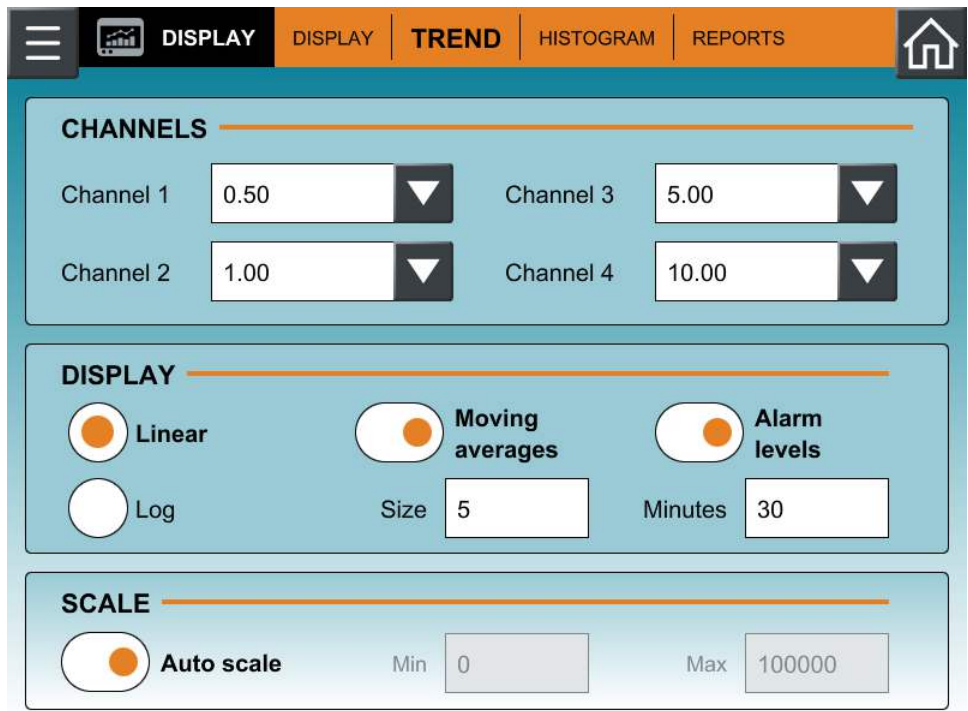


Figure 10-2. TREND tab, DISPLAY

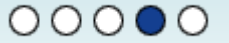
The options of the **TREND** tab of the **DISPLAY** screen pertain to the fourth display option () on the **MAIN** screen. See **Table 10-2** for a description of each option.

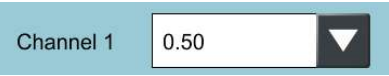
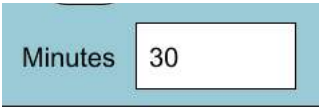
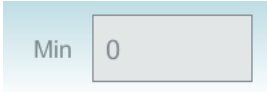
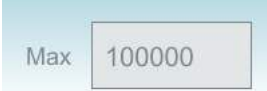
Image	Name	Description
CHANNELS		
	Channel 1 Channel 2 Channel 3 Channel 4	Sets the size of each channel to be displayed on the trend graph. Your choice of channel size will be displayed in the TREND tab of the ALARM screen.
SETTING		
	Minutes	The interval (total time span) to display on the trend graph's x-axis.
	Moving averages	Displays the moving average value as a dashed line on the graph for two samples. The moving average value is the mean value for the Size number of previous samples.
Table 10-2. TREND tab, DISPLAY		

Image	Name	Description
SETTING		
	Size	Defines how many previous samples are used for calculating the moving average (2-10). The default value is 5. - The value for this field should be less than the number of samples for the x-axis. - This field is only activated when the Moving averages option is enabled.
	Alarm levels	Displays the configured alarm levels as horizontal lines across the trend graph. Alarm levels are set on the PARTICLES tab of the ALARMS screen. See Chapter 7.
SCALE		
	Linear	This option sets the y-axis scale as linear. 0 is the minimum value
	Log	This option sets the y-axis scale as logarithmic where: 1 is the minimum value 0 to 1 the scale is linear 1 to the maximum y-axis value is logarithmic
	Auto scale	This option allows all sampling data to be displayed on the graph. The maximum value for the y-axis scale adjusts automatically.
	Min	The minimum value to display for the y-axis. This field is only active when the Auto Scale option is Off.
	Max	The maximum value to display for the y-axis. This field is only active when the Auto Scale option is Off.
Table 10-2. TREND tab, DISPLAY		

Example Trend Graph



Figure 10-3. Example trend graph, **MAIN** screen

NOTE: Each datapoint represents one sample.

HISTOGRAM Tab

The screenshot shows the HISTOGRAM tab selected in the top navigation bar. Below the navigation bar, there are three configuration sections:

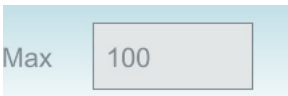
- DATA TYPE:** Two radio buttons are present. 'Cumulative' is selected (indicated by an orange dot), and 'Differential' is unselected.
- DISPLAY MODE:** Three radio buttons are present. 'Percent of full scale' is selected (indicated by an orange dot), 'Linear' is unselected, and 'Log' is unselected.
- SCALE:** A toggle switch for 'Auto scale' is selected. To its right, there is a 'Max' label and a text input field containing the value '100'.

Figure 10-4. HISTOGRAM tab, DISPLAY

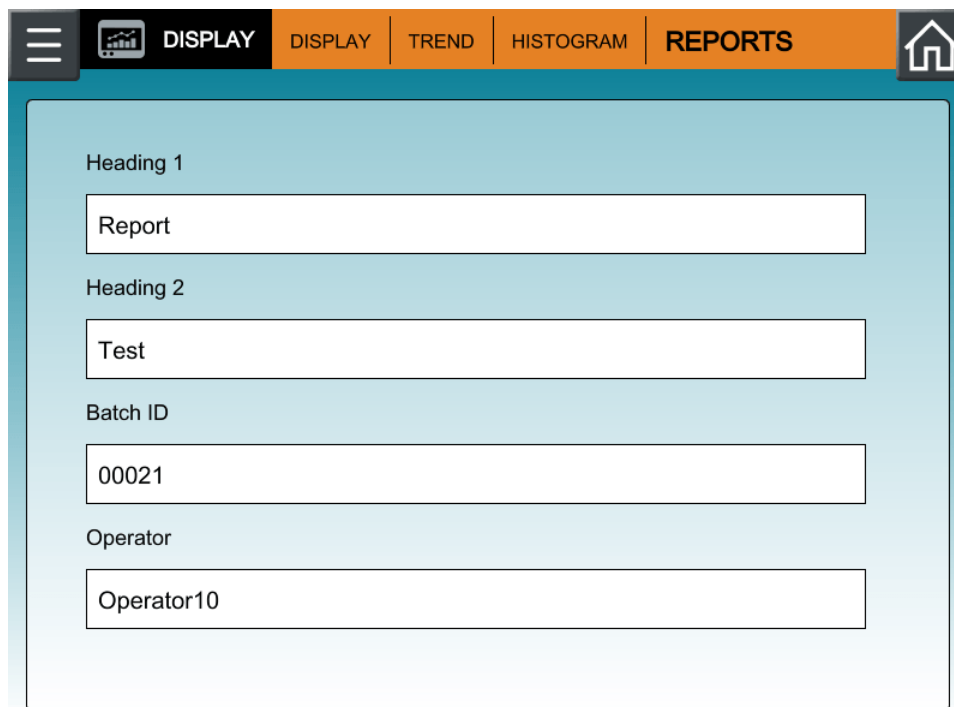
On the **Histogram** tab, you can configure settings for the graphical and report data display. See **Table 10-3** on page 10-7 for a description of each setting on this screen.

Image	Name	Description
DATA TYPE		
 Cumulative	Cumulative Data	Sets cumulative as the type of data to be used for the histogram graph. Cumulative Count is a number of particles of certain size and bigger that are found in one sample.
 Differential	Differential Data	Sets differential as the type of data to be used for the histogram graph. Differential Count refers to a number of particles of certain size that are found in one sample.

Table 10-3. HISTOGRAM tab, DISPLAY

Image	Name	Description
DISPLAY MODE		
	Percent full scale	Sets the histogram to show the percentages for all enabled channels. The minimum setting is 0 and the maximum setting is 100.
	Linear	Represents linear scale for the y-axis. The minimum value is 0.
	Log	Represents the logarithmic scale for the y-axis. The minimum value is 1.
SCALE		
	Enable Auto Scale	Enables graphical displays to auto scale with data.
	Max	Represents the maximum y-axis value for Percent of full scale, Linear and Log(arithmic) scale. - When Percent of full scale is selected, this field displays the maximum value (5 - 100) for this display mode. - When the Linear or Log scale mode is selected, the field displays a default value (100000 for either option).
Table 10-3. HISTOGRAM tab, DISPLAY		

REPORTS Tab



The screenshot shows the 'REPORTS' tab selected in the top navigation bar. The main content area is light blue and contains four text input fields, each with a label above it: 'Heading 1' with the value 'Report', 'Heading 2' with the value 'Test', 'Batch ID' with the value '00021', and 'Operator' with the value 'Operator10'. The navigation bar includes icons for a menu, a display, and a home button, along with the labels 'DISPLAY', 'TREND', 'HISTOGRAM', and 'REPORTS'.

Figure 10-5. REPORTS tab, DISPLAY

Reports can be personalized to include additional text used in the report layout for PDF files. The **REPORTS** tab allows the user to add the following text to sampling reports:

- **Heading 1:** Heading to display on the first line of the reports (maximum 42 alphanumeric characters).
- **Heading 2:** Heading to display on the second line of the reports (maximum 42 alphanumeric characters).
- **Batch ID:** Batch identifier (maximum 16 alphanumeric characters) to display on the reports.
- **Operator:** Name of the operator to display on the reports (maximum 32 alphanumeric characters). The **Operator** field is automatically disabled and shows the current logged-in user when the instrument security is active.

Reports Overview

You can output sampling results to the following:

- Built-in thermal printer
- USB key
- PMS software such as FacilityPro and Pharmaceutical Net Pro

NOTE: For information about transferring sampling data to PMS software, see the user guide that comes with the software.

After completing a sample, you can press one of the following buttons on the **HOME** screen to transfer the results:

	Save to USB	Saves the report as a PDF to the USB key.
	Print	Prints the report to the thermal printer.

Final Sample Report Example

			21 CFR Part 11 Compliant 	
1	Final Sample Report			
2	Heading 1			
3	Heading 2			
4	Generated on:		01/01/2021	
5	Instrument Model:		Lasair Pro_310C	
5	Instrument ID:		Lasair Pro	
5	Serial Number:		XXXXX	
6	Calibrated:		01/01/2021	
7	Batch ID:		00021	
8	Operator:		John Doe	
9	Area:		Fill Point	
10	Room:		1416A	
11	Location:		#001	
12	Recipe:		Recipe Name	
13	Started:		04/01/2021 13:57:07	
14	Finished:		04/01/2021 13:57:17	
15	Sample:		81	
16	Sample Status:		VALID	
17	Particle Data			
18	μm	Δ (N)	Σ (N)	
19	0.3	6,679	8,751	
19	0.5	1,371	2,072	
19	1.0	675	701	
19	5.0	20	26	
19	10.0	6	6	
19	25.0	0	0	
20	Volume: 0.0047 m ³		Flow: 0.03 m ³ /min	
21	Duration: 00:00:10			
22	Environmental Data			
23		Avg	Min	Max
24	Analog 1	mA	8.2	8.1
24	Analog 2	mA	15.8	15.9
24	Analog 3	mA	NaN	NaN
24	Analog 4	mA	NaN	NaN
25	Alarms:			
26	Alarm Reason:			

Line No.	Displayed Text	Description
1	Final Sample Report	Title of Report. Possible values: Final: Report printed after the sampling completed. Partial: Report printed during the sampling process.
2	Heading 1	Heading 1 text specified in the REPORTS tab of the DISPLAY screen. Not shown if the field is blank.
3	Heading 2	Heading 2 text specified in the REPORTS tab of the DISPLAY screen. Not shown if the field is left blank.
4	Generated on	Date on which the final sample report was generated.
5	Instrument Model, Instrument ID, and Serial Number	These lines pertain to instrument-specific parameters: Instrument Model: The model of the Lasair Pro, also found on the label above the touchscreen. Instrument ID: Name/ID of the Lasair Pro particle counter that produced the data. The ID of the instrument may be edited on the SETUP tab of the SYSTEM screen, impacting all reports. Serial Number: Serial number of the Lasair Pro particle counter that produced the data.
6	Calibrated	Date on which the Lasair Pro particle counter was last calibrated (format selectable on the DATE/TIME tab of the SYSTEM screen).
7	Batch ID	Batch ID text specified in the REPORTS tab of the DISPLAY screen. Not shown if Batch ID field is blank.
8	Operator	Operator text specified in the REPORTS tab of the DISPLAY screen or the current logged user if security is enabled. See Chapter 6 for security configuration.
9	Area	Area where the sampling was performed. Labeled as “Unassigned” if no areas are defined. See Chapter 8 for area configuration.
Table 10-4. Final Sample Report legend		

Line No.	Displayed Text	Description
10	Room	Room where the sampling was performed. Labeled as “Unassigned” if no rooms are defined. See Chapter 8 for area configuration.
11	Location	Location where the sampling was performed. Labeled as “Unassigned” if no locations are defined. See Chapter 8 for location configuration.
12	Recipe	Name of the recipe used, if any. See Chapter 9 for recipe configuration.
13	Started: 04/01/2021 13:57:07	Date stamp (format selectable on the DATE/TIME tab of the SYSTEM screen) followed by a time stamp (hour : minute : second) when the sample was started.
14	Finished: 04/01/2021 13:57:17	Date stamp (format selectable on the DATE/TIME tab of the SYSTEM screen) followed by a time stamp (hour : minute : second) when the sample ended. NOTE: The sample number is not shown when the sample is printed after an Alarm Acknowledge Reason is selected.
15	Sample	The sequential sample number out of the total samples taken with the instrument. Also corresponds the the row number on the TABLE tab of the DATA screen.
16	Sample Status	Validity of the sample. Possible values: VALID: Particle counter did not detect any condition that would invalidate the sample. INVALID: Particle counter detected a condition that invalidates the sample.
17	Particle Data	Header for particle data report that follows.
Table 10-4. Final Sample Report legend		

Line No.	Displayed Text	Description
18	μm ΔN ΣN	Column headers: • μm: Particle size in microns or nanometers • Δ: Number of particles detected of that size. When followed by N, indicates raw counts. When followed by N/m³, N/ft³, or N/l, indicates normalized data. • Σ: Sum of all particles of particle size and larger counted. When followed by N, indicates raw counts. When followed by N/m³, N/ft³, or N/l, indicates normalized data.
19	0.3 6,679 8,751	Channel and channel data. For column definitions, see Line 15 above.
20	Volume Flow	Volume: Total volume of medium (e.g., air) sampled. Flow: Flowrate of the medium during sampling. For thermal printouts of sampling reports, this information is below Environmental Data.
21	Duration	Total sampling time. For thermal printouts of sampling reports, this information is below Environmental Data.
22	Environmental Data	Header for analog data that follows. This information displays only if one or more analog sensors are configured and enabled. See Analog on page 4-6 for analog channel configuration.
23	Avg Min Max	Column headers for average, minimum, and maximum values for each analog channel.
24	Analog 1 mA 8.2 8.1 8.4	Average, minimum, and maximum values for the analog channel. If a channel is enabled, but a sensor is not attached, the value is NaN.
Table 10-4. Final Sample Report legend		

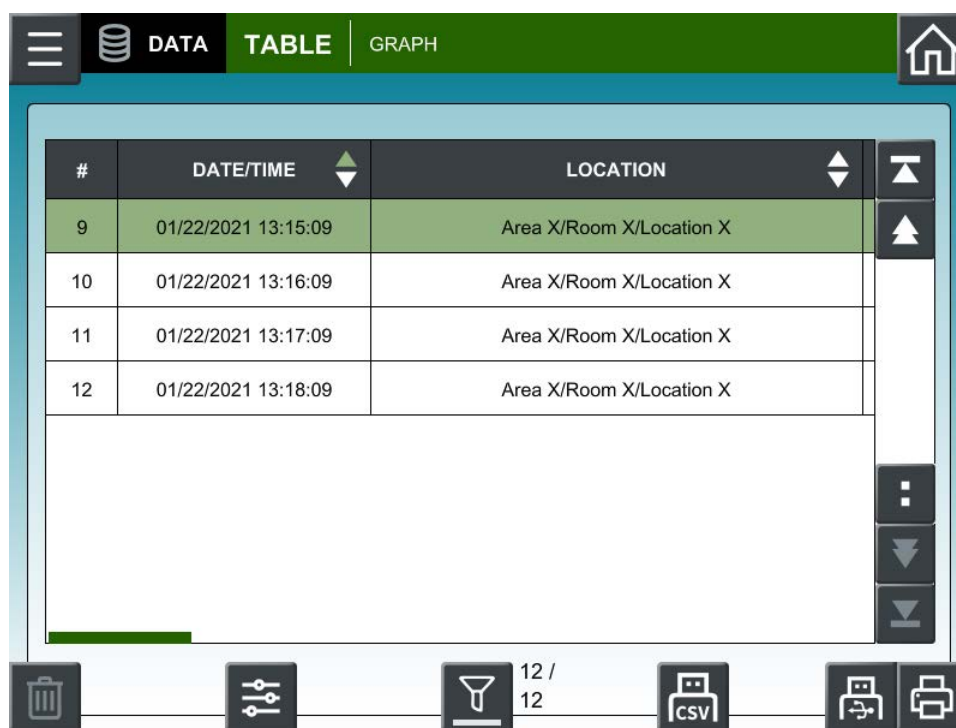
Line No.	Displayed Text	Description
	Alarms:	Lists the alarms that occurred during sampling. Flow Error: This alarm prints when the particle counter senses that the flowrate is outside the boundary of 1 CFM, 50 LPM, or 100 LPM $\pm 5\%$. Laser Error: This alarm prints when the particle counter senses that the laser power is out of the specified range. Coincidence Error: This line prints when 10% coincidence error is exceeded during a sample. Other alarms: Particle Alarm, Particle Warning, Trend Alarm, Environmental Alarm
25	Alarm Reason	This line prints on alarm if Alarm Reasons are enabled. See Chapter 7 for alarm configuration.
26	Alarm Reason Text	This line prints the user-defined alarm reason if Alarm Reasons are enabled.
Table 10-4. Final Sample Report legend		

NOTE: The numbers on the example report are for description purposes only and do NOT appear on the actual file output.

DATA Screen

Results of individual samples and trending of multiple samples can be viewed with the tabs of the **DATA** screen.

TABLE Tab



#	DATE/TIME	LOCATION
9	01/22/2021 13:15:09	Area X/Room X/Location X
10	01/22/2021 13:16:09	Area X/Room X/Location X
11	01/22/2021 13:17:09	Area X/Room X/Location X
12	01/22/2021 13:18:09	Area X/Room X/Location X

Figure 10-6. Table display of sampling data

The **TABLE** tab of the **DATA** screen displays all sampling and environmental sensor data stored internally on the Lasair Pro counter in a list format. The list is automatically updated each time a new sample is completed. All stored data displays unless filters have been set.

Use the scroll bars on the right side and bottom of the data table to go up, down, left and right. Column order can be adjusted by pressing the arrows in the column headers.

All of the following columns can be re-ordered:

- DATE/TIME
- LOCATION
- OPERATOR
- SAMPLE TIME
- VOLUME

GRAPH Tab

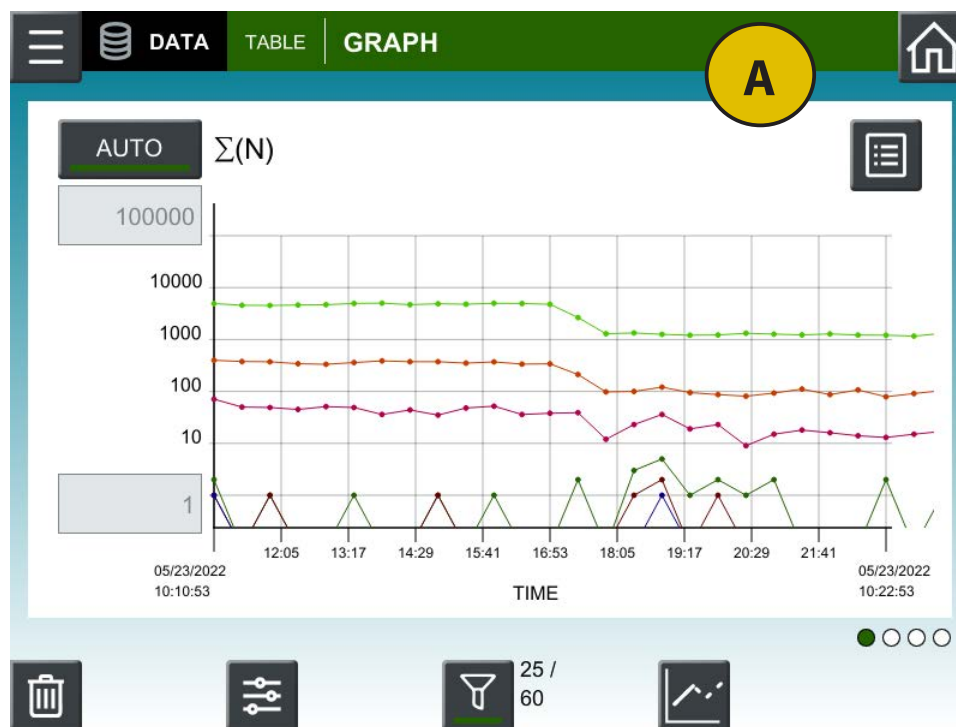


Figure 10-7. GRAPH tab, swipe left/right to for additional formats

The **GRAPH** tab is for viewing four possible graphical displays:

- **A. Historical Trend (●○○○)**: Particle counts over time for all configured channel sizes. Multi-colored lines represent individual channels. Used for trending data over multiple samples. Time format is DD/HH:MM.
- **B. Box Plot (○●○○)**: Multi-colored box and whisker plot displays particle counts for all configured channel sizes.
- **C. Historical Histogram (○○●○)**: Bar graph displays particle counts for all configured channel sizes. Raw data: Displays the sum of particle channel data. Normalized data: Displays the average of the samples.
- **D. Frequency Polygon (○○○●)**: Displays line graph of particle counts from eight samples for all configured channel sizes. Multi-colored lines represent individual samples.

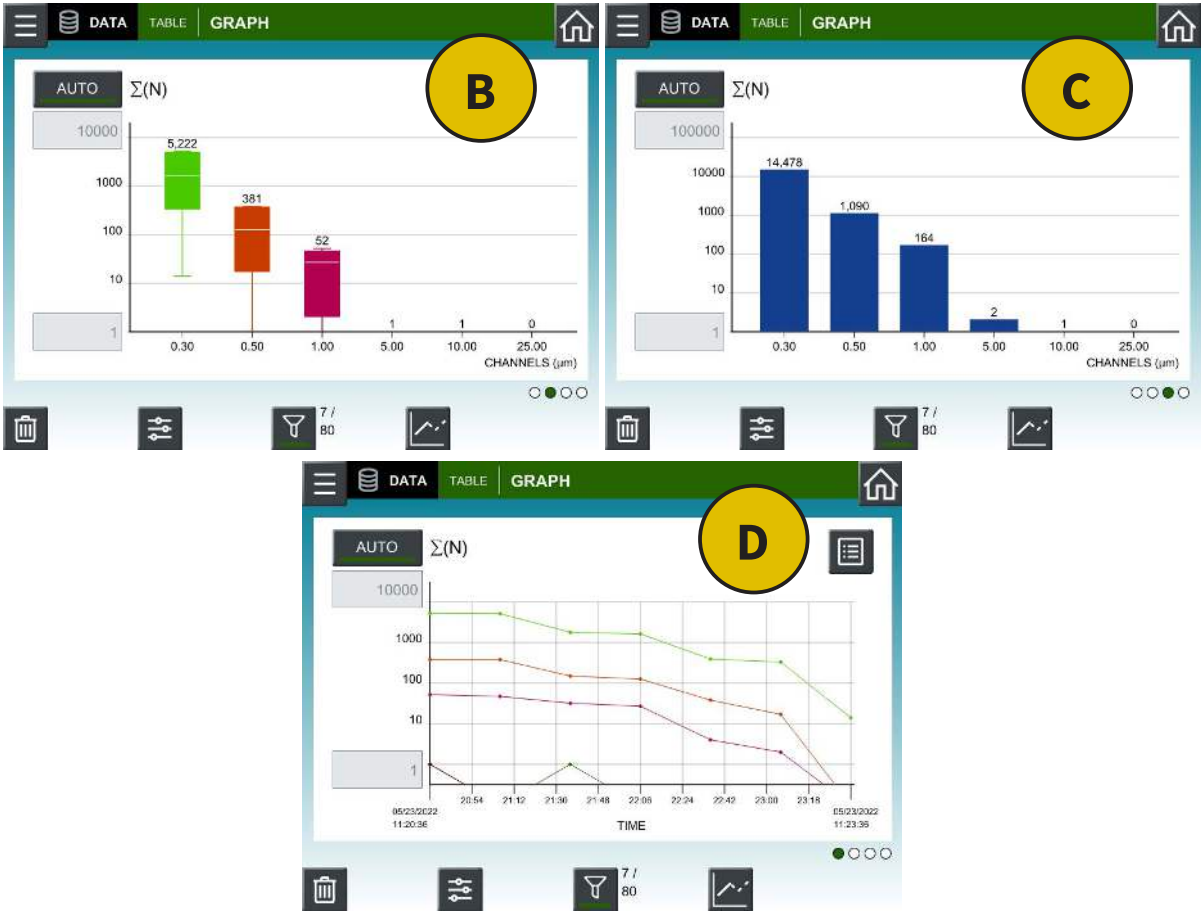


Figure 10-8. Additional formats on the **GRAPH** tab, **DATA**

NOTE: The **TABLE** and **GRAPH** tabs support data filtering. Press  to filter the display to show specific ranges of data.

Buttons

Image	Name	Description
	Auto Scaling	Automatically adjusts scaling to show all data values.
	Delete All Historical Data	Deletes all sampling data from the Lasair Pro. A confirmation appears before deletion.
	Restore Historical Data	Restores previously deleted historical (sampling) data.

Table 10-5. **TABLE** and **GRAPH** buttons

Image	Name	Description
	Legend	Press and hold to display information for each channel's graph. There are two legends, one for each channel. Each legend has the following information: • Solid box: Line color and style for actual line count • x (next to solid box): Most recent value • Dashed box: Line color and style for moving average value • x (next to dashed box): Moving average value • Line: Alarm value that appears as a horizontal line across the graph • N μm: Particle size channel associated with above information
	Options	Opens general display options, which include the following: • Cumulative or differential counts • Raw or normalized counts • Units of volume • Linear, log, or % of full scaling • Size channel view/hide • Enable moving averages • Enable alarm limits
	Filter Options	Opens filter options, which include the following: • Operator • Date/time • Start/end row • Area • Room • Location
	Display	Enables graphical display with AUTO size fit.
Table 10-5. TABLE and GRAPH buttons		

Image	Name	Description
	Save as CSV File	Saves a series of sample data as a CSV or XML file to the USB key.
	Save to USB	Saves tables to a PDF file on the inserted USB key. Reports include the following (see Figure 10-9 on page 10-20)
	Print	Prints a series of sample data in a report to the thermal printer.

Table 10-5. TABLE and GRAPH buttons

Options

OPTIONS

DATA

☒ Σ

☐ Δ

☐ N

☒ N/ft³

☐ m³

☒ ft³

☐ ℓ

SCALE

☐ Percent of full scale

☒ Linear

☐ Log

CHANNELS

0.30

0.50

1.00

5.00

10.00

25.00

..

..

☐ Moving averages

Size

5

LIMITS

☐ Alarm

OK

CANCEL

Figure 10-9. Options dialog

Data

Allows the user to configure the units of their sampling data.

- **Cumulative(Σ):** Sets the data display to cumulative counts only.
- **Differential(Δ):** Sets the data display to differential counts only.
- **Raw(N):** Sets the data display as raw particle counts
- **N/volume:** Sets the data display as normalized. Volume units are set below this option.
- **Volume units:** Defined as either m³, ft³, or l.

Scale

- **Percent of full scale:** Displays the size channel's value as a percentage of the current maximum value. This option is disabled for the Historical Trend graph.
- **Linear:** Displays the size channel's value as a comparison to the linear maximum y-axis value. The value is located above each bar.
- **Log:** Displays the size channel's value as a comparison to the logarithmic maximum y-axis value. The value is located above each bar.

Channels

Allows the user to:

- Configure which configured size channels will be included in the display. Channels can be configured in the **CHANNELS** tab of the **SYSTEM** screen.
- Enable **Moving averages**, which is the sampling average displayed beside the graph. The **Size** field is the set number of samples (2-10) used to calculate the average.

Limits

Allows the user to adjust the display of configured particle alarm levels. These levels are configured in the **PARTICLES** tab of the **ALARMS** screen.

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Chapter 11

Statistics

Overview

The Lasair Pro particle counter can be configured for certification statistics when in Statistics Mode. A choice of certification standards includes ISO 14644-1:2015, FS-209E, EU GMP, China GMP, and AVERAGE.

Selecting the certification standard and class automatically sets the particle count limits for the sampling location. After configuring parameters such as the size of the room to be certified and its state (dynamic or static), enabling Statistics Mode opens a prompt window for the user to select their locations to sample. The user is automatically taken to the **HOME** screen to start the sampling process, where upon successful completion, a report can be generated.



21 CFR 11 Compliant 

Cleanroom Certification Report

Instrument ID: Lasair Pro
 Serial Number: XXXXX
 Calibrated: 11/7/2019

Batch ID:
 Operator:
 Area: Area X
 Room: Room X
 Recipe: -
 Certification Standard: ISO 14644-1:2015
 Standard Class: ISO 5

Particle Size (µm)	Limit
0.30	10,200
0.50	3,520
1.00	832
5.00	29

Certification Result: **PASSED**

Sampling Plan

	Min	Plan	Actual
Area (ft²)	0.0	1.0	1.0
Locations	1	1	1
Samples per Location	1	1	1
Total Samples	1	1	1
Volume (m³)	0.0900	0.0900	0.0900

Room State: Static

Particle Data

	µm	N/m³
TARGET	0.30	10200.0
Max	0.30	2.9
Mean	0.30	2.9
SD	0.30	1.0

Figure 11-1. Example Cleanroom Certification Report

HOME Screen

In Statistics Mode, the **HOME** screen and its data displays are adjusted to include the standard, limits, and locations configured on the **STATISTICS** screen. Refer to **Figure 3-2** on page 3-5 for the details not described in **Figure 11-2**.

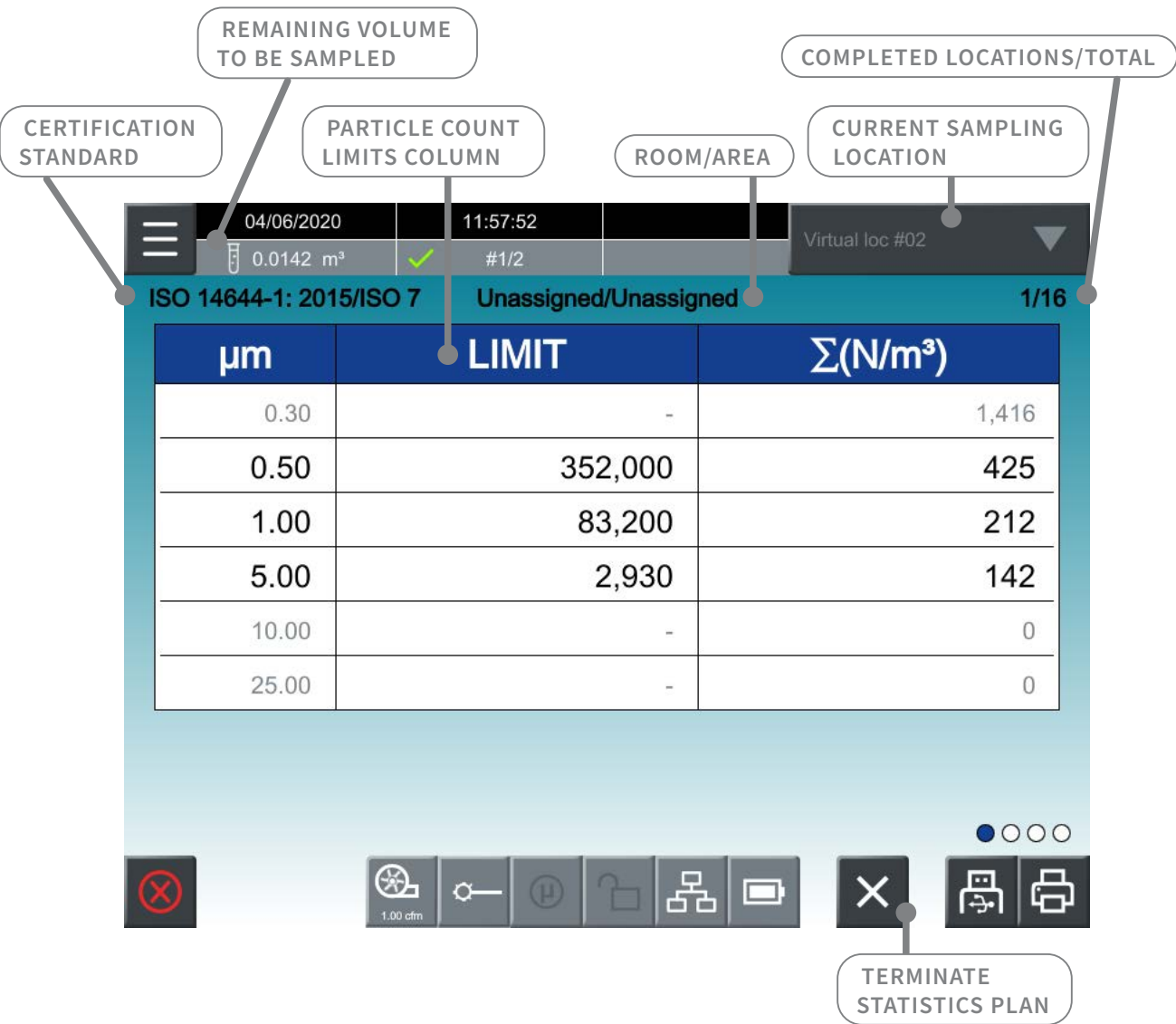


Figure 11-2. HOME screen, Statistics Mode

SCAN OR CLICK to
Download a Paper about
ISO Certification of Cleanrooms



Data Displays

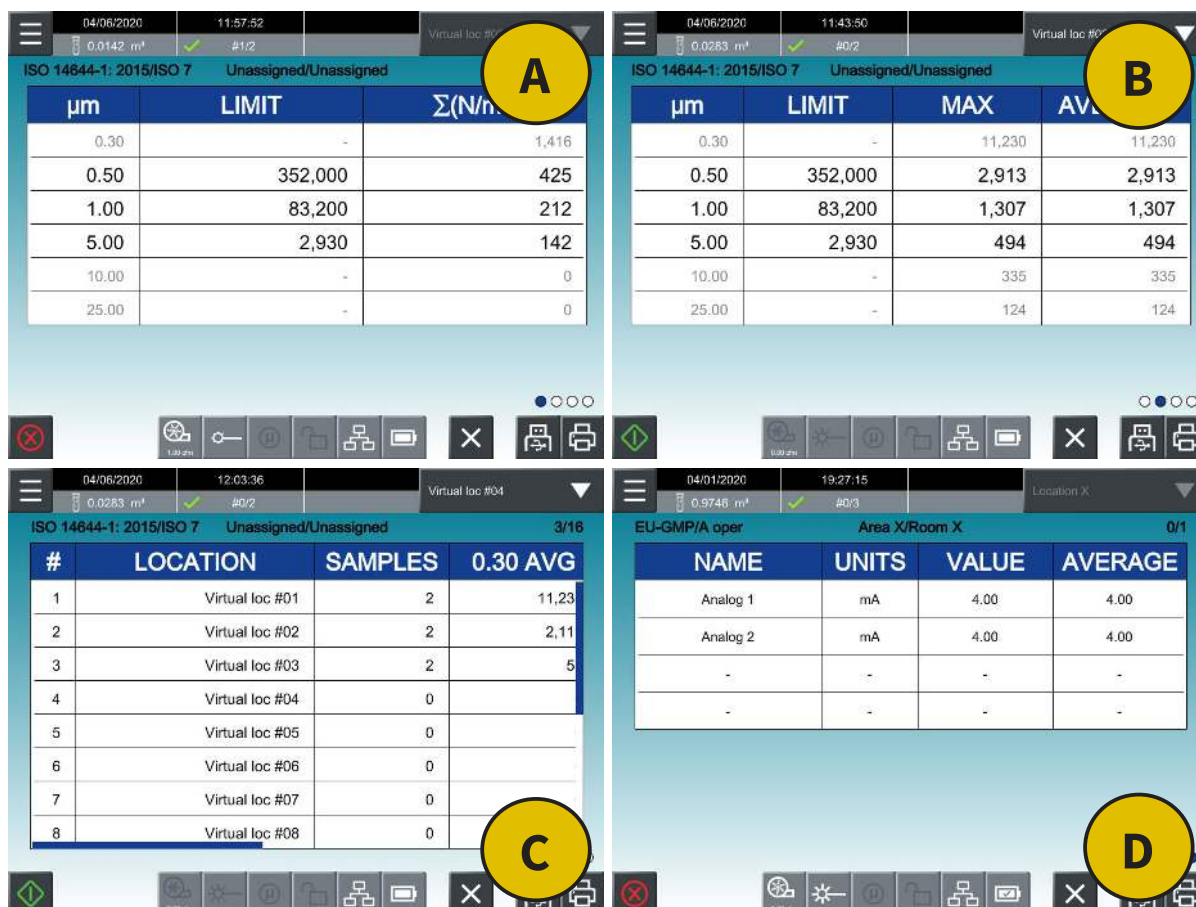


Figure 11-3. Swipe left to switch between displays

In Statistics Mode, the following data displays are available on the **HOME** screen:

- **A. Cumulative particle count display:** For each channel size, the table displays the particle count limit to meet the standard, and the cumulative particle count for the current volume sampled at the location.
- **B. Maximum and Average counts display:** For each channel size, the table displays the maximum and average cumulative particle count recorded for all locations.
- **C. Completed sampling data by location:** Displays all completed sampling data for each location and each particle size, including those not enabled for the statistics plan. Scrollbars on the right side and bottom of the table allow the entire table to be shown.
- **D. Environmental (analog) input channel display:** Displays environmental sensor readings while Statistics Mode is running. See **Environmental (Analog) Input** on page 4-6 for more information.

NOTE: All particle count data is normalized, meaning it has been divided by the sample volume.

NOTE: When the Statistics Mode is enabled, TCP/IP communications are disabled.

NOTE: When Statistics Mode is enabled, global alarms are automatically disabled. You must exit Statistics Mode to change alarm parameters.

Average Mode

Average mode calculates simple statistics on data from one or more locations.

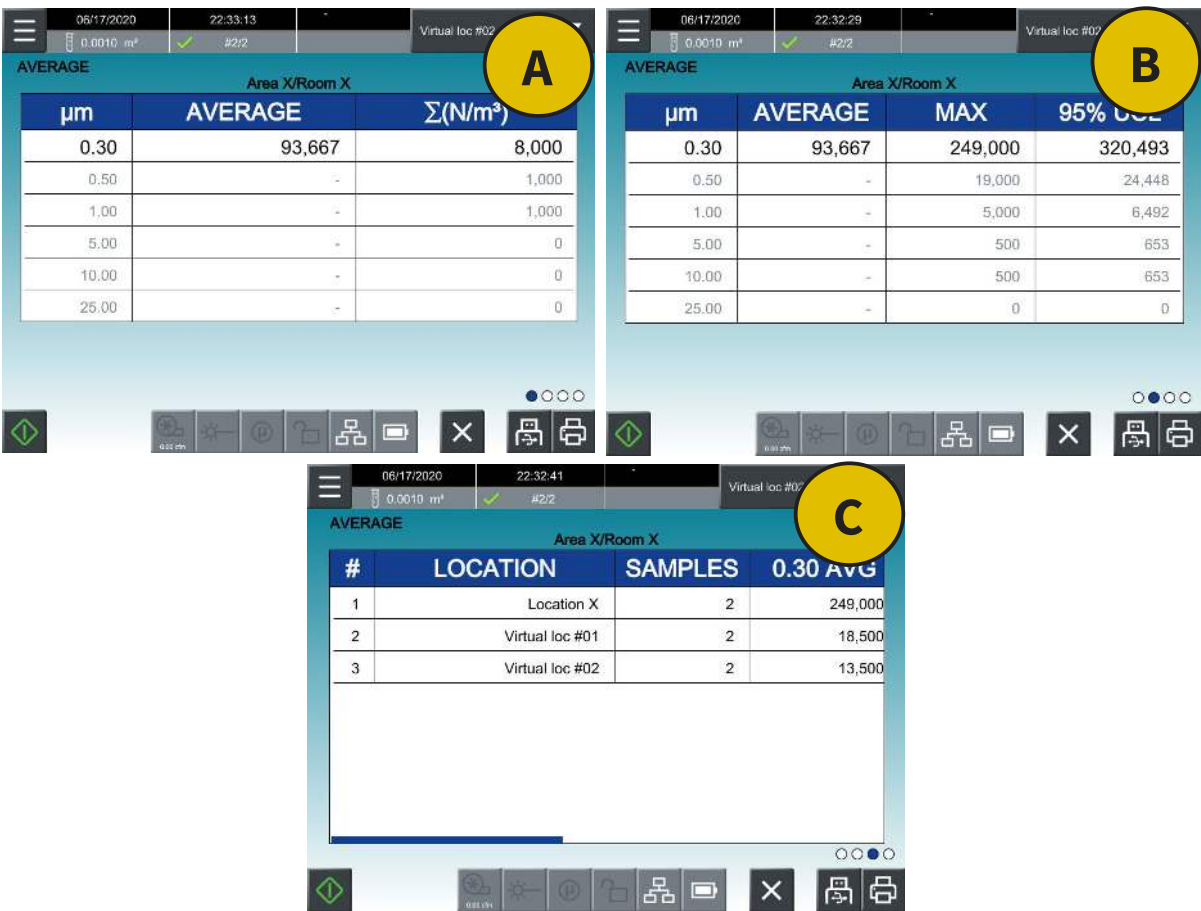


Figure 11-4. HOME screen displays for Average mode

Figure 11-4 shows the following adjustments to the **HOME** screen:

- **A. Average and cumulative normalized counts:** Average values refer to the mean particle count data for all samples across all locations, directly comparable to cumulative normalized counts (counts of a certain particle size and larger over the configured sample volume) for all locations.
- **B. Average, maximum, and 95% UCL statistics:** Average values refer to the mean particle count data for all samples across all locations, directly comparable to the maximum particle size count of all samples, and the 95% Upper Confidence Limit, a more conservative value indicating how many particles or less of a certain size are found within the tested locations with 95% certainty.

NOTE: 95% UCL will only be calculated for the FS209E standard with sample numbers configured as ≥ 2 and ≤ 9 . The “Average” shall be used otherwise.

- **C. Average particle counts by size and location:** Organizes data into tabular format by location and the average count for each particle size. Swipe right and left to view the table in its entirety.

Results

You can print or save a classification report similar in scope to the other standard options

by pressing either  or  on the bottom-left of display **B** or **C** of the **HOME**

screen (see **Figure 11-4**). An example is provided in **Figure 11-5**.



PARTICLE MEASURING SYSTEMS®
a Sigmet Technologies company

21 CFR 11 Compliant 

Cleanroom Certification Report

Instrument ID: Lasair Pro
 Serial Number: XXXXX
 Calibrated: 11/7/2019

Batch ID:
 Operator:
 Area: Area X
 Room: Room X
 Recipe: -
 Certification Standard: Average
 Standard Class: 1

Particle Size (µm)	Limit
0.30	-
0.50	-
1.00	-
5.00	-
10.00	-
25.00	-

Certification Result: **PASSED**

Sampling Plan

	Min	Plan	Actual
Area (m²)	0.0	50.0	50.0
Locations	1	15	15
Samples per Location	1	3	3
Total Samples	1	45	45
Volume (m³)	0.0005	0.0005	0.0005

Particle Data

	µm	N/m³
Mean	0.30	2037999.9
Max	0.30	26875998.0
SD	0.30	1.0
95% UCL	0.30	-

Figure 11-5. Average mode report, first page

Data unique to this report include the following:

- Average particle count of a certain size for all samples (Mean), maximum particle count of all samples for a certain particle size (Max), how different each sample differs from the mean of all samples or standard deviation (SD), and 95% upper confidence limit (95% UCL) for each particle size.
- Average cumulative normalized counts for each particle size at each location. Units are either Avg(N/m³) or Avg(N/ft³).

Switch Mode

After enabling Statistics Mode, the user is prompted for a selection of locations. Previously created areas, rooms, and locations can be selected here, in addition to virtual locations. Virtual locations are not stored for later use in the Lasair Pro, but are generated specifically for one-time use after Statistics Mode is enabled. They are labeled as “Virtual loc #01” and so on in sampling data and reports.

SWITCH MODE

Area
Area X
Location(s) required: 16

Room
Room X

Location(s) selected: 0
Location X

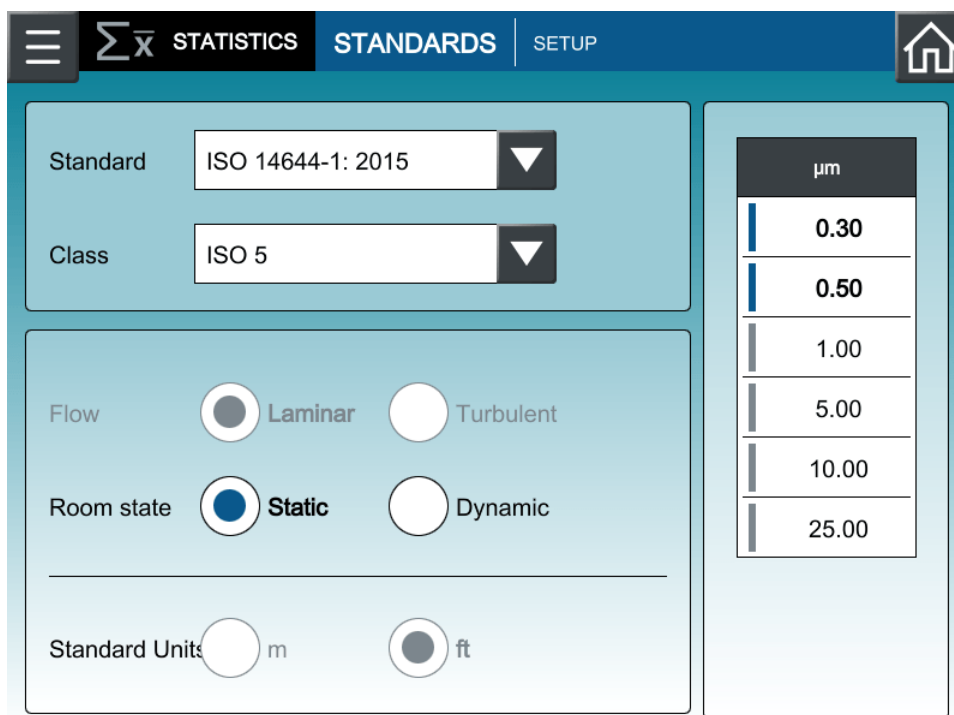
Virtual location(s): 16

☒ Add virtual

OK CANCEL

Figure 11-6. Virtual locations in Statistics Mode

STANDARDS Tab



The screenshot shows the 'STANDARDS' tab within a software interface. At the top, there are tabs for 'STATISTICS', 'STANDARDS', and 'SETUP'. The 'STANDARDS' tab is active. Below the tabs, there are several configuration options:

- Standard:** A dropdown menu set to 'ISO 14644-1: 2015'.
- Class:** A dropdown menu set to 'ISO 5'.
- Flow:** Two radio buttons: 'Laminar' (selected) and 'Turbulent'.
- Room state:** Two radio buttons: 'Static' (selected) and 'Dynamic'.
- Standard Units:** Two radio buttons: 'm' and 'ft' (selected).
- Particle Size Channels:** A list of particle sizes in micrometers (μm): 0.30, 0.50, 1.00, 5.00, 10.00, and 25.00. Each size has a corresponding vertical bar indicating its status.

Figure 11-7. STANDARDS tab, STATISTICS

The following configurations can be made on the **STANDARDS** tab:

- **Standard:** Set the cleanliness standard to determine the particle count limits for an area.
- **Class:** Set the cleanliness level of the area to be certified.
- **Flow:** Set the room's airflow conditions to laminar or turbulent. Only available when using the FS-209E standard.
- **Room state:** Set the **Class** options to pertain to **Static** (At rest) or **Dynamic** (In operation) conditions.
- **Standard Units:** Set the units to meters (m) or feet (ft).
- **μm:** Enable or disable particle size channels.

SETUP Tab

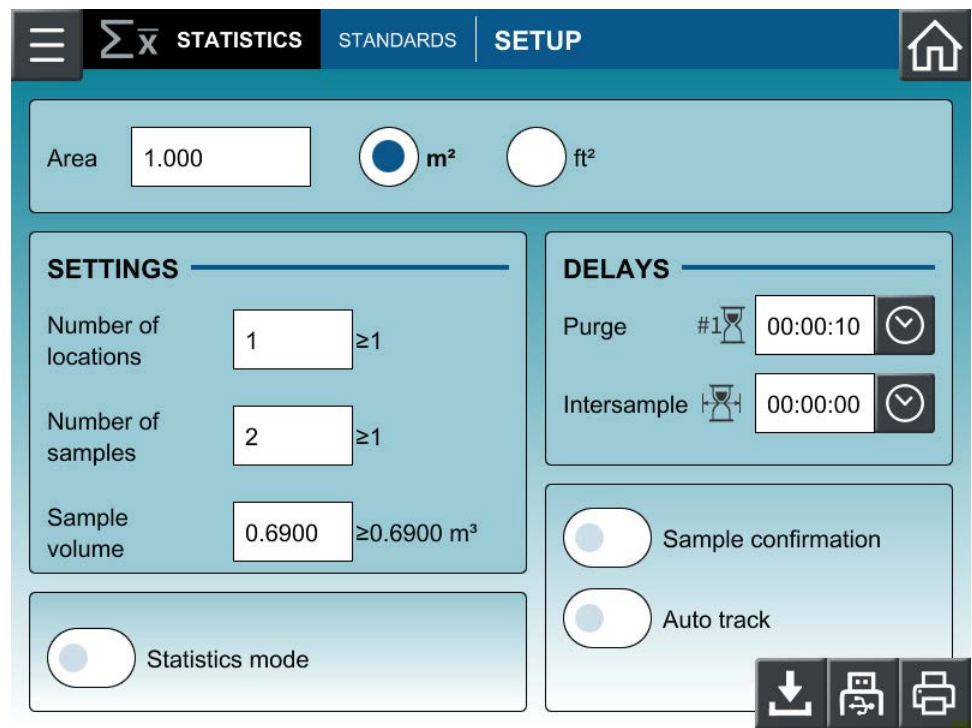


Figure 11-8. SETUP tab, STATISTICS

Configuration Settings

The following table describes the settings the users can configure before enabling Statistics Mode. Once Statistics Mode is enabled, settings cannot be changed until the Statistics plan has been terminated.

Image	Name	Description
	Area	Sets the area of the room to be certified in m² or ft². You cannot change this parameter once Statistics Mode is enabled.
	m²	Sets the Area units in squared meters. Units cannot be changed once Statistics Mode is enabled.

Table 11-1. SETUP tab, STATISTICS

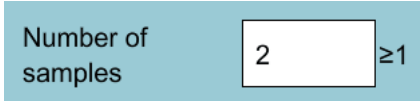
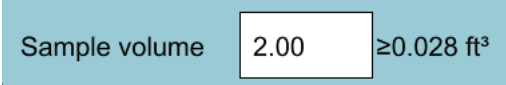
Image	Name	Description
	ft²	Sets the Area units in squared feet. Units cannot be changed once Statistics Mode is enabled.
SETTINGS		
	Number of Locations	Sets the minimum number of the locations to be sampled. The number is automatically calculated to comply with the selected standard based on the Area setting. The number can be increased but not decreased.
	Number of Samples	Sets the number of samples to be taken at each location.
	Sample Volume	Sets the minimum sample volume collected at each location.
DELAYS		
	Purge	Initial delay before the start of sampling.
	Intersample	Delay between samples if Number of samples is greater than one.
Table 11-1. SETUP tab, STATISTICS		

Image	Name	Description
ENABLE / DISABLE OPTIONS		
	Enable Statistics Mode	Enables Statistics Mode. When enabled, the user is prompted to select the area, room, and location for certification. After pressing OK , the HOME screen automatically appears with statistics sampling criteria loaded. Terminating the Statistics plan from the HOME screen automatically disables Statistics Mode.
	Enable Sample Confirmation	Enables a prompt for either accepting or rejecting the previously completed sample. Rejecting the sample will prevent the use of associated data in statistical calculations.
	Auto Track	Enables the incremental selection of sampling locations on the HOME screen without user prompt.
BUTTONS		
	Save Statistics Recipe	Saves the current Statistics Mode configuration as a recipe.
	Save to USB	Saves the Certification Setup Report to the inserted USB key.
	Print to Thermal Printer	Prints the Certification Setup Report to the thermal printer.
Table 11-1. SETUP tab, STATISTICS		

Example Certification Setup Report



**PARTICLE
MEASURING
SYSTEMS®**
a specTris company

21 CFR 11 Compliant 

Certification Setup Report

Instrument ID:	Lasair Pro
Serial Number:	XXXXX
Calibrated:	11/7/2019

Batch ID:	
Operator:	Admin
Recipe:	

Certification Standard

Standard:	ISO 14644-1: 2015
Class:	ISO 2
Flow:	Laminar
Room State:	Static
Standard Units:	m

Particle Sizes:	0.50 µm
-----------------	---------

Sampling Plan

Area:	5000.000 m²
Number of Locations:	26
Number of Samples:	2
Total Samples:	52
Sample Volume:	2.0000 m³

Delays

Purge:	00:00:10
Intersample:	00:00:00

Options

Auto Track:	No
Sample Confirmation:	No

Figure 11-9. Certification Setup Report example

The Certification Setup Report displays the current parameters of the **STANDARDS** and **SETUP** tabs of the **STATISTICS** screen.

Walkthrough

This section describes the general step-by-step process of conducting a statistics plan. The following is an example only.

1. Press  and then  (**STATISTICS**).
2. Configure the **STANDARDS** and **SETUP** tabs. In this example, we will be using the ISO 14644-1:2015 standard for ISO Class 7. The **Area** of the room to be sampled is 1000 m³.
3. After settings are configured, press the **Statistics mode** slider button to enable Statistics Mode. Note that once this button is pressed, all parameters in the **STANDARDS** tab cannot be changed. On the **SETUP** tab, the **Area** and units cannot be changed.
4. In the **Switch Mode** window, select the locations to be included in the statistics plan. You can leave the area, room, and location unassigned, but the **Number of Locations** selection made on the **SETUP** tab must match the number of location selections in this window.

NOTE: Independent of user-defined locations, there is the option to use virtual locations that are automatically generated for use with the statistics plan. The number generated is dependent on the **Number of Locations** field on the **SETUP** tab. Selecting user-defined locations subtracts from this number.

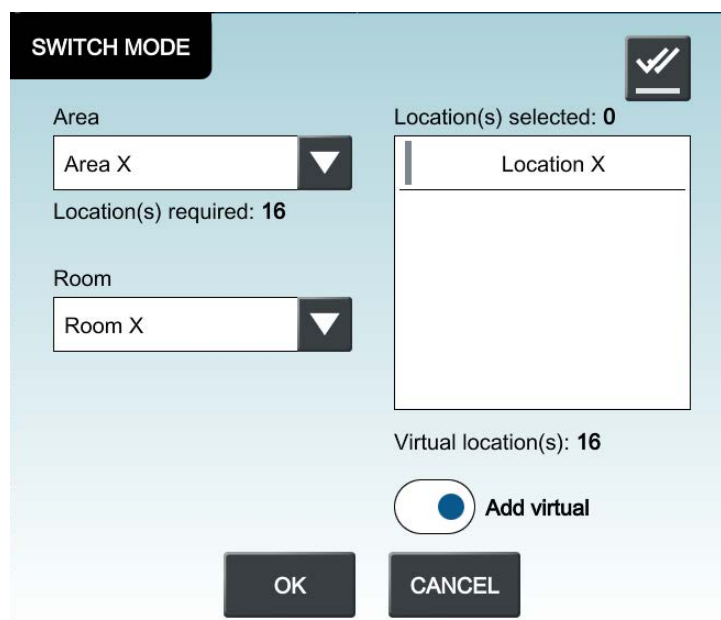


Figure 11-10. Switch Mode window, virtual locations added

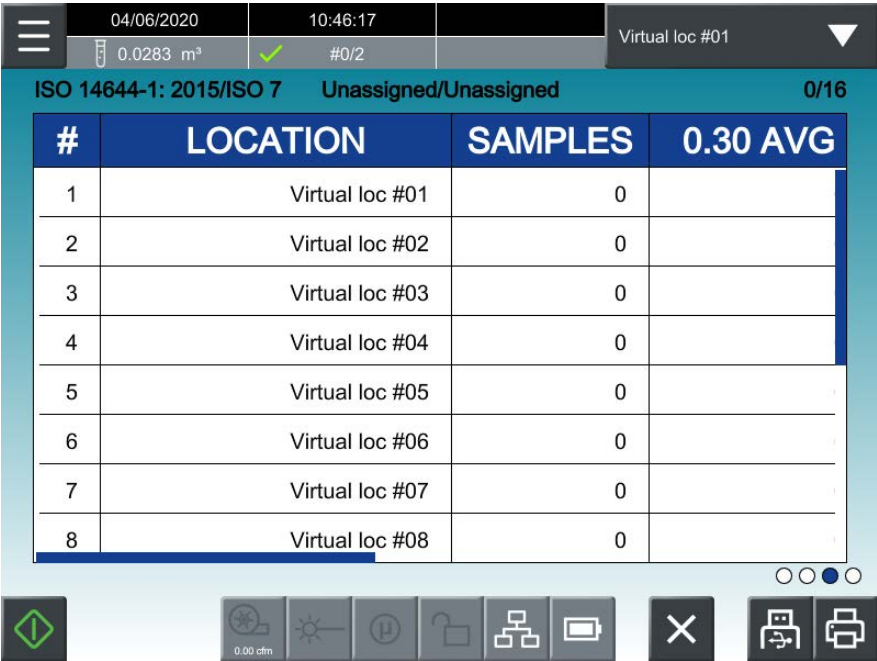


Figure 11-11. Automatic list of virtual locations, **HOME** screen

- 5. Press **OK** when done. You will be automatically taken to the **HOME** screen.
- 6. When ready, press the  button to begin sampling.
- 7. After the sample has completed, you will see either of the following messages. If you did not enable Sample Confirmation, you will see **Figure 11-12**. If you enabled Sample Confirmation, you will see **Figure 11-13**.

NOTE: If you choose to reject the sample data, it will not be used in the final report. You will be prompted to start the next sample in the series.

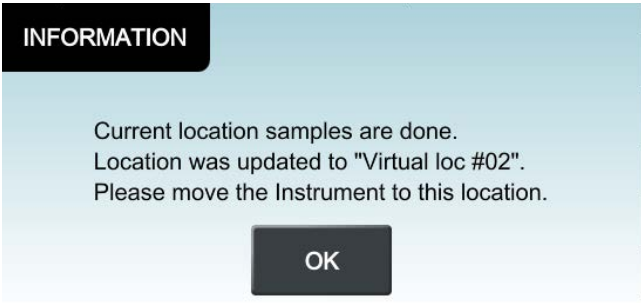


Figure 11-12. Statistics sample complete

SAMPLE ACKNOWLEDGMENT

Do you wish to acknowledge sample with data?

μm	$\Sigma(\text{N}/\text{m}^3)$	LIMIT
0.30	22,460	-
0.50	5,827	352,000
1.00	2,613	83,200
5.00	989	2,930
10.00	671	-
25.00	247	-

ACCEPT REJECT

Figure 11-13. Sample Confirmation/Acknowledgement window

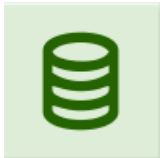
8. After sampling is complete, you will receive the following message.

INFORMATION

All locations were sampled.
Plan completed

OK

Figure 11-14. Statistics plan complete message

9. To save and view the report data, you have the following options:
- Swipe left across the touchscreen to view all the data displays.
 - Press  to save all data as a PDF file on the inserted USB key.
 - Press  to print all data to the thermal printer.
 - Go to  (**DATA**) to view individual sampling data. Double tap on a row in the **TABLE** tab for more details.

Statistics Report Example

The following is an example of the Lasair Pro particle counter's Statistics Report generated when a room is certified to the ISO 14644-1 standard. The lines have been numbered to match the accompanying table containing their descriptions.

	 21 CFR Part 11 Compliant 																									
1	Cleanroom Certification Report																									
2	Heading 1																									
3	Heading 2																									
4	Instrument ID:	Lasair Pro																								
5	Serial Number:	XXXXX																								
6	Calibrated:	01/01/2020																								
7	Batch ID:	00021																								
8	Operator:	John Doe																								
9	Area:	Fill Point																								
10	Room:	1416A																								
11	Location:	X																								
12	Recipe:	Recipe Name																								
13	Started:	04/01/2020 09:00:00																								
14	Finished:	04/01/2020 09:30:35																								
15	Certification Standard:	ISO 14644-1: 2015																								
16	Standard Class:	ISO 5																								
17	Particle Size (μm)	Limit																								
18	0.3	10,200																								
18	0.5	3,520																								
18	1.0	832																								
18	5.0	29																								
19	Certification Result <u>PASSED</u>																									
20	Sampling Plan																									
21		<table border="1" style="width: 100%;"> <tr> <th></th> <th>Min</th> <th>Plan</th> <th>Actual</th> </tr> <tr> <td>22 Area (ft^2)</td> <td>0.0</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>23 Locations</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>24 Samples per Location</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>25 Total Samples</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>26 Volume (m^3)</td> <td>0.6900</td> <td>0.6900</td> <td>0.6900</td> </tr> </table>		Min	Plan	Actual	22 Area (ft^2)	0.0	1.0	1.0	23 Locations	1	1	1	24 Samples per Location	1	1	1	25 Total Samples	1	1	1	26 Volume (m^3)	0.6900	0.6900	0.6900
	Min	Plan	Actual																							
22 Area (ft^2)	0.0	1.0	1.0																							
23 Locations	1	1	1																							
24 Samples per Location	1	1	1																							
25 Total Samples	1	1	1																							
26 Volume (m^3)	0.6900	0.6900	0.6900																							
27	Room State:	Static																								

28	Particle Data			
29		μm	N/m³	
30	TARGET	0.30	10200.0	
31	Max	0.30	2.9	
32	Mean	0.30	2.9	
34	Location Averages			
35	Location	#	μm	Avg(N/m³)
36	Location X	1	0.30	3
36	Location X	1	0.50	1
36	Location X	1	1.00	1
36	Location X	1	5.00	0
36	Location X	1	10.00	0
36	Location X	1	25.00	0
37	Deleted Samples: 0			

Figure 11-15. Example statistics sampling report

Line No.	Displayed Text	Description
1	Cleanroom Certification Report	Title of report.
2	Heading One	Heading 1 text specified in the REPORTS tab of the DISPLAY screen. Not shown if Heading One field is blank.
3	Heading Two	Heading 2 text specified in the REPORTS tab of the DISPLAY screen. Not shown if Heading One field is blank.
4	Instrument ID	Name/ID of the particle counter that produced the data.
5	Serial Number	Serial number of the particle counter that produced the data.
6	Calibrated	Date on which the particle counter was last calibrated.
7	Batch ID	Batch ID text specified in the REPORTS tab of the DISPLAY screen. Not shown if Heading One field is blank.
8	Operator	Operator text specified in the REPORTS tab of the DISPLAY screen. Not shown if Heading One field is blank.
Table 11-2. Statistics Printout legend		

Line No.	Displayed Text	Description
9	Area	Area where the sampling was performed. See Chapter 8 for area configuration.
10	Room	Room where the sampling was performed. See Chapter 8 for area configuration.
11	Location	Location where the sampling was performed. See Chapter 8 for location configuration.
12	Recipe	Name of the recipe used, if any. See Chapter 9 for recipe configuration.
13	Started: 04/01/2020 09:00:00	Date stamp (day / month / year) followed by a time stamp (hour : minute : second) when the statistics sample was started.
14	Finished: 04/01/2020 09:30:35	Date stamp (day / month / year) followed by a time stamp (hour : minute : second) when the sample ended.
15	Certification Standard	The certification standard chosen. Possible values: • FS-209E • EU-GMP: 2015 • ISO 14644: 2015 • Average • EUGMP: 2022
16	Standard Class	The classification the room is being tested against. The Standard Class determines the particle limits to meet classification.
17	Particle Size & Limits	Refers to the column headers for particle sizes of interest and their limits to meet classification.
18	0.3 10200	Lists particle sizes and their classification limits.
19	Certification Results	Results of certification. Possible values: • PASSED: Sampling met certification standards. • FAILED: Sampling did not meet certification standards. • INCOMPLETE: Sampling was not completed.
20	Sampling Plan	Header for sampling plan that follows.
Table 11-2. Statistics Printout legend		

Line No.	Displayed Text	Description
21	Min Plan Actual	Number of samples to be taken. • Min: Minimum number of samples to be taken • Plan: Number of samples planned to be taken • Actual: Actual number of samples taken.
22	Area	The area of cleanroom being certified.
23	Locations	The number of locations to be sampled. For column definitions, see line 21 above.
24	Samples per Locations	Number of samples taken at each location. For column definitions, see line 21 above.
25	Total Samples	Total number of samples taken.
26	Volume	Minimum volume to be sampled.
27	Room State	Refers to the option chosen in the STANDARDS tab of the STATISTICS screen before enabling Statistics Mode.
28	Particle Data	Header for the particle data that follows.
29	μm (N/m ³)	Column headers: • μm: Particle size in microns. • N/m³: Normalized particle counts per cubic meter.
30	TARGET	The particle size of interest. For column definitions, see line 29 above.
31	Max	The maximum value of the samples averaged.
32	Mean	Mean of all locations. For column definitions, see line 29 above.
34	Location Averages	Header for the location data that follows.
35	Location # μm Avg(N/m ³)	Column headers for data that follows. • Location – Location of sample • # – Number of samples taken at location. • μm – Particle size sampled. • Avg(N/m³) – Average number of particles detected and normalized per cubic meter.
36	Location X 1 0.3 3	Summary of sample at each location for the particle size chosen. For column definitions, see line 35 above.
37	Deleted Samples	Number of samples removed from statistical summary.
Table 11-2. Statistics Printout legend		

Cleanliness Standards

The standards tables in this section are reproductions of those found in their respective documents, and are supported by the Lasair Pro particle counter. The blank areas of the tables represent invalid settings. For example, the ISO 14644-1 standard does not allow certification of a Class 1 cleanroom using a 0.3 μm or greater particle size.

ISO 14644-1:2015 Standard

The particle limits shown in **Table 11-3** are cumulative counts, meaning they include all particles of a certain size and larger. For example, for particle sizes in the range of 0.5 μm to 5.0 μm , there can be no more than 3,520 particles counted to meet ISO 5 certification standards. Note that 0.1 and 0.2 μm particle sizes are not counted with the Lasair Pro.

Class	0.1 μm	0.2 μm	0.3 μm	0.5 μm	1.0 μm	5.0 μm
ISO 1	10					
ISO 1.5	32					
ISO 2	100	24	10			
ISO 2.5	316	75	32			
ISO 3	1,000	237	102	35		
ISO 3.5	3,160	748	322	111		
ISO 4	10,000	2,370	1,020	352	83	
ISO 4.5	31,600	7,480	3,220	1,110	263	
ISO 5	100,000	23,700	10,200	3,520	832	29*
ISO 5.5	316,000	74,800	32,200	11,100	2,630	
ISO 6	1,000,000	237,000	102,000	35,200	8,320	293
ISO 6.5	3,160,000	748,000	322,000	111,000	26,300	924
ISO 7				352,000	83,200	2,930
ISO 7.5				1,110,000	263,000	9,240
ISO 8				3,520,000	832,000	29,300
ISO 8.5				11,100,000	2,630,000	92,400
ISO 9				35,200,000	8,320,000	293,000
*ISO 5 at 5 μm requires a smaller particle size to be used.						
Table 11-3. ISO 14644-1:2015 Standard Class Details						

EU GMP Annex 1 Standard and China GMP

As a derivative of the ISO standard, the EU GMP Annex 1 standard uses most of the ISO rules. However, a comparison of maximum particle counts between the two standards shows that the EU GMP Annex 1 is slightly different. The minimum sample volume is also different between the two standards. For Grade A, the sample volume is a minimum of 1 m³ for each location of all samples taken.

Table 11-4 shows EU GMP Annex 1 and corresponding ISO classes. **Table 11-5** are the cumulative particle concentration limits for the EU GMP Annex 1 standard. The China GMP uses the same limits.

EU GMP Annex 1 Grade	At Rest (Static)	In Operation (Dynamic)
A	ISO 5	ISO 5
B	ISO 5	ISO 7
C	ISO 5	ISO 8
D	ISO 8	N/A
Table 11-4. EU GMP Grade and ISO classes		

Maximum Particles per m ³				
	At Rest		In Operation	
Grade	0.5 µm	5.0 µm	0.5 µm	5.0 µm
A	3,520	Not Specified ^(a)	3,520	Not Specified ^(a)
B	3,520	Not Specified ^(a)	352,000	2,930
C	352,000	2,930	3,520,000	29,300
D	3,520,000	29,300	Not Predetermined ^(b)	Not Predetermined ^(b)
Table 11-5. Maximum Limits for Total Particles				

^(a) Classification including 5µm particles may be considered where indicated by the CCS or historical trends.

^(b) For grade D, in operation limits are not predetermined. The manufacturer should establish in operation limits based on a risk assessment and routine data where applicable.

FS-209E Standard

ISO 14644-1 is used in place of the FS-209E standard globally, but the Lasair Pro particle counter still implements the classes specified in **Table 11-6**. Note that 0.1 and 0.2 μm particle sizes are not counted with the Lasair Pro.

Maximum Particles Per Unit Volume											
Class		0.1 μm		0.2 μm		0.3 μm		0.5 μm		5.0 μm	
SI	English	m^3	ft^3	m^3	ft^3	m^3	ft^3	m^3	ft^3	m^3	ft^3
M1		350		75.7		30.9		10.0			
M1.5	1	1,240	35.0	265	7.50	106	3.00	35.3	1.00		
M2		3,500		757		309		100			
M2.5	10	12,400	350	2,650	75.0	1,060	30.0	353	10.0		
M3		35,000		7,570		3,090		1,000			
M3.5	100			26,500	750	10,600	300	3,530	100		
M4				75,700		30,900		10,000			
M4.5	1,000							35,300	1,000	247	7.00
M5								100,000		618	
M5.5	10,000							353,000	10,000	2,470	70.0
M6								1,000,000		6,180	
M6.5	100,000							3,350,000	100,000	24,700	700
M7								10,000,000		61,800	

Table 11-6. Maximum Particles Per Unit Volume

Chapter 12

System Configuration

Use **SYSTEM** to set general system options such as the instrument ID, calibration warning, language, date format, channel size, and sampling medium. You can also view the status of the instrument, including firmware version, the last calibration date, laser and pump information, and battery life.

To view the status and configure system settings, go to  >  (**SYSTEM**).

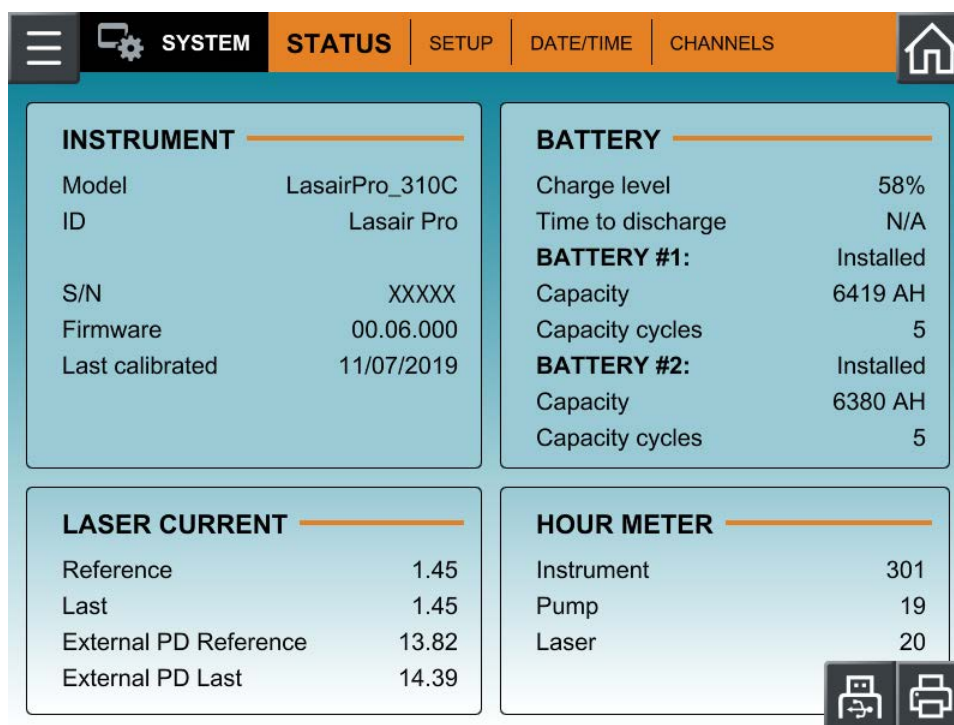


Figure 12-1. STATUS tab, SYSTEM

Press  or  to generate the Instrument Status Report, which summarizes the information of the **STATUS** tab of the **SYSTEM** screen.

SETUP Tab

The screenshot displays the 'SETUP' tab within the 'SYSTEM' configuration menu. The top navigation bar includes 'SYSTEM', 'STATUS', 'SETUP', 'DATE/TIME', and 'CHANNELS'. The 'SETUP' tab is active, showing two main sections: 'SETTINGS' and 'LANGUAGE'.

SETTINGS

- Instrument ID**: A text field containing 'Lasair Pro'.
- Calibration warning**: A toggle switch is turned on. Below it are two radio buttons for '6 months' and '12 months'.
- MEDIUM**: A section header for the 'Gas' dropdown menu, which is currently set to 'Air'.

LANGUAGE

- Interface**: A dropdown menu currently set to 'English'.
- Input**: A list of languages: English, Français, Italiano, Español, Deutsch, and Português.

At the bottom left, there are icons for saving, loading, and deleting settings. At the bottom right, there is a gear icon for further configuration.

Figure 12-2. SETUP tab, SYSTEM

Instrument ID

Press inside the field to open the keyboard to personalize the particle counter identification. The character limit is 16. This text appears on sampling and audit reports.

Calibration Warning

Enable the calibration warning to display when a calibration is due every six months or twelve months. Also enables a warning message when calibration is past due. If a calibration is due, the warning message will appear every time the Lasair Pro is turned on.



**Scan or click for a Quick Demo Video
about Initial Setup of the Instrument**
(Units, Date/Time, Language, Channels, NTP, etc.)

Gas

Allows the user to set the gas medium, which is associated with an unchangeable specific density in kg/m³. Choices of gas include:

- Air (1.205 kg/m³)
- CO₂ (1.842 kg/m³)
- Argon (1.661 kg/m³)
- Nitrogen (1.165 kg/m³)

Language

The Lasair Pro interface supports several international languages:

- | | |
|--------------------------|----------------------|
| • English | • Russian (Русский) |
| • French (Français) | • Chinese CHT (繁體中文) |
| • Italian (Italiano) | • Chinese CHS (简体中文) |
| • German (Deutsch) | • Japanese (日本語) |
| • Portuguese (Português) | |

This language setting affects field names, prompts, and user messages. Data remains in English. Choose the desired language from the dropdown menu to adjust the display language.

Keyboard Inputs

Press the desired keyboard languages to activate (orange)  or deactivate (gray)  them for use. The user can switch between keyboards while typing (see **Figure 12-3**).

CSV Exporting for Non-Standard Characters

If the CSV file contains accented, Asian or any other non-standard characters, it may not be read by programs such as Microsoft Excel with the proper encoding. To ensure your CSV files are encoded properly:

1. Open a blank workbook in Excel.
2. On the **Data** tab, select **Get Data** → **From File** → **From Text/CSV**.
3. Choose the CSV file to import. A pop-up window will open.
4. Set the **File Origin** to **Unicode (UTF-8)**.



Figure 12-3. Change to another language keyboard

NOTE: Some symbols are shown in the top-left of the numeric character buttons. Press and hold until the field is populated with the symbol.

NOTE: Some keyboard letters only display when the user holds down their finger against a displayed letter for 2 - 3 seconds. See **Figure 12-4**.



Figure 12-4. Press and hold the ‘s’ letter on the DE keyboard for more options

Other examples of additional letters not shown in the keyboards main display include the following:

	Press and hold...	...to generate this list of characters.
FR	‘a’	à, á, â, ã, ä, å, æ, ā, a
	‘e’	è, é, ê, ë, ē, è, e
	‘y’	ÿ
	‘u’	ù, ú, û, ū, ü
	‘i’	ì, í, î, ï, ī, i
	‘o’	ò, ó, ô, õ, ö, ø, œ, o
	‘c’	ç, č, c
	‘n’	ñ, ñ

	Press and hold...	...to generate this list of characters.
IT	'e'	è, é, ê, ë, ē, è, e
	'u'	ù, ú, û, ū, ü
	'i'	ì, í, î, ï, ī, i
	'o'	ò, ó, ô, õ, ö, ø, œ, o
	'a'	à, á, â, ã, ä, å, æ, ā, a
	's'	ß, ś, š
	'c'	ç, č, c
ES	'e'	è, é, ê, ë, ē, è, e
	'u'	ù, ú, û, ū, ü
	'i'	ì, í, î, ï, ī, i
	'o'	ò, ó, ô, õ, ö, ø, œ, o
	'a'	à, á, â, ã, ä, å, æ, a, ā, a
	's'	š
	'd'	đ
	'c'	ç, č, c
	'n'	ñ
DE	'e'	è, é, ê, ë, è
	'u'	ù, ú, û, ū
	'i'	ì, í, î, ī, i
	'o'	ò, ó, ô, õ, ö, ø, ō, œ
	'a'	à, á, â, ã, ä, å, æ, ā
	's'	ß, ś, š
	'y'	ÿ
	'c'	ç, č, c
	'n'	ñ, ñ
PT	'e'	è, é, ê, ë, ē, è, e
	'u'	ù, ú, û, ū, ü
	'i'	ì, í, î, ï, ī, i
	'o'	ò, ó, ô, õ, ö, ø, ō, œ, o
	'a'	à, á, â, ã, ä, å, æ, a
	'c'	ç, č, c
	'n'	ñ

	Press and hold...	...to generate this list of characters.
PL	'e'	è, é, ê, ë, ē, è, ẹ
	'o'	ò, ó, ô, õ, ö, ø, ō, œ
	'a'	à, á, â, ã, ä, å, æ, ā, ą
	's'	ß, ś, š
	'l'	ł
	'z'	ž, ž, ž
	'c'	ç, č, ć
	'n'	ñ, ñ
RU	'e'	ë
	'b'	б
KR	'ㅏ'	ㅏ
	'ㅑ'	ㅑ
	'ㅓ'	ㅓ
	'ㅕ'	ㅕ
	'ㅗ'	ㅗ
	'ㅛ'	ㅛ

NOTE: The **CHT**, **CHS** and **JP** options use Input Method Editors (IMEs) to generate text for selection beneath the input field.

NOTE: If using the **JP** keyboard, the  icon beside the IME text area may be used to switch between hiragana, katakana, and roman characters.

Clone Export and Import

The Lasair Pro system and data can be cloned and copied to another Lasair Pro instrument. Settings in the clone file include:

- All **SYSTEM** screen parameters
- All **SAMPLE** screen parameters
- All **STATISTICS** screen parameters
- All **SECURITY** screen parameters (including all user data)
- All **COMM** screen parameters
- IP addresses (selectable with Comm Settings)
- Area, Room, Locations and assignments
- Recipes
- All **IN/OUT** screen parameters
- All **DISPLAY** screen parameters
- All **DATA** screen parameters
- Clone file encryption

1. Press  (**SYSTEM**).

2. Go to the **SETUP** tab.

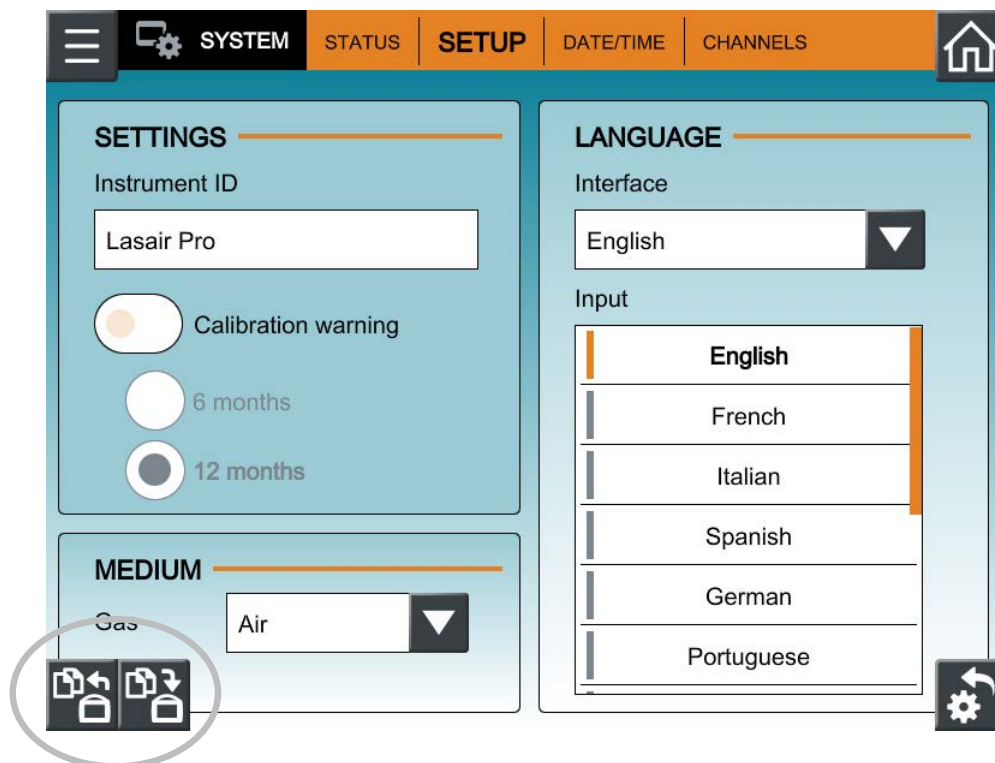


Figure 12-5. Clone Export and Import buttons, SETUP tab, SYSTEM

3. Press either of the following buttons:

	Clone Export	Exports a file to the attached USB with selected parameters. You may choose to encrypt the file.
	Clone Import	Imports previously exported files using the Clone Export button.

- a. Choosing **Clone Export** opens the following window.

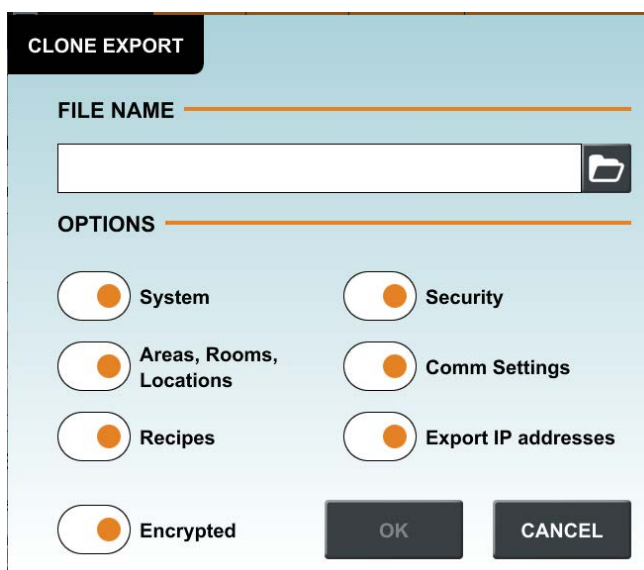


Figure 12-6. Clone Export window

- i. Press inside the **File Name** field to open the keyboard, or press  to select a file to overwrite.
- ii. Select the options to be included in the export file and press **OK**. Note that if you choose "Security", Lasair Pro security will automatically become disabled. An administrator will need to re-enable security after import.

b. Choosing **Clone Import** opens the following window.

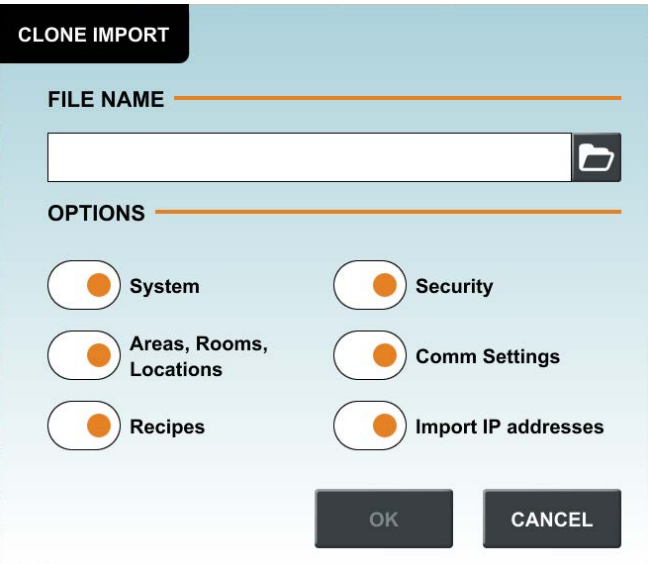


Figure 12-7. Clone Import window

- i. Press inside the **File Name** field to open the keyboard to type the name of the import file, or press  to select a file to import.
- ii. Select the options to be imported and press **OK**.
- iii. The Lasair Pro will logout any users and restart with the imported options.

Buttons

Image	Name	Description
	Restore Factory Settings	Purges all data and settings on the device and loads the factory default settings. The system displays a confirmation message before completing the action.
	Clone Export Window	Clones the following settings into a file that can be transferred to another Lasair Pro counter via USB key.
	Clone Import Window	Allows instrument to read and load a clone file from the USB key. After pressing OK , the Lasair Pro will logout any users and restart with the imported file options.

Table 12-1. SETUP tab, SYSTEM

DATE/TIME Tab

The screenshot shows the DATE/TIME configuration tab within the SYSTEM menu. The top navigation bar includes tabs for SYSTEM, STATUS, SETUP, DATE/TIME (selected), and CHANNELS. The DATE/TIME tab is divided into two panels: MANUAL SETTINGS and NTP SETTINGS. The MANUAL SETTINGS panel contains four rows: Date (08/16/2023 with a calendar icon), Date format (mm/dd/yyyy with a dropdown arrow), Time (15:56:45 with a clock icon), and Time zone (UTC-06:00 with a globe icon). The NTP SETTINGS panel contains a 'Use NTP' toggle (checked), Primary NTP Server (0.0.0.0), Backup NTP Server (0.0.0.0), and Update interval (240).

Figure 12-8. DATE/TIME tab, SYSTEM

The **DATE/TIME** tab allows the user to set the formats of both date and time, used on the **HOME** screen, sampling data, and reporting. **Table 12-2** lists the options available for the user to configure.

Buttons

Image	Name	Description
	Date	Press the calendar icon to define the current date.
	Date Format	Press the down arrow to set the date format. Options are: • dd/mm/yyyy • mm/dd/yyyy • yyyy/mm/dd

Table 12-2. DATE/TIME tab, SYSTEM

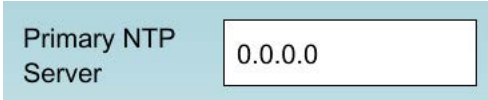
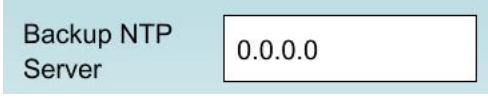
Image	Name	Description
	Time	Press the clock icon to set the current time for your time zone. The time displays in a format of HH:MM:SS for hours, minutes, and seconds.
	Use NTP	Enables or disables Network Time Protocol (NTP). Use if you are synchronizing the time display of multiple Lasair Pro counters and other NTP-linked devices.
	Primary NTP Server	Press to set the IP address of the NTP server.
	Backup NTP Server	Press to set the IP address of the backup NTP server.
	Update Interval	Press to set the time interval in minutes that the date and time will update.
	Time Zone	Press the globe to set the time zone for your location. If the instrument is attached to Facility Net or FacilityPro, the time zone and date/time are automatically updated. The time zone must be manually changed for daylight savings.

Table 12-2. DATE/TIME tab, SYSTEM

Scan or click for a
Quick Demo Video
about Initial Setup



CHANNELS Tab

The **CHANNELS** tab allows the user to switch between **All channels mode** and **Pharmaceuticals** mode.

- **All channels mode:** Enables all eight particle size channels for use with sampling.
- **Pharmaceuticals mode:** Enables only the 0.5 and 5.0 particle size channels.

Channel sizes can only be set in **All channels** mode. The size range is 0.30 to 25.00 with a resolution of 0.01 for sizes less than 0.50, 0.05 for sizes between 0.50 and 1.00, 0.5 for sizes between 1.00 and 3.00, and 1 for sizes between 3.00 and 25.00. Channel size units can be changed between micrometers (μm) and nanometers (nm).

#	SIZE		#	SIZE	
1	0.30	▼	5	10.00	▼
2	0.50	▼	6	25.00	▼
3	1.00	▼	7	-	▼
4	5.00	▼	8	-	▼

Figure 12-9. CHANNELS tab, SYSTEM

NOTE: All sampling data is deleted when the mode is switched. If you wish to save your sample data, ensure it is manually exported via USB before changing sampling modes.

NOTE: Changing between **Pharmaceuticals** mode and **All channels** mode is

confirmed by pressing . This will cause the Lasair Pro to reboot and reconfigure itself. All existing data is deleted.

Buttons

Image	Name	Description
	Dropdown Available	Press to open the dropdown menu for either the Mode or channel size.
	Micrometer Units	Select for all channel size units to be in µm.
	Nanometer Units	Select for all channel size units to be in nm.
	Restore Factory Default	When pressed, all channel changes made from factory defaults will be undone.
	Return to Previous Saved Settings	When pressed, all channel changes made since starting the Lasair Pro will be undone.
	Delete All Channel Settings	Deletes size settings for each channel.
	Undo Most Recent Change	Reverts display to the last channel size setting. Can be pressed to undo the Delete All Channel Settings option.
	Save	Saves current channel configuration.

Table 12-3. CHANNELS tab, SYSTEM

Chapter 13

Maintenance and Diagnostics

This chapter describes the maintenance you can perform at your location, and includes information for:

- **Cleaning and Disinfecting the Enclosure** on page 13-1
- **Replacing the Printer Paper Roll** on page 13-3
- **Calibration Reminder** on page 13-5
- **Other Maintenance** on page 13-5
- **Diagnostics** on page 13-6

NOTE: There are no user-serviceable parts inside the Lasair Pro.

Cleaning and Disinfecting the Enclosure

The Lasair Pro particle counter's streamlined design minimizes particle traps and makes the unit easy to clean. The enclosure case is made of polycarbonate. The tempered glass display screen is sealed around its edges to prevent ingress of fluids.

CAUTION

Although the Lasair Pro particle counter is resistant to liquids, it is NOT liquid tight. **Avoid** the application of large amounts of liquids and never submerge the instrument. **Always** wipe away free standing liquid and wet wipe the particle counter after applying a cleaner. **Never** put liquids into the air intake port. Never wipe the display screen with anything that is hard or sharp.

Recommended Cleaning Agents

The following cleaning agents are recommended to clean and disinfect the enclosure case of the particle counter:

- Bleach, typically 0.5 - 1% concentration
- Ethyl/isopropyl alcohol (in a solution of less than 70%)
- Hydrogen peroxide, aqueous
- Phenolic detergents
- Paracetic acid
- Peroxide/quaternary ammonium solutions

Call Instrument Service and Support at Particle Measuring Systems (1-800-557-6363) for advice about other cleaning chemicals.

Cleaning the Enclosure Case

WARNING

Always wear eye protection when working with cleaning chemicals.

WARNING

Disconnect the power cord from its power source.

WARNING

Ensure the Lasair Pro ISP is covered before spray down of the room. Any liquid in the ISP will damage the particle counter's optics.

Follow this procedure when cleaning the Lasair Pro's polycarbonate case and tempered glass screen:

1. Turn the particle counter off, unplug the power cord from the power source and particle counter, and remove the battery or batteries.
2. Disconnect all other cables and tubes.
3. Remove the sample probe and cover the sample inlet.
4. Dampen a cleanroom wipe or other cloth with the cleaning solution and then wipe the enclosure case and screen.
5. Follow this cleaning solution wipe, with a wipe or cloth damped with water.

Replacing the Printer Paper Roll

Pull the right case cover out with the finger notch. You must purchase paper directly from Particle Measuring Systems, or ensure the paper has a width of 61 to 62.5 mm. Paper outside specifications will print improperly.

1. Turn the Lasair Pro ON and remove the printer roll holder. Remove the previous printer roll plastic center from the printer roll holder.
2. Insert the printer roll holder into the printer roll's plastic center.
3. Thread the paper into the top of the interior cavity as shown until the automatic feed is engaged. The cutter will automatically snip a small portion of the roll.

NOTE: The printer paper must be threaded into the automatic feed as shown in **Figure 13-1**. Paper is coated for printing on one side only. Ensure the edge is oriented straight and square with the automatic feed.

4. Roll the paper so that it fits snug inside the interior cavity. Close the case and restart the Lasair Pro.

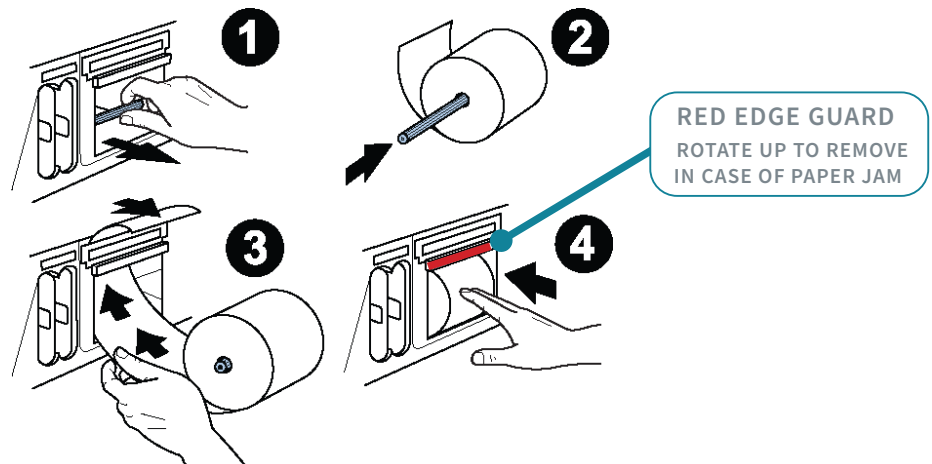


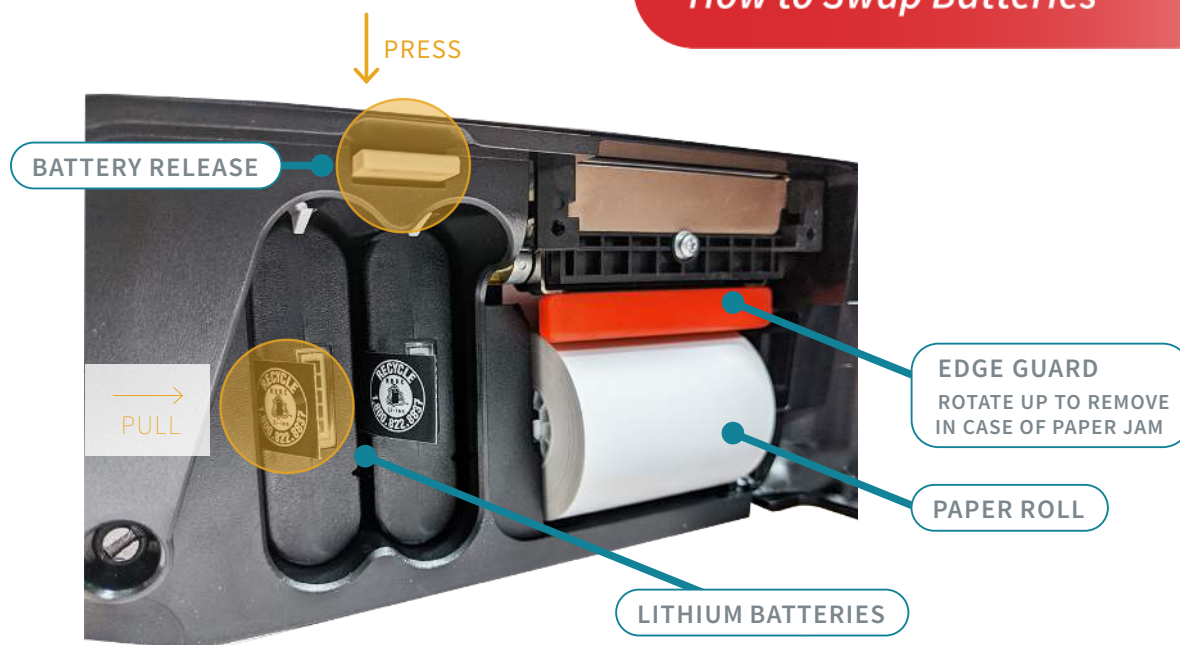
Figure 13-1. Steps to install printer roll

Scan or click for a
*Quick Tutorial Video about
How to Replace Paper Rolls*



Replacing the Batteries

Scan or click for a
*Quick Tutorial Video about
How to Swap Batteries*



1. Open the battery and printer chamber door on the side of the Instrument.
2. Press down on the gray battery release tab. You will hear a click when the release unlocks.
3. If replacing a battery, pull on the lithium battery tab protruding from the battery to gently remove it from the bay.
4. Insert the battery with the battery tab protruding from the left side of its individual bay. Install up to two batteries.
5. Lock the battery release by pressing up on the gray tab. You will hear a click when the release locks.
6. Close the battery and printer chamber door.

Battery Disposal

At end-of-life, batteries should be recycled or discarded safely. However, you need to follow your local guidelines for battery disposal. Your local waste authority will have information on return and collection systems in your area.

Calibration Reminder

Calibration should be performed once each year. Particle Measuring Systems provides calibration services at our Boulder, Colorado facility. You can schedule your calibration in advance to ensure that you can use your instrument up to the scheduled servicing.

- Turnaround time for calibration is typically five business days when service work is scheduled at least four (4) weeks in advance.
- The calibration warning can be set for either a 6-month notification or a 12-month notification. It can also be disabled with no notification provided. See the **SETUP** tab of the **SYSTEM** screen on your Lasair Pro for configuration.

Schedule the calibration online at:

<https://www.pmeasuring.com/service-and-support/service-repair-and-calibration/>



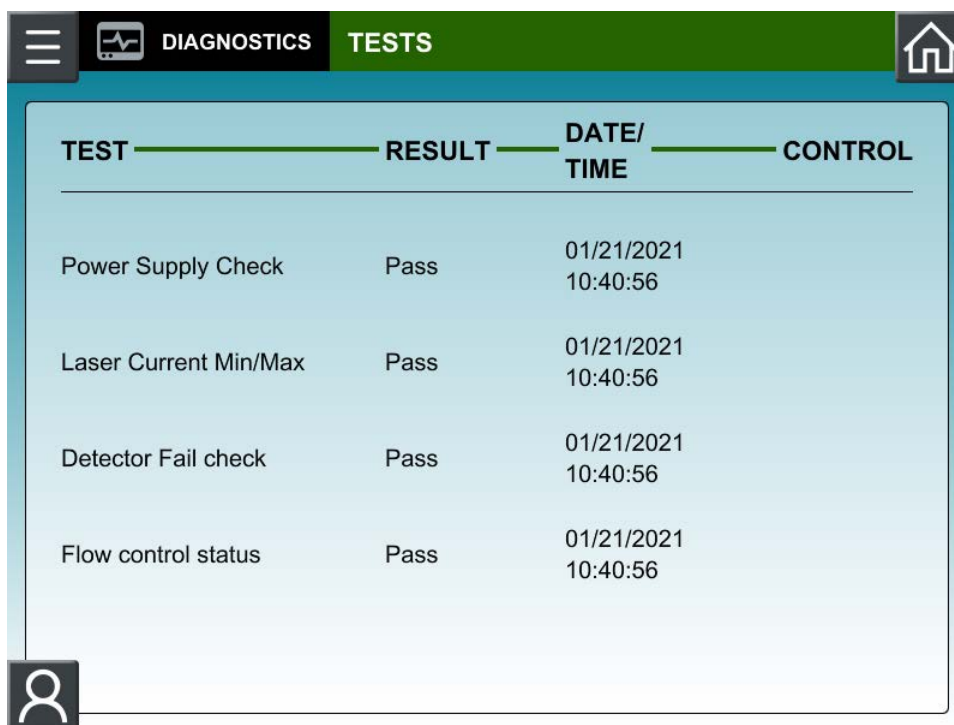
Service Repair and Calibration

Other Maintenance

For other maintenance needs, including ALL servicing inside the instrument, contact Instrument Service and Support at Particle Measuring Systems at 1 (800) 557-6363 or (303) 443-7100.

Diagnostics

The Lasair Pro performs automatic diagnostic tests daily. You can view the results of this test by navigating to the **TESTS** tab of the **DIAGNOSTICS** screen. Use the button in the bottom left to view PMS contact information.



The screenshot shows the 'DIAGNOSTICS' screen with the 'TESTS' tab selected. The table displays the following data:

TEST	RESULT	DATE/ TIME	CONTROL
Power Supply Check	Pass	01/21/2021 10:40:56	
Laser Current Min/Max	Pass	01/21/2021 10:40:56	
Detector Fail check	Pass	01/21/2021 10:40:56	
Flow control status	Pass	01/21/2021 10:40:56	

A user icon button is located in the bottom left corner of the screen.

Figure 13-2. TESTS tab, DIAGNOSTICS

The Lasair Pro performs the following tests:

- Detector Fail Check
- Flow Control Status
- Laser Current Min/Max
- Power Supply Check

Press the  button to view Particle Measuring Systems contact information.

Appendix A

International Precautions

WARNING

This instrument is designated as a Class 1 laser product and complies with US 21 CFR 1040.10, EN 60825-1, and IEC60825-1. Use of controls, or adjustment, or performance of procedures other than those specified in this manual may result in hazardous radiation exposure.

AVERTISSEMENT

Cet appareil est classé comme produit laser de Catégorie 1 et est conforme aux normes US 21 CFR 1040.10, EN 60825-1, et IEC60825-1. L'utilisation de commandes, de réglages ou l'exécution de procédures autres que celles spécifiées dans le présent document peut provoquer une exposition à des radiations dangereuses.

WARNUNG

Bei diesem Gerät handelt es sich um ein Laserprodukt der Klasse 1, welches den Normen US 21 CFR 1040.10, EN 60825-1, und IEC60825-1 entspricht. Das Justieren der Lasereinheit, das Verändern des Gerätes oder Einsatzbereiche, die nicht den Vorgaben dieser Anleitung für das Gerät entsprechen, können dazu führen, dass gefährliches Laserlicht austritt.

ATTENZIONE

Lo strumento è classificato come prodotto laser di Classe 1 e rispetta l'US 21 CFR 1040.10, l'EN 60825-1, e IEC60825-1. L'uso dei comandi o la regolazione dello strumento, o l'esecuzione delle procedure con metodi non conformi a quanto specificato in questo manuale posso provocare una pericolosa esposizione alle radiazioni.

ADVERTENCIA

Este instrumento está catalogado como producto láser de Clase 1 y cumple con las normativas US 21 CFR 1040.10, EN 60825-1, y IEC60825-1. El uso de controles o el ajuste o la realización de procedimientos que no sean los especificados en este manual pueden provocar la exposición a radiación pveligrosa.

Hazard Symbols

The meaning of hazard symbols appearing on the equipment is as follows:

Symbol	Nature of Hazard
 	Attention, consult this document for warnings.
	Dangerous High Voltage
	Warning – Laser radiation! Avoid exposure to beam.

Symboles de risque

Des symboles représentant les risques sont placés sur l'appareil. Leur signification est la suivante:

Symbole	Natur du risque
 	Attention, veuillez consulter ce document pour tout avertissements.
	Danger Electricite
	Avertissement – Rayonnement laser ! Éviter toute exposition au faisceau.

Warnschilder

Die, an dem Gerät angebrachten Warnschilder haben folgende Bedeutungen:

Symbol	Gefahrenart
 	Achtung, ziehen Sie dieses Dokument hinzu bei Warnhinweisen.
	Achtung Hochspannung
	Warnung – Laserstrahlung! Nicht in den Strahl blicken.

Simboli di pericolo

Il significato dei simboli di pericolo che appaiono sugli strumenti il seguente:

Simbolo	Natura del pericolo
 	Attenzione, consultare questo documento per le avvertenze.
	Tensione Pericolosa
	Avvertenza – Radiazione laser! Evitare l'esposizione ai raggi.

Simbolos de peligro

Los simbolos de peligro que aparecen en el equipo significan:

Símbolo	Naturaleza del Peligro
	Atención, consulte este documento para ver las advertencias.
	Peligro alto voltaje.
	Advertencia – ¡Radiación láser! Evite exponerse al rayo.

Appendix B

Comma Separated Value (CSV) Format

With this file format, you can properly label the value headings. The following items are numbered in the order that they will appear in the CSV file. The CSV file, however, will not include the order numbers. The CSV file output is in the UTF8 text format. Value Headings are printed in the language selected for instrument operation. The total number of fields present in the CSV file depends on the number of particle channels active on the instrument.

Ref #	Value Heading	Description
1	Sample Date	Format matches date format as set on the System Setup screen. The format is either YYYY/MM/DD or DD/MM/YYYY or MM/DD/YYYY
2	Sample Time	Formatted HH:MM:SS (end of sample)
3	Sensor Name	User entered name. Up to 16 characters. Name is delimited by quotation (") marks.
4	Sensor Type	Hard-coded value. Example: "LasairPro_5100"
5	S/N	Sensor serial number. This value programmed during initial calibration.
6	Statistics or Monitoring	This field is used to indicate whether the sample is part of a statistics room certification, a monitoring plan, or just a sample. The field will display either Statistics or Monitoring to indicate the type of sample.
7	Location Changed	When outputting a CSV block, this field will be set to an asterisk (*) if the location has changed from the last record printed. Otherwise, this field will be a period mark (.).
Table B-1. CSV fields and descriptions		

Ref #	Value Heading	Description
8	Location	User location name. The location name is given in the format AREA/ROOM/LOCATION. The full name is delimited by quotation (") marks. The room, area and location have a maximum of 16 Unicode characters each. In the UTF8 output, the names may take up to 48 characters each, plus the / delimiters. The total string length may therefore be approximately 150 characters.
9	Manifold	The manifold position. The value will be zero (0) if no manifold exists. With a manifold, lowest number will be one (1).
10	Laser OK	1 = OK, 0 = bad (language independent)
11	Flow OK	1 = OK, 0 = bad (language independent)
12	<10% Coinc.	1 = OK, 0 = bad (i.e. coincidence limit flag set due to too many particles)
13	Sample Valid	The sample will be declared invalid if the laser current is bad during the sample, or if the sample flow falls outside the 5% ISO limit, or if the user invalidates the sample manually (only under statistics mode). 1 = OK, 0 = bad
14	Sample Interval	Time display. Format is HH:MM:SS.
15	Sample Volume Units	This field indicates the format of the sample volume units. It will show one of (m ³ , ft ³ or ℓ).
Table B-1. CSV fields and descriptions		

Ref #	Value Heading	Description
16	Particle Count Units	This field indicates particle count data type. There are three parameters that affect the data format as follows: - Whether the counts data is cumulative (Σ) or differential (Δ) - Whether the counts data is raw (N) or normalized (N/unit volume) - If normalized, the volume units are shown (m^3, ft^3, ℓ) Examples: $\Delta N/m^3$ — Differential, normalized particle data, per cubic meter ΣN — Cumulative, raw particle data ΔN — Differential, raw particle data $\Sigma N/ft^3$ — Cumulative, normalized particle data, per cubic feet
17	Sample Volume	Floating point value. In “Volume Units” given above.
18	Number of Channels	Varies from 8 to 2 depending on channel configuration of instrument. Factory default is 6 channels. If Pharmaceutical mode is enabled the instrument has 0.5 and 5.0 channels only.
19	Size 1	Particle size for channel 1.
20	Counts 1	The particle counts for channel 1. Count data may be configured to be raw or normalized and may be either cumulative or differential. See Particle Counts Units (Ref # 16) for details.
21	Size 2	See Size 1.
22	Counts 2	See Counts 1.
23	Size 3	Size 1. Only used if 3 channels are active.
24	Counts 3	See Counts 1. Only used if 3 channels are active.
25	Size 4	See Size 1. Only used if 4 channels are active.
26	Counts 4	See Counts 1. Only used if 4 channels are active.
27	Size 5	See Size 1. Only used if 5 channels are active.
28	Counts 5	See Counts 1. Only used if 5 channels are active.
29	Size 6	See Size 1. Only used if 6 channels are active.
Table B-1. CSV fields and descriptions		

Ref #	Value Heading	Description
30	Counts 6	See Counts 1. Only used if 6 channels are active.
31	Size 7	See Size 1. Only used if 7 channels are active.
32	Counts 7	See Counts 1. Only used if 7 channels are active.
33	Size 8	See Size 1. Only used if 8 channels are active.
34	Counts 8	See Counts 1. Only used if 8 channels are active.
35	Number Analogs	Fixed at 4 for the Lasair Pro.
36	Name 1	User defined name (16 char max) for the analog channel.
37	Units 1	User name (10 char max) for sensor units.
38	Average 1	Average value for channel.
39	Min. 1	Minimum value for channel.
40	Max. 1	Maximum value for channel.
41	Name 2	Same as Name 1
42	Units 2	Same as Units 1
43	Average 2	Same as Average 1
44	Min. 2	Same as Min. 1
45	Max. 2	Same as Max. 1
46	Name 3	Same as Name 1
47	Units 3	Same as Units 1
48	Average 3	Same as Average 1
49	Min. 3	Same as Min. 1
50	Max. 3	Same as Max. 1
51	Name 4	Same as Name 1
52	Units 4	Same as Units 1
53	Average 4	Same as Average 1
54	Min. 4	Same as Min. 1
55	Max. 4	Same as Max. 1
56	Alarm Reason	Text detailing the alarm reason. This field is a null string if the sample has no alarm and/or alarm reasons are not enabled. The string is delimited by quotation (") marks. See Chapter for information on Alarm Reasons.

Table B-1. CSV fields and descriptions

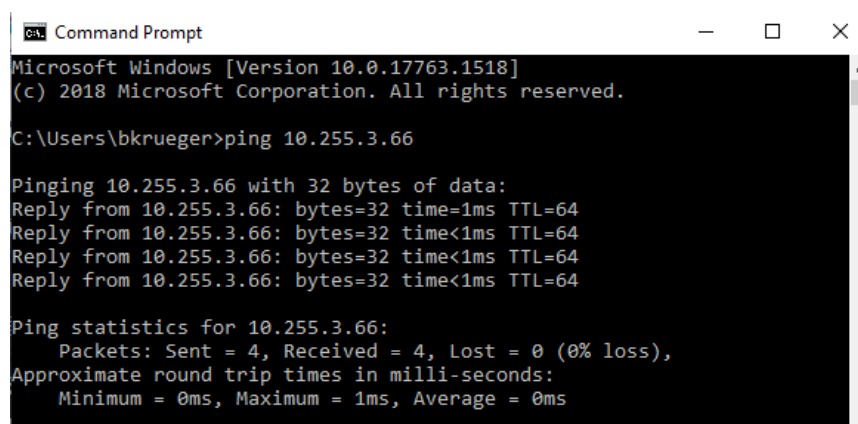
Appendix C

Troubleshooting Ethernet

Connectivity

These steps may be used to check communications to an Ethernet device.

1. Check for light on LEDs of the Ethernet connector. There should be at least one steady light to indicate a connection. If not, there is hardware connection problem.
 - a. Is the cable bad?
 - i. Try a different cable.
 - ii. If there is a direct laptop to instrument connection, a cross-over cable may be required. Cross-over cables are specially marked as such.
PMS cross-over cable: P/N 1000011477
 - b. Is the other end of the cable alive?
Ensure a known good device works when connected instead.
2. Verify the device can talk using ping.
 - a. Open a command prompt on a PC, and type **ping aaa.bbb.ccc.ddd** where **aaa.bbb.ccc.ddd** is the address of the device.
If there is no response, there is an addressing problem.



```
Command Prompt
Microsoft Windows [Version 10.0.17763.1518]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Users\bkrueger>ping 10.255.3.66

Pinging 10.255.3.66 with 32 bytes of data:
Reply from 10.255.3.66: bytes=32 time=1ms TTL=64
Reply from 10.255.3.66: bytes=32 time<1ms TTL=64
Reply from 10.255.3.66: bytes=32 time<1ms TTL=64
Reply from 10.255.3.66: bytes=32 time<1ms TTL=64

Ping statistics for 10.255.3.66:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Figure C-1. Example for ping test

- b. Make sure the PC and the device are on the same network.
- c. Check the PC's address by opening a command prompt and typing ipconfig.
 - i. Ensure the Mask is the same on both the PC and the device.
 - ii. Ensure the network portion of the address is the same on both the PC and the device.



```
Ca. Command Prompt
C:\>ipconfig

Windows IP Configuration

Ethernet adapter Local Area Connection:

    Connection-specific DNS Suffix  . : pms.dmn
    IP Address. . . . . : 192.168.40.234
    Subnet Mask . . . . . : 255.255.224.0
    Default Gateway . . . . . : 192.168.32.14

C:\>_
```

Figure C-2. Example for ipconfig command

- d. Does an LED on the device's Ethernet connector blink when a ping is transmitted to it?
If not, there may be an addressing error with the device, or a configuration problem with the router or switch the device is attached to.
 - i. Try repowering the device to re-establish communications with the router or switch.

Appendix D

Modbus

Communications with the Lasair Pro particle counter are available via Modbus TCP/IP. The instrument presents a single TCP/IP Ethernet connection at port 502 using the standard Modbus protocol. Two specification documents were used in the development of the Modbus interface:

- “MODBUS MESSAGING ON TCP/IP IMPLEMENTATION GUIDE V1.0b”
- “MODBUS APPLICATION PROTOCOL SPECIFICATION V1.1b”

The Modbus protocol, as implemented in this instrument, utilizes generic 0-based addressing.

The portable Lasair Pro unit allows the operator to enable/disable the Modbus interface on the communications screen.

Modbus Overview

Each register in the Modbus map is defined to be 16 bits. The map can contain three distinct sections:

- | | |
|-----------------------------|--|
| 1. Input registers | Read Only information for ID and data collection |
| 2. Holding registers | Read/Write parameters for configuring the device |
| 3. Coils | Read/Write individual bits to control the device |

The supported functions include:

- | | |
|----|---------------------------------------|
| 1 | Read Coils |
| 3 | Read Holding Registers |
| 4 | Read Input Registers |
| 5 | Write Single Coil |
| 6 | Write Single Holding Register |
| 15 | Write Multiple Coils |
| 16 | Write Multiple Holding Registers |
| 22 | Mask Write Holding Register |
| 23 | Read/Write Multiple Holding Registers |

- Any registers accessed but not defined will generate an address error.
- Spare coils/registers will “set” without error and always return a zero value.
- Registers set with invalid data will return a function error.

The map delineates three types of register assemblies:

1. **Unary** an individual 16 bit register
2. **Dual** a register pair used for a 32 bit representation
3. **String** a group of registers containing ASCII bytes

There is a setting available that toggles the interpretation of selected dual-register values. These values can be interpreted as integer representations of floating point numbers with a fixed scaling factor or as IEEE-754 floating point representations of that value. Refer to the register map to determine which register pairs have this feature applied. This setting can be made in the setup interface and saved in non-volatile storage, or it can be set real-time via a coil.

Even though the Modbus protocol itself is standard, the contents of the registers are application-specific. A description of the register map is the definitive specification for that application interface.

The following Modbus register map has comments and notes to help with its intended use.

Input Registers

The input registers are in two sections: Configuration and Data.

- The **Configuration** section description begins on this page.
- The **Data** description begins on page D-5.

Configuration

This section contains:

- Modbus Map Version
- Sensor Firmware Version
- Product Name
- Flow Rate and Volume Scale Factors
- Flow Rate
- Number of Channels (Particle and Analog)
- Particle Channel Sizes

30001: Modbus Map Version	This is a fixed value representing the version number of the Lasair Pro Modbus map multiplied by 100. The version can change if/when the structure of the map is adjusted. NOTE: Additions and/or definitions to the spare entries will not generally require a version change - they will simply be annotated as to the applicability to that instrument. The same reasoning is applied to unique registers and/or coils for a particular instrument – they will simply be annotated as being specific to that device.
30002: Sensor Firmware Version	This is a value representing the firmware version as follows: Main * 10000 + Major * 1000 + Minor (e.g. Version 1.9.006 would become a value of 19006).
30003 - 30010: Product Name	Product name entered using ASCII bytes and positioned as shown in the map.
30011: Flow Rate Scale Factor	The power of 10 multiplied to the flowrate and then entered into registers 30013/30014 and 30222/30223. Used when the floating-point representation is disabled. The Lasair Pro uses a value of 3 to represent a fixed scaling factor of 1000 for flowrate.
30012: Volume Scale Factor	The power of 10 multiplied to the volume and then entered into registers 30224/30225. Used when the floating-point representation is disabled. The Lasair Pro uses a value of 4 to represent a fixed scaling factor of 10000 for volume.
30013 - 30014: Flow Rate	Dual-register representation of the nominal flowrate in cubic feet per minute. Can be integer or float depending on mode selected. The integer representation uses scale factor from register 30011.
30015: Number of Particle Channels	Processed as a variable but fixed to a value of 8 for Lasair Pro. The Lasair Pro allows for a variable number of channels and variable sizes for each channel. All 8 channels can be read. Unused size channels will show a value of zero.
Table D-1. Configuration descriptions	

30016: Number of Analog Channels	Processed as a variable but fixed to a value of four for the Lasair Pro.
30017 - 30032 Dual-Register Representation of the Particle Channel Sizes in Nanometers	Dual-register representation of the particle channel sizes in nanometers. The Lasair Pro allows for a variable number of channels and variable sizes for each channel. All 8 channels can be read. Unused size channels will show a value of zero.
Table D-1. Configuration descriptions	

Input Registers		Description (Configuration)	Comment	Notes
30001	ushort	Modbus Map Version	Version 1.00 (Static 100)	
30002	ushort	Sensor Firmware Version	Encoded Firmware version	
30003	string	Product Name: Char 00, 01	Product Name	
30004	string	Product Name: Char 02, 03	Product Name	
30005	string	Product Name: Char 04, 05	Product Name	
30006	string	Product Name: Char 06, 07	Product Name	
30007	string	Product Name: Char 08, 09	Product Name	
30008	string	Product Name: Char 10, 11	Product Name	
30009	string	Product Name: Char 12, 13	Product Name	
30010	string	Product Name: Char 14, 15	Product Name	
30011	ushort	Scale: Flow Rate	Multiplier in fixed: Flow Rate	3 (1000)
30012	ushort	Scale: Volume	Multiplier in fixed: Volume	4 (10000)
30013	ushort	Flow Rate (high)	Flow * 10 ^{Scale} cfm	Float Mode
30014	ushort	Flow Rate (low)	Flow * 10 ^{Scale} cfm	Float Mode
30015	ushort	Number of Particle Channels	Fixed number of sizes	8 fixed
30016	ushort	Number of Analog Channels	Fixed number of analogs	4 fixed
30017	ushort	Channel 1 Size (high)	nanometers	
30018	ushort	Channel 1 Size (low)	nanometers	Variable
30019	ushort	Channel 2 Size (high)	nanometers	
Table D-2. Configuration section of the Input Register				

Input Registers		Description (Configuration)	Comment	Notes
30020	ushort	Channel 2 Size (low)	nanometers	Variable
30021	ushort	Channel 3 Size (high)	nanometers	
30022	ushort	Channel 3 Size (low)	nanometers	Variable
30023	ushort	Channel 4 Size (high)	nanometers	
30024	ushort	Channel 4 Size (low)	nanometers	Variable
30025	ushort	Channel 5 Size (high)	nanometers	
30026	ushort	Channel 5 Size (low)	nanometers	Variable
30027	ushort	Channel 6 Size (high)	nanometers	
30028	ushort	Channel 6 Size (low)	nanometers	Variable
30029	ushort	Channel 7 Size (high)	nanometers	
30030	ushort	Channel 7 Size (low)	nanometers	Variable
30031	ushort	Channel 8 Size (high)	nanometers	
30032	ushort	Channel 8 Size (low)	nanometers	Variable

Table D-2. Configuration section of the Input Register

Data

The Data section starts with what would have normally been considered configuration information - calibration date and serial number. This was added to allow for a single contiguous read when this particular information was desired along with the regular sample data. If not desired, then start reading at register 30212.

The following table contains:

- Calibration Date
- Serial Number
- Device Status
- Device State
- Number of Data Samples in Queue
- Sample Data information
- Location Identifier

30201: Calibration Date (Month)	A value between 1 and 12.
30202: Calibration Date (Day)	A value between 1 and 31.
30203: Calibration Date (Year)	A value representing the year (e.g. 2012)
30204 - 30211: Serial Number	Serial number entered using ASCII bytes and positioned as shown in the map.
30212 - 30213: Device Status	Dual-register representation of device status. Integer bit mask matching the current coil selections for convenience. The host can use this to check for data availability, data format, etc while reading the data. A separate coil read would not be required. Values are defined in Table D-9 on page D-20.
30214: Device State	Least Significant byte (LSB) is State. Most Significant Byte (MSB) is sub-state. Values are defined in Table D-9 .
30215: Number of Data Samples in the Queue	A value of zero is identical to no data available (same meaning as coil 02 read as zero). The buffer size setting will determine if the data register section shows real-time data or stored data. If the buffer size setting has been set to one, the sample data will always represent the last real-time data packet and the queue value will be non-zero if there is a data packet available. If the buffer size setting is not set to one, the queue will be the amount of stored data in the unit since the last Modbus packet was deleted. This value can be set into non-volatile storage via the setup interface command “set buffer 1”.
Table D-3. Data descriptions	

cont. 30215: Number of Data Samples in the Queue	This interface was designed for “in-line” or “portable download” operations. The “in-line” operation is intended to control and collect data in a continuous monitoring environment. The “portable download” operation is intended to unload stored data that was collected while the instrument was used in a portable environment. The two operations are supported by the same Modbus register map and are delineated by how the host system processes the register/coil fields and the instrument buffer setting. The data register section can be forced to show real-time data by setting the buffer size to one or to show the entire set of queued data by setting the buffer size to something other than one (i.e., the buffer size value is not utilized other than as a switch). Queued data is always presented oldest first. The buffer size command is “set buffer #” where # is a value between 1 and 10000. The number of data samples available to the Modbus interface on the Lasair Pro will not necessarily be the same number of data samples shown on the front screen of the device. The Modbus interface does not delete stored data on the instrument, but uses a filtering mechanism to simulate data deletion. Any data deleted by one Modbus host will, in effect, be deleted for all future Modbus host connections.
30216 - 30217: Time Stamp	Dual-register representation of data packet time stamp. Integer value representing start date/time in seconds since January 1, 1970. The real-time clock may be set either via NTP protocol, or it may be set via Modbus Holding registers 40001-40002 as described below. Modbus time is time in UTC time not corrected for local time.
30218 - 30219: Sample Time	Dual-register representation of data packet sample time. Can be integer or float depending on mode selected. The integer representation represents seconds multiplied by 100. Modbus time is time in UTC time not corrected for local time.
30220- 30221: Data Packet Status	Values are defined in Table D-9.
30222 - 30223: Flow Rate	Dual-register representation of the data packet flowrate in cubic feet per minute. Can be integer or float depending on mode selected. The integer representation uses scale factor from register 30011.
Table D-3. Data descriptions	

30224 - 30225: Volume	Dual-register representation of the data packet volume in cubic feet. Can be integer or float depending on mode selected. The integer representation uses scale factor from register 30012.
30226: Location	Index of location value associated with data packet. Value set to -1 if not valid.
30227: Number of Particle Channels	Processed as a variable since the Lasair Pro can have 1 to 8 channels selected. Unused channel registers will be zero (0).
30228: Number of Analog Channels	Processed as a variable but fixed to a value of four (4) for Lasair Pro.
30229 - 30244 Cumulative Particle Data	Dual-register representation of particle size counts. Unused size channels will be loaded with a value of zero.
30245 - 30252 Analog Data	Dual-register representation of the data packet analog value. Can be integer or float depending on mode selected. The integer value represents the scaled 4-20 mA input multiplied by 10000. Integer representation limited to a value between -214748.3648 to 214748.3647.
30253 - 30284 Location	Location entered using ASCII/UTF-8 bytes and positioned as shown in the map. Can contain UTF-8 representation of the original 16 characters (a potential of 64). Locations are normally associated with data taken using “portable download” operations.
30385 - 30316 Room	Room entered using ASCII/UTF-8 bytes and positioned as shown in the map. Can contain UTF-8 representation of the original 16 characters (a potential of 64). Rooms are normally associated with data taken using “portable download” operations.
30317 - 30348 Area	Area entered using ASCII/UTF-8 bytes and positioned as shown in the map. Can contain UTF-8 representation of the original 16 characters (a potential of 64). Areas are normally associated with data taken using “portable download” operations.
Table D-3. Data descriptions	

Input Registers		Description (Data Packet)	Comment	Notes
30201	ushort	Calibration Date (Month)	Calibration Date	
30202	ushort	Calibration Date (Day)	Calibration Date	
30203	ushort	Calibration Date (Year)	Calibration Date	
30204	string	Serial Number: Char 00, 01	Serial Number	
30205	string	Serial Number: Char 02, 03	Serial Number	
30206	string	Serial Number: Char 04, 05	Serial Number	
30207	string	Serial Number: Char 06, 07	Serial Number	
30208	string	Serial Number: Char 08, 09	Serial Number	
30209	string	Serial Number: Char 10, 11	Serial Number	
30210	string	Serial Number: Char 12, 13	Serial Number	
30211	string	Serial Number: Char 14, 15	Serial Number	
30212	ushort	Device Status (high)	Device Status Mask	
30213	ushort	Device Status (Low)	Device Status Mask	
30214	ushort	Device State	Device State	
30215	ushort	Number of data samples in queue	Number of samples queued	
30216	ushort	Time Stamp (high)	time_t	UTC Time
30217	ushort	Time Stamp (low)	time_t	UTC Time
30218	ushort	Sample Time (high)	Seconds * 100	Float Mode
30219	ushort	Sample Time (low)	Seconds * 100	Float Mode
30220	ushort	Data Packet Status (high)	Bit Mask	
30221	ushort	Data Packet Status (low)	Bit Mask	
30222	ushort	Flow Rate (high)	Flow * 10 ^{Scale} cfm	Float Mode
30223	ushort	Flow Rate (low)	Flow * 10 ^{Scale} cfm	Float Mode
30224	ushort	Volume (high)	Volume * 10 ^{Scale} cf	Float Mode
30225	ushort	Volume (low)	Volume * 10 ^{Scale} cf	Float Mode
30226	ushort	Location	Location value	N/A
30227	ushort	Number Particle Channels	Fixed number of sizes	Variable (1-8)
30228	ushort	Number Analog Channels	Fixed number of analogs	4 fixed
30229	ushort	Particle Channel 1 (high)	Cumulative Raw Ch1	
30230	ushort	Particle Channel 1 (low)	Cumulative Raw Ch1	
Table D-4. Data section of the Input Register				

Input Registers		Description (Data Packet)	Comment	Notes
30231	ushort	Particle Channel 2 (high)	Cumulative Raw Ch2	
30232	ushort	Particle Channel 2 (low)	Cumulative Raw Ch2	
30233	ushort	Particle Channel 3 (high)	Cumulative Raw Ch3	
30234	ushort	Particle Channel 3 (low)	Cumulative Raw Ch3	
30235	ushort	Particle Channel 4 (high)	Cumulative Raw Ch4	
30236	ushort	Particle Channel 4 (low)	Cumulative Raw Ch4	
30237	ushort	Particle Channel 5 (high)	Cumulative Raw Ch5	
30238	ushort	Particle Channel 5 (low)	Cumulative Raw Ch5	
30239	ushort	Particle Channel 6 (high)	Cumulative Raw Ch6	
30240	ushort	Particle Channel 6 (low)	Cumulative Raw Ch6	
30241	ushort	Particle Channel 7 (high)	Cumulative Raw Ch7	
30242	ushort	Particle Channel 7 (low)	Cumulative Raw Ch7	
30243	ushort	Particle Channel 8 (high)	Cumulative Raw Ch8	
30244	ushort	Particle Channel 8 (low)	Cumulative Raw Ch8	
30245	ushort	Analog Channel 1 (high)	Analog 1 * 10000	Float Mode
30246	ushort	Analog Channel 1 (low)	Analog 1 * 10000	Float Mode
30247	ushort	Analog Channel 2 (high)	Analog 2 * 10000	Float Mode
30248	ushort	Analog Channel 2 (low)	Analog 2 * 10000	Float Mode
30249	ushort	Analog Channel 3 (high)	Analog 3 * 10000	Float Mode
30250	ushort	Analog Channel 3 (low)	Analog 3 * 10000	Float Mode
30251	ushort	Analog Channel 4 (high)	Analog 4 * 10000	Float Mode
30252	ushort	Analog Channel 4 (low)	Analog 4 * 10000	Float Mode
30253	string	Location: Char 00, 01	Location	
30254	string	Location: Char 02, 03	Location	
30255	string	Location: Char 04, 05	Location	
30256	string	Location: Char 06, 07	Location	
30257	string	Location: Char 08, 09	Location	
30258	string	Location: Char 10, 11	Location	
30259	string	Location: Char 12, 13	Location	
30260	string	Location: Char 14, 15	Location	
30261	string	Location: Char 16, 17	Location	
Table D-4. Data section of the Input Register				

Input Registers		Description (Data Packet)	Comment	Notes
30262	string	Location: Char 18, 19	Location	
30263	string	Location: Char 20, 21	Location	
30264	string	Location: Char 22, 23	Location	
30265	string	Location: Char 24, 25	Location	
30266	string	Location: Char 26, 27	Location	
30267	string	Location: Char 28, 29	Location	
30268	string	Location: Char 30, 31	Location	
30269	string	Location: Char 32, 33	Location	
30270	string	Location: Char 34, 35	Location	
30271	string	Location: Char 36, 37	Location	
30272	string	Location: Char 38, 39	Location	
30273	string	Location: Char 40, 41	Location	
30274	string	Location: Char 42, 43	Location	
30275	string	Location: Char 44, 45	Location	
30276	string	Location: Char 46, 47	Location	
30277	string	Location: Char 48, 49	Location	
30278	string	Location: Char 50, 51	Location	
30279	string	Location: Char 52, 53	Location	
30280	string	Location: Char 54, 55	Location	
30281	string	Location: Char 56, 57	Location	
30282	string	Location: Char 58, 59	Location	
30283	string	Location: Char 60, 61	Location	
30284	string	Location: Char 62, 63	Location	
30285	string	Room: Char 00, 01	Room	Selectable
30286	string	Room: Char 02, 03	Room	
30287	string	Room: Char 04, 05	Room	
30288	string	Room: Char 06, 07	Room	
30289	string	Room: Char 08, 09	Room	
30290	string	Room: Char 10, 11	Room	
30291	string	Room: Char 12, 13	Room	
30292	string	Room: Char 14, 15	Room	
Table D-4. Data section of the Input Register				

Input Registers		Description (Data Packet)	Comment	Notes
30293	string	Room: Char 16, 17	Room	
30294	string	Room: Char 18, 19	Room	
30295	string	Room: Char 20, 21	Room	
30296	string	Room: Char 22, 23	Room	
30297	string	Room: Char 24, 25	Room	
30298	string	Room: Char 26, 27	Room	
30299	string	Room: Char 28, 29	Room	
30300	string	Room: Char 30, 31	Room	
30301	string	Room: Char 32, 33	Room	
30302	string	Room: Char 34, 35	Room	
30303	string	Room: Char 36, 37	Room	
30304	string	Room: Char 38, 39	Room	
30305	string	Room: Char 40, 41	Room	
30306	string	Room: Char 42, 43	Room	
30307	string	Room: Char 44, 45	Room	
30308	string	Room: Char 46, 47	Room	
30309	string	Room: Char 48, 49	Room	
30310	string	Room: Char 50, 51	Room	
30311	string	Room: Char 52, 53	Room	
30312	string	Room: Char 54, 55	Room	
30313	string	Room: Char 56, 57	Room	
30314	string	Room: Char 58, 59	Room	
30315	string	Room: Char 60, 61	Room	
30316	string	Room: Char 62, 63	Room	
30317	string	Area: Char 00, 01	Area	Selectable
30318	string	Area: Char 02, 03	Area	
30319	string	Area: Char 04, 05	Area	
30320	string	Area: Char 06, 07	Area	
30321	string	Area: Char 08, 09	Area	
30322	string	Area: Char 10, 11	Area	
30323	string	Area: Char 12, 13	Area	
Table D-4. Data section of the Input Register				

Input Registers		Description (Data Packet)	Comment	Notes
30324	string	Area: Char 14, 15	Area	
30325	string	Area: Char 16, 17	Area	
30326	string	Area: Char 18, 19	Area	
30327	string	Area: Char 20, 21	Area	
30328	string	Area: Char 22, 23	Area	
30329	string	Area: Char 24, 25	Area	
30330	string	Area: Char 26, 27	Area	
30331	string	Area: Char 28, 29	Area	
30332	string	Area: Char 30, 31	Area	
30333	string	Area: Char 32, 33	Area	
30334	string	Area: Char 34, 35	Area	
30335	string	Area: Char 36, 37	Area	
30336	string	Area: Char 38, 39	Area	
30337	string	Area: Char 40, 41	Area	
30338	string	Area: Char 42, 43	Area	
30339	string	Area: Char 44, 45	Area	
30340	string	Area: Char 46, 47	Area	
30341	string	Area: Char 48, 49	Area	
30342	string	Area: Char 50, 51	Area	
30343	string	Area: Char 52, 53	Area	
30344	string	Area: Char 54, 55	Area	
30345	string	Area: Char 56, 57	Area	
30346	string	Area: Char 58, 59	Area	
30347	string	Area: Char 60, 61	Area	
30348	string	Area: Char 62, 63	Area	
Table D-4. Data section of the Input Register				

Holding Registers

Like the coils, spares are in place between the “standard” registers and those that are specific/optional. There are no specific/optional coils defined for the Lasair Pro particle counter.

If sample setting holding registers are sent while the unit is sampling, it will transition to a state of Idle.

40001 - 40002: Real Time Clock	Dual-register representation date & time. Integer value (type defined as time_t) representing date/time in seconds since January 1, 1970. The Lasair Pro particle counter has a built-in real time clock and may make the use of these registers unnecessary.
40003: Sample Interval/ Sample Volume	This register representation depends on the Sample Volume Mode setting (coil 00/09). When the Sample Volume Mode is disabled - this register represents the number of seconds to run a sample. When the Sample Volume Mode is enabled - this register represents the volume in cubic feet multiplied by 100. This creates a limit of 655.35 cubic feet for a single sample volume - approximately 11 hours of sample time. This amount of resolution is required to get the nearest second, sample interval, when requesting a cubic meter.
40004: Hold/Tare Time	Time, in seconds, processed between the start command and starting the first sample but with the pump running.
40005: Repeat Count	Number of samples to process. A value of zero will command continuous processing.
40006: Delay Time	Time, in seconds, processed between each sample.
40007 - 40032: Spare	
Table D-5. Holding Registers description	

Holding Registers		Description (Setup)	Comment	Notes
40001	ushort	Real Time Clock (high)	time_t	
40002	ushort	Real Time Clock (low)	time_t	
40003	ushort	Sample Interval/Volume	Seconds/Units*100	
40004	ushort	Hold/Tare Time	Seconds	
40005	ushort	Repeat Count	Repeat Count	≥ 0
40006	ushort	Delay Time	Seconds	
Spare	ushort	26 spare registers	Reserve future “common” registers	

Table D-6. Holding Registers section of the Modbus Map

Coils

Like the holding registers, spares are in place between the “standard” coils and those that are specific/optional. There are no specific/optional coils defined for the Lasair Pro.

NOTE: The coils are processed as “commands” not “states”. For example, sending Coil 00/01 set to 1 will start the instrument. Re-sending Coil 00/01 set to 1 will attempt to re-start the instrument. Most instruments will ignore repeated requests to start if already sampling.

00/01:	The data collection coil will enable/disable sampling. Read: 1=Sampling Enabled, 0=Sampling Disabled. Write: 1=Sampling Enabled, 0=Sampling Disabled.
00/02:	The data available coil is used to both inform the host that data is now available and to delete the queued data packet (if present). Read: 1=Data Available, 0=No Data Available. Write: 0=Delete queued data element, 1=No effect, • If the buffer size setting has been set to one, the sample data will always represent the last real-time data packet and the data deleted will only be the copy of the last sample taken(no stored data will be affected). • If the buffer size setting is not set to one, the queue will be a subset of the amount of stored data in the unit and the oldest data packet in the stored data will be be tagged in such a way as to make it unavailable to the Modbus interface (no stored data will be affected). The Modbus interface tracks the data which it has processed, it is up to the operator to permanently delete data from the unit.
00/03:	The data clear coil will delete all data in the queue. Read: Always 0 Write: 1=Delete all queued data, 0=No effect • If the buffer size setting has been set to one, the sample data will always represent the last real-time data packet and the data deleted will only be the copy of the last sample taken (no stored data will be affected). • If the buffer size setting is not set to one, the queue will be a subset of the total amount of stored data in the unit and the Modbus interface will only process future data (no stored data will be affected).
Table D-7. Holding Registers description	

00/04:	The reset sensor coil will reset the sensor. Read: Always 0 Write: 1=Reset sensor, 0=No effect
00/05 - 00/07	Not Applicable for Lasair Pro instrument.
00/08:	IEEE-754 Float. The float control will change the specified registers from a dual-register integer with fixed scaling to a dual-register IEEE-754 float representation. The IEEE-754 version is likely to yield better resolution, but it is not part of the official Modbus specification. This value can also be set into non-volatile storage via the setup interface command “set instrument float (on/off)”. Read: 1=Float mode enabled, 0=Float mode disabled Write: 1=Float mode enabled, 0=Float mode disabled
00/09:	Sample Volume Mode. The sample volume control will change how the unit controls sampling. If set, holding register 40003 will contain the sample volume to be processed multiplied by a factor of 100. If clear, holding register 40003 will contain the sample interval to be processed in seconds. This value can also be changed from the display. It is recommended that the coil selection be set every-time the holding registers are sent. Read: 1=Sample Volume, 0=Sample Interval Write: 1=Sample Volume, 0=Sample Interval
00/10 - 00/32:	Spare. Read: Always 0 Write: No effect
Table D-7. Holding Registers description	

Coils	Description (Coils)		Comment	Notes
00/01	Data Collection	On/Off	Sampling Control	
00/02	Data Available	Yes/No	Data Available/Queue Control	
00/03	Data Clear	Toggle	Data Queue Delete	
00/04	Reset Sensor	Toggle	Reset control	
00/05	Unused			
00/06	Unused			
00/07	Unused			
00/08	IEEE-754 Float	On/Off	Modbus Float representation	Float Control
00/09	Sample Volume Mode	On/Off	Sample Volume Mode	
Spare	23 spare coils		Reserve “common” coils	

Table D-8. Coils section of the Modbus Map

Data Register Processing

There is an additional Data section starting at register 32201. This data section is identical to the data section starting at 30201 except that it contains the latest collected sample (as opposed to the oldest sample in the queue). This data section can be used in lieu of setting the buffer to one which is done in order to force the queued data (at register 30201) to show “real-time” data.

The unit can provide either real-time data or queued data. The section of data packet input registers starting at 30216 can handle both these types of information and the type of information will depend on a setting designating the amount of queued data as described below. There is also a set of identical data packet input registers starting at 32216 (offset by 2000 from the queued data registers) which always show the next available real-time sample (i.e., does not require setting the amount of queued data).

If the unit is setup to queue data, then the data packet shown in the registers starting at 30216 is the oldest data in the queue. The data available coil (00/02) will be set on a read if there is data in the queue. The data available coil (00/02) can be cleared and written (i.e., set coil to zero) in which case that data element shown is popped-off of the queue. If there is more data in the queue, the new data will be shown, and the data available coil (00/02) will be set again right away. If there is no more data in the queue, the data available coil (00/02) will only be set again once the next sample is completed.

- If the buffer size setting has been set to one, then the data shown in the registers starting at 30201 will always represent the last real-time data packet. The data shown is always the last data processed and is representative of real-time data only.
- If the buffer size setting is not set to one, the queue size will be a subset of the amount of stored data in the unit. The data shown in the registers starting at 30201 will always be the oldest data taken.

Queued data will always be available - even when not sampling. This will allow data taken by the instrument at prescribed locations during portable use to be downloaded at a later time.

If there is no data available - the input registers (associated with the actual sample collected) will yield zeros. This is done instead of generating an execution exception so that the customer can simply read the data packet, along with the Device Status (i.e., current coil settings), in one command.

Processing of 32 Bit Register Value - Integer Representation

Some parameters such as particle counts are 32 bit values. Modbus does not natively support 32 bit data; however, it is common in industry to use two 16 bit registers to create a single 32 bit value. Here are two methods for doing this:

- Add the value as two unsigned numbers.
Example:
$$[32\text{-Bit Unsigned Reg}] = [16\text{ Bit Low Unsigned}] + 65536 * [16\text{ Bit High Unsigned}]$$
- Use arithmetic OR and left- shift operation.
Example:
$$[32\text{-Bit Unsigned Reg}] = ([16\text{ Bit High Unsigned}] \ll 16\text{-bit left-shift}) \{\text{arithmetic OR}\} [16\text{ Bit Low Unsigned}]$$

Never combine the values as signed integers or floating-point value. If the final value is signed, convert the 32-bit Unsigned value to a 32-bit signed value after combining the unsigned 16-bit values. If the final value is a floating-point value, interpret the final 32-bit value as floating point after combining the numbers as unsigned 16-bit integers.

Processing of 32 Bit Register Value - Float Representation

Some parameters such as flow rate and volume are 32-bit values which can have Integer or Float representations. Modbus does not natively support 32-bit data; however, it is common in industry to use two 16-bit registers to create a single 32-bit value. The method for interpreting the 32-bit Float representation is described by the IEEE-754 standard.

Associated Values for Specific Registry Entries

Device Status Entries	0x0001	Data Collection	Matches the common coil settings
	0x0002	Data Available	
	0x0004	Data Clear	
	0x0008	Reset	
	0x0080	IEEE Float mode	
	0x0100	Volume Mode	
Device State Entries (LSB)	0	Idle	
	1	Sampling	
Device SubState Entries (MSB)	0	Idle	N/A
	0	Sampling	Normal
	1	Sampling	Tare
	2	Sampling	Delay
Data Packet Status Entries	0x0001	Laser Good	
	0x0002	Flow Good	
	0x0004	Hardware Good	Coincidence Limit not set

Table D-9. Associated values for specific registry entries

Modbus Processing Example

The following flowchart provides a basic example of controlling the Lasair Pro using Modbus protocol. The flowchart is meant to be a starting point. It does not detail error handling and does not provide other functionalities which may be desired. The Optional processing is not applicable to the Lasair Pro.

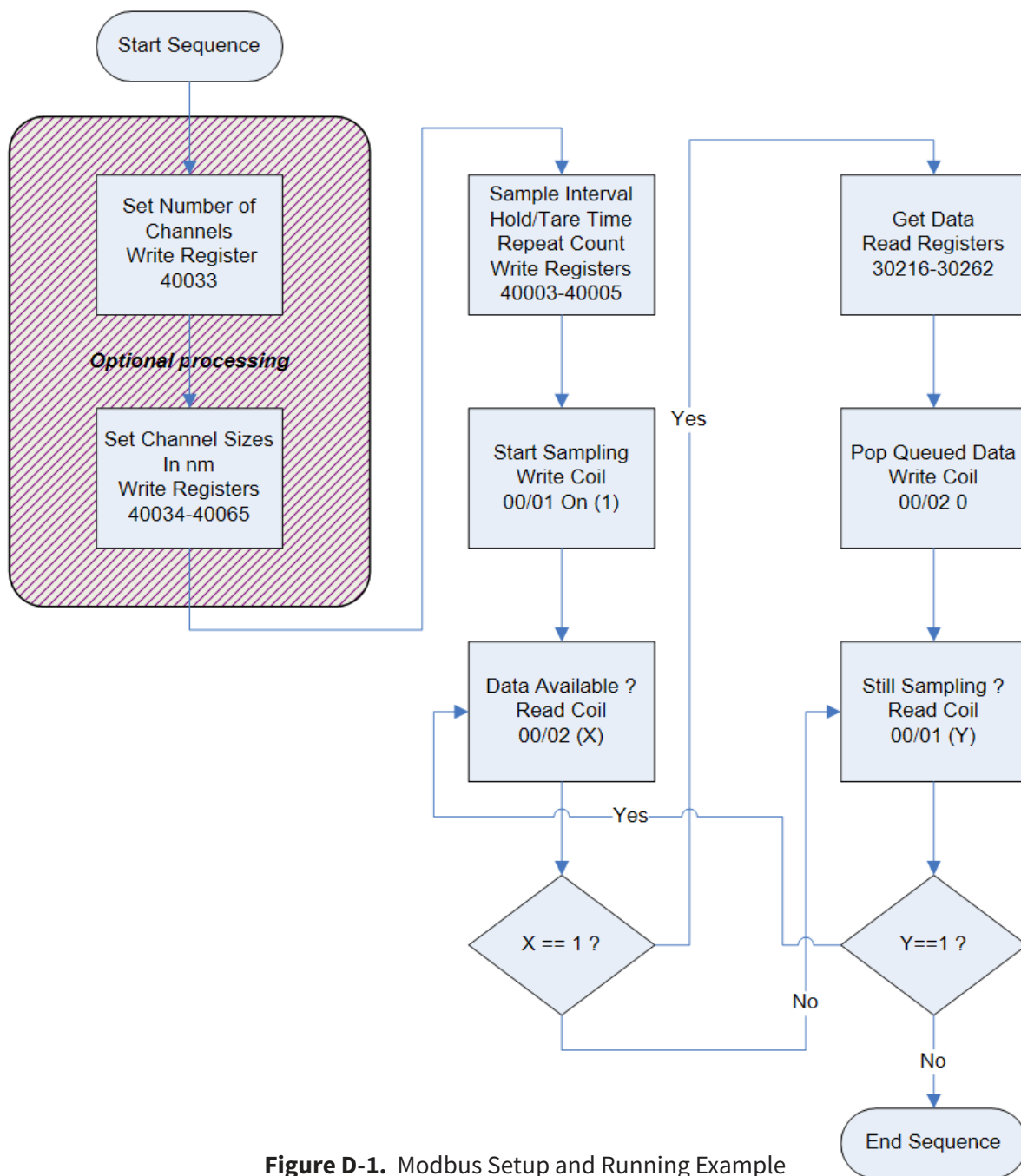


Figure D-1. Modbus Setup and Running Example

Modbus Dequeuing Example

The following flowchart provides a basic example of de-queuing data using Modbus protocol. The flowchart is meant to be a starting point. It does not detail error handling and does not provide other functionalities which may be desired.

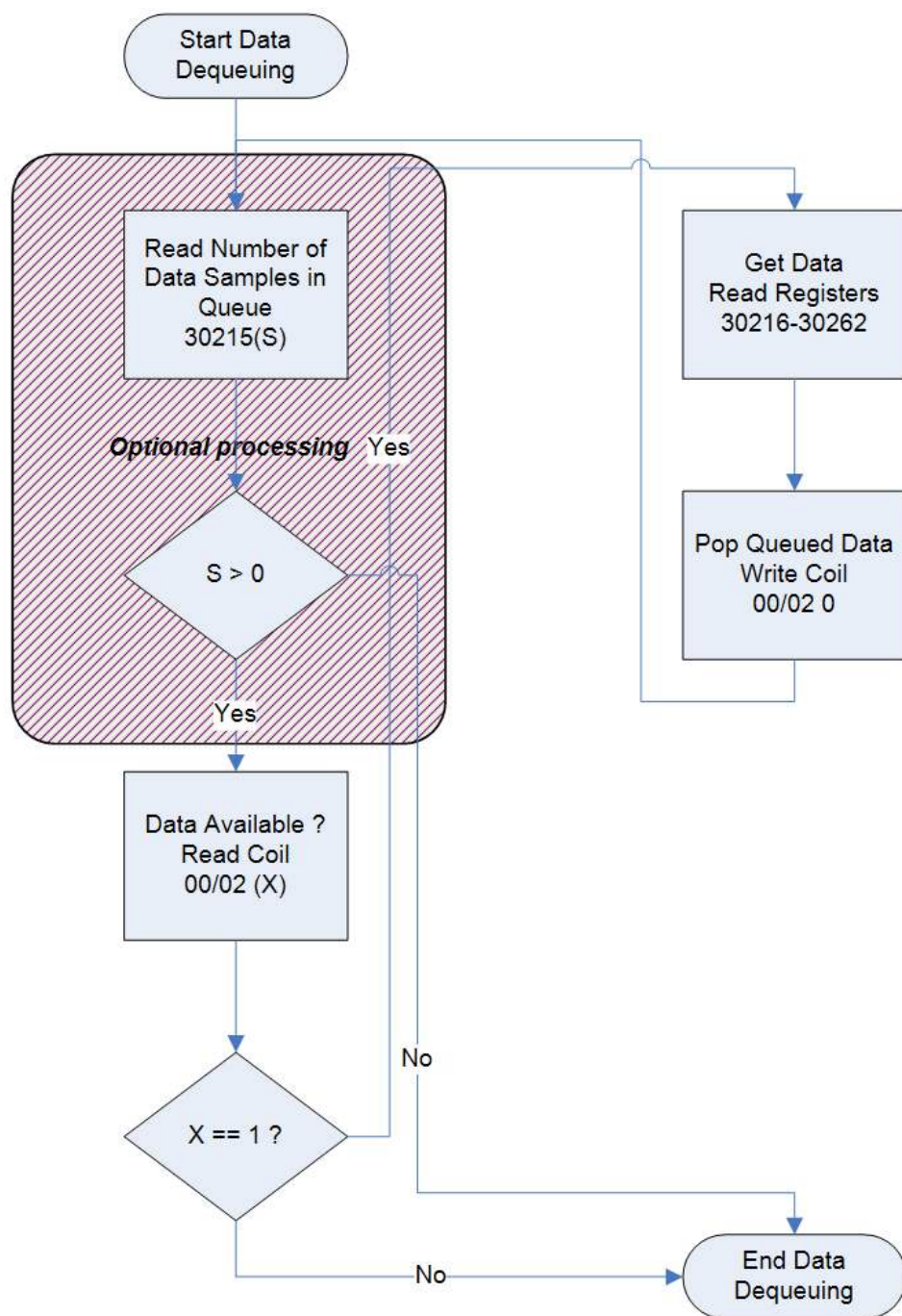


Figure D-2. Modbus Dequeuing Example

Appendix E

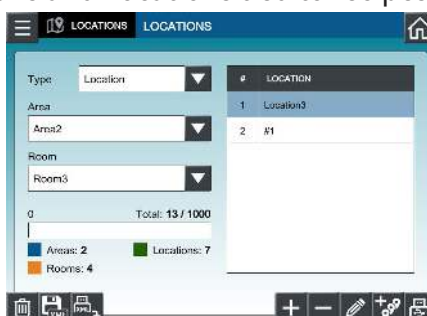
WEB API

This is the Web interface definition for the Lasair Pro instrument. The main goal of these APIs is to easily and remotely control your Lasair Pro instrument as well as to transfer samples and audit trails. Communications with the Lasair Pro particle counter via the WEB API can be done through the TCP/IP Ethernet connection at port 443. This interface allows to setup the Lasair Pro as if the user wherein front of the following instrument screens:

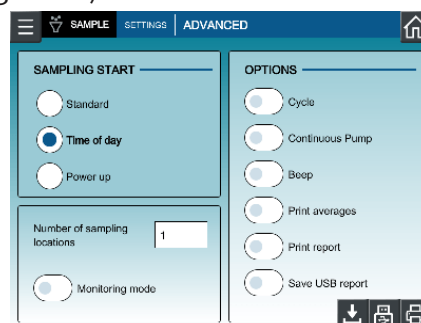
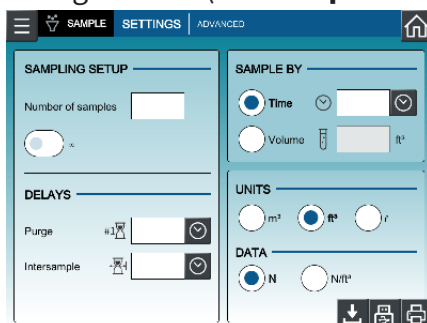
- Alarms (see **Alarms** on page E-3)



- Locations and Locations tied to recipes (see **Locations** on page E-23)



- Recipe configurations (see **Samples** on page E-31)



- Security configurations (see **Security** on page E-68)



- System setup and configuration (see **System Configuration** on page E-77)



Moreover it allows to transfer from the instrument the following databases:

- Audit trail database (see **getAuditData** on page E-18)
- All data stored in the particle database (see **getSampleData** on page E-43)

Interface Commands

Format

ExampleCommand

Definition: *Definition of the command.*

Command Code: *ACTION
code for command*

Example Script (Curl): *Example of script for command written in Curl Language*

Path Parameters: *Defined inputs for command*

Body Parameters: *Defined inputs for command*

Responses: *Possible system responses (Format: Status: ### - Response)
See **Table E-1. Bidirectional HTTP Status Codes** on page E-91*

*For Schema of 4XX codes, See **Schema for 4XX Status Responses** on page E-92*

Alarms

addAlarmReason

Definition:	Create a new alarm reason.
Command Code:	POST /v1/lproapi/alarm/reason
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/ reason"
Path Parameters:	N/A
Body Parameters:	Name: body * Description: { text: string, maxLength:32 }
Responses:	Status: 201 - Created Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden

configAlarmEnvironmental

Definition:	Setup environmental (or analog) channel alarms configuration.
Command Code:	PUT /v1/lproapi/alarm/environmental/{envId}
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/ environmental/{envId}"
Path Parameters:	Name: envId* Description: Long (int64) <i>ID of the environmental channel to modify (from 1 to 4).</i> Required

Body Parameters:	Name: body *
	Description: { channel: { <i>Environmental (or analog) channel alarm configuration.</i> enabled: boolean <i>Enable flag of the analog channel.</i> name: string, maxLength:16 <i>Name of the analog channel</i> units: string, maxLength:10 <i>Unit of the analog channel</i> min: number <i>Minimum value for alarm triggering. Values at or below the minimum value will trigger the alarm.</i> enabledMin: boolean <i>Enable/disable minimum alarm trigger.</i> max: number <i>Maximum value for alarm triggering. Values at or above the maximum value will trigger the alarm.</i> enabledMax: boolean <i>Enable/disable maximum alarm trigger.</i> } }

Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found
------------	---

configAlarmParticles

Definition:	Setup alarm particles.
Command Code:	PUT /v1/lproapi/alarm/particles/{partId}

Example Script (Curl):	<pre>curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/ particles/{partId}"</pre>
Path Parameters:	Name: partId* Description: Long (int64) <i>ID of the channel to modify (from 1 to 8).</i> Required
Body Parameters:	Name: body * Description: { warning: { <i>Warning configuration.</i> value: number <i>Triggering value of the generation of a warning.</i> enabled: boolean <i>If the warning trigger is enabled/disabled.</i> } alarm: { <i>Alarm configuration.</i> value: number <i>Triggering value of the generation of an alarm.</i> enabled: boolean <i>If the alarm trigger is enabled/disabled.</i> } }
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden

configAlarmSetting

Definition:	Setup alarm setting.
Command Code:	PUT /v1/lproapi/alarm/general
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/general"
Path Parameters:	N/A
Body Parameters:	Name: body * Description: { settings: { enableAlarms: boolean <i>Enables all alarms (particle, environmental, and trend). When it is disabled, all alarms and alarm settings are disabled. Alarms are triggered after warning limits are reached.</i> enableWarnings: boolean <i>Enables all particle warnings. When it is disabled, all warnings and warning settings are disabled. Warnings are triggered prior to alarms.</i> enableSystemAlarms: boolean <i>Enables Pump, Laser, Coincidence alarms during sampling.</i> enableAlarmReasons: boolean <i>Enables the alarm reason feature. The user may predefine up to 32 alarm reasons.</i> enableAudibleAlarms: boolean <i>Enables or disables an audible buzzer when alarm occurs.</i> } <i>continued on next page...</i>

```

reports:{
  enablePrintReport:  boolean
    Enables printing of the sampling report
    on alarm to the thermal printer.

  enableSaveUsbReport: boolean
    Enables printing on alarm to an
    attached USB key.
}
}

```

Responses:

- Status: 204 - No Content
- Status: 400 - Bad Request
- Status: 401 - Unauthorized
- Status: 403 - Forbidden
- Status: 404 - Not Found

configAlarmTrend

Definition: Modify a trend alarm of a specified channels size.

Command Code: PUT
/v1/lproapi/alarm/trend/{trendId}

Example Script (Curl):

```

curl -X PUT \
-H "Authorization: Bearer {accessToken}" \
-H "Accept: application/json" \
-H "Content-Type: application/json" \
"https://{lpro_device_address}:{port}/v1/lproapi/alarm/
trend/{trendId}"

```

Path Parameters:

- Name: trendId*
- Description: Long (int64)
ID of the channel for which the trend alarm is being modified.
Required

Body Parameters:

- Name: body *
- Description: {
trends: {
Trend alarm configuration of a specific channel size.
continued on next page...

```

enabled:    boolean
            enable/disable channel trend alarm

value:      number
            Change the triggering value of the
            trend alarm. Unit depends on the
            SampleSetting/units.

nSample:    integer, minimum:1 maximum:35
            Set the number of samples (1 to 35) to
            exceed the set VALUE before alarm is
            triggered. N is also known as Triggered
            Sample Count. This number should be
            less than or equal to the M value.

mSample:    integer, minimum:1 maximum:35
            Set the number of samples (1 to 35) to
            elapse before the alarm is triggered.
            M is also known as the Last Number of
            Samples. This number should be greater
            than or equal to the N value.

        }

    }

```

Responses:

- Status: 204 - No Content
- Status: 400 - Bad Request
- Status: 401 - Unauthorized
- Status: 403 - Forbidden
- Status: 404 - Not Found

deleteAlarmReason

Definition: Delete an alarm reason.

Command Code: DELETE
/v1/lproapi/alarm/reason/{reasonId}

Example Script (Curl):

```

curl -X DELETE\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/alarm/
reason/{reasonId}"

```

Path Parameters: Name: reasonId*
 Description: Long (int64)
 ID of reason to delete
 Required

Body Parameters: N/A

Responses: Status: 204 - No Content
 Status: 401 - Unauthorized
 Status: 403 - Forbidden
 Status: 404 - Not Found

deleteAllAlarmReason

Definition: Delete all alarm reasons.

Command Code: DELETE
 /v1/lproapi/alarm/allreasons

Example Script (Curl): curl -X DELETE\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/alarm/
 allreasons"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 204 - No Content
 Status: 401 - Unauthorized
 Status: 403 - Forbidden

getAlarmEnvironmental

Definition: Get environmental (or analog) channel alarms configuration.

Command Code: GET
 /v1/lproapi/alarm/environmental

Example Script (Curl): curl -X GET\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/alarm/
 environmental"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK

```
[ (4..4) {  
    channel: {  
        Environmental (or analog) channel alarm  
configuration.  
  
        enabled:       boolean  
                     Enable flag of the analog channel.  
  
        name:           string, maxLength:16  
                     Name of the analog channel  
  
        units:           string, maxLength:10  
                     Unit of the analog channel  
  
        min:            number  
                     Minimum value for alarm triggering.  
Values at or below the minimum value  
will trigger the alarm.  
  
        enabledMin:   boolean  
                     Enable/disable minimum alarm trigger.  
  
        max:            number  
                     Maximum value for alarm triggering.  
Values at or above the maximum value  
will trigger the alarm.  
  
        enabledMax:   boolean  
                     Enable/disable maximum alarm trigger.  
    }  
}  
]
```

 Status: 401 - Unauthorized
 Status: 403 - Forbidden

getAlarmParticles

Definition:	Get particle alarm setting.
Command Code:	GET /v1/lproapi/alarm/particles
Example Script (Curl):	curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/particles"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 200 - OK <pre>{ data: string When cumulative is enabled, particle counts will be triggered when the cumulative count reaches the warning or alarm limit set. Cumulative counts are the number of particle counts of a certain size and larger in one sample. When differential is enabled, particle counts will be triggered when the differential count reaches the warning or alarm limit set. Differential counts are the number of particle counts of a certain size in one sample.</pre> Enum: cumulative, differential <pre>warnings: [List of warnings configuration. { size: string Channel's particle size. Unit depends on the configuration of the SystemChannels/units Default: 0.5 value: number Triggering value of the generation of a warning.</pre> <i>continued on next page...</i>

```

    enabled:      boolean
                  If the warning trigger is enabled/disabled.
  }
]

alarms: [
  List of alarms configuration.
  {
    size:         string
                  Channel's particle size. Unit depends on
                  the configuration of the SystemChannels/units
                  Default: 0.5

    value:        number
                  Triggering value of the generation of an alarm.

    enabled:      boolean
                  If the alarm trigger is enabled/disabled.
  }
]

```

Status: 401 - Unauthorized

Status: 403 - Forbidden

getAlarmReasons

Definition: Get all defined alarm reasons.

Command Code: GET
/v1/lproapi/alarm/reason

Example Script (Curl):
 curl -X GET\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/alarm/
 reason"

Path Parameters: N/A

Body Parameters: N/A

Responses:	Status: 200 - OK
	<pre>[(0..30) { reason: { List of user-defined pre-set alarm reasons to for alarm acknowledgement of particle environmental alarms. enable: boolean Enabling status of the alarm reason. Default: true id: integer, minimum:1 text: string, minLength:1 } } }]</pre>
select or	
maximum:30	Identifier of the alarm reason. Up to 30 different alarm reasons can be defined.
maxLength:32	Alarm reason text defined by the user.
	Status: 401 - Unauthorized
	Status: 403 - Forbidden

getAlarmSettings

Definition:	Get current general alarm setting.
Command Code:	GET /v1/lproapi/alarm/general
Example Script (Curl):	<pre>curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/ general"</pre>
Path Parameters:	N/A
Body Parameters:	N/A

Responses:

Status: 200 - OK

```
{ settings: {  
    enableAlarms:      boolean  
        Enables all alarms (particle, environmental,  
        and trend). When it is disabled, all alarms and  
        alarm settings are disabled. Alarms are  
        triggered after warning limits are reached.  
    enableWarnings:    boolean  
        Enables all particle warnings. When it is  
        disabled, all warnings and warning settings  
        are disabled. Warnings are triggered prior to  
        alarms.  
    enableSystemAlarms: boolean  
        Enables Pump, Laser, Coincidence alarms during  
        sampling.  
    enableAlarmReasons: boolean  
        Enables the alarm reason feature. The user may  
        predefine up to 32 alarm reasons.  
    enableAudibleAlarms: boolean  
        Enables or disables an audible buzzer when alarm  
        occurs.  
    }  
  reports: {  
    enablePrintReport:  boolean  
        Enables printing of the sampling report on alarm  
        to the thermal printer.  
    enableSaveUsbReport: boolean  
        Enables printing on alarm to an attached USB key.  
    }  
  }
```

Status: 401 - Unauthorized

Status: 403 - Forbidden

getAlarmTrend

Definition:	Get trend alarms for all defined channels size.
Command Code:	GET /v1/lproapi/alarm/trend
Example Script (Curl):	curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/trend"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 200 - OK <pre>[{ trends: { Trend alarm configuration of a specific channel size. enabled: boolean enabled/disabled channel trend alarm size: string Channel's particle size. value: number Change the triggering value of the trend alarm. Unit depends on the SampleSetting/units. nSample: integer, minimum:1 maximum:35 Set the number of samples (1 to 35) to exceed the set VALUE before alarm is triggered. N is also known as Triggered Sample Count. This number should be less than or equal to the M value. mSample: integer, minimum:1 maximum:35 Set the number of samples (1 to 35) to elapse before the alarm is triggered. M is also known as the Last Number of Samples. This number should be greater than or equal to the N value. } }]</pre> Status: 401 - Unauthorized Status: 403 - Forbidden

modifyAlarmReason

Definition:	Modify an alarm reason.
Command Code:	PUT /v1/lproapi/alarm/reason/{reasonId}
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/ reason/{reasonId}"
Path Parameters:	Name: reasonId* Description: Long (int64) <i>ID of reason to modify.</i> Required
Body Parameters:	Name: body * Description: { enabled: boolean <i>Enabled/disabled state of new alarm reason</i> text: string, maxLength:32 }
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

setAlarmParticleDataType

Definition:	Set particle data type to cumulative or differential.
Command Code:	PUT /v1/lproapi/alarm/particle/data
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/alarm/ particle/data"
Path Parameters:	N/A

Body Parameters:	Name: body * Description: { data: string <i>When cumulative is enabled, particle counts will be triggered when the cumulative count reaches the warning or alarm limit set. Cumulative counts are the number of particle counts of a certain size and larger in one sample. When differential is enabled, particle counts will be triggered when the differential count reaches the warning or alarm limit set. Differential counts are the number of particle counts of a certain size in one sample.</i> Enum: cumulative, differential }
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden

ApiVersion

getInstrumentApiVersion

Definition:	Get latest API version.
Command Code:	GET /lproapi/rest/api
Example Script (Curl):	curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/rest/api"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 200 - OK { Required: firmwareVersion,restApiVersion firmwareVersion: string <i>Provides information on the firmware version</i> restApiVersion: integer <i>Provides information on the rest API version</i> }

Audit

deleteAuditData

Definition:	Clears all current audit trail records from the Lasair Pro.
Command Code:	DELETE /v1/lproapi/audit/database
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/audit/ database"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden

getAuditData

Definition:	Get all audit data stored in the LasairPro.
Command Code:	GET /v1/lproapi/audit/database
Example Script (Curl):	curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/audit/ database"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 200 - OK [{ total_count: integer Total number of audit trail entries available continued on next page...

```
audit_data: [  
  Audit trail entries available  
  {  
    id: integer minimum:1  
      Sequence counter of the audit.  
    activityType: string  
      Activity type that triggered the audit.  
    date: string  
      Date of when the activity occurred.  
    time: string  
      Time of when the activity occurred.  
    user: string  
      User that triggered the audit.  
    data: string  
      Description of the activity that  
      triggered the audit.  
  }  
]  
}
```

Status: 401 - Unauthorized

Status: 403 - Forbidden

Authorization

generateToken

Definition: Generate the token for the user.

Command Code: POST
/lproapi/oauth/token

Example Script (Curl):
curl -X POST\
-H "Authorization: Basic {basicHash}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/oauth/
token"

Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 200 - OK <pre>{ Required: access_token,expiration_time,token_type access_token: string Access token to be used for next requests. expiration_time: integer Duration of the token in seconds. token_type: integer }</pre> Status: 403 - Forbidden

Instrument Control

getsSamplingStatus

Definition:	Gets the sampling status on the LasairPro.
Command Code:	GET /v1/lproapi/hostcontrol/samplingStatus
Example Script (Curl):	<pre>curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ hostcontrol/samplingStatus"</pre>
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 200 - OK <pre>{ laser: { status: string Indicates laser status Default: Ok Enum: Ok, Failure } }</pre>

continued on next page...

```

        mode:      string
                   Indicates laser mode
                   Default: Off
                   Enum: Off, On
      }
    flow: {
      rate:        number
                   Indicated pump flow rate value.

      status:      string
                   Indicates pump status
                   Default: Ok
                   Enum: Ok, Failure

      mode:        string
                   Indicates pump mode
                   Default: Off
                   Enum: Off, On
    }
  }

```

Status: 400 - Bad Request
 Status: 403 - Forbidden

releaseToken

Definition:	Stops the control of the instrument from a remote host and invalidates the current token.
Command Code:	POST /v1/lproapi/hostcontrol/releaseToken
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ hostcontrol/releaseToken"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 403 - Forbidden

startSampling

Definition:	Starts the sampling on the LasairPro.
Command Code:	POST /v1/lproapi/hostcontrol/startSampling
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ hostcontrol/startSampling"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 403 - Forbidden

stopSampling

Definition:	Stops the sampling on the LasairPro.
Command Code:	POST /v1/lproapi/hostcontrol/stopSampling
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ hostcontrol/stopSampling"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 403 - Forbidden

Locations

configLocationArea

Definition:	Modify the specified area id.
Command Code:	PUT /v1/lproapi/location/areas/{areaid}
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/location/ areas/{areaid}"
Path Parameters:	Name: areaid* Description: Long (int64) <i>ID of area to modify.</i> Required
Body Parameters:	Name: body * Description: { name: string }
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

configLocationLocations

Definition:	Modify the specified location id.
Command Code:	PUT /v1/lproapi/location/locations/{locId}
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/location/ locations/{locId}"

Path Parameters:	Name: locId*
	Description: Long (int64) <i>ID of location to modify.</i> Required
Body Parameters:	Name: body *
	Description: { name: string pid: integer }
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

configLocationRoom

Definition:	Modify the specified room id.
Command Code:	PUT /v1/lproapi/location/rooms/{roomId}
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/rooms/{roomId}"
Path Parameters:	Name: roomId*
	Description: Long (int64) <i>ID of room to modify.</i> Required
Body Parameters:	Name: body *
	Description: { name: string pid: integer }
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

createLocationAreas

Definition:	Create a new area.
Command Code:	POST /v1/lproapi/location/areas
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/areas"
Path Parameters:	N/A
Body Parameters:	Name: body * Description: { name: string }
Responses:	Status: 201 - Created Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden

createLocationLocations

Definition:	Create a new location.
Command Code:	POST /v1/lproapi/location/locations
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/locations"
Path Parameters:	N/A
Body Parameters:	Name: body * Description: { name: string pid: integer }
Responses:	Status: 201 - Created Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden

createLocationRooms

Definition:	Create a new room.		
Command Code:	POST /v1/lproapi/location/rooms		
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/rooms"		
Path Parameters:	N/A		
Body Parameters:	Name:	body *	
	Description:	{ name:	string
		pid:	integer }
Responses:	Status: 201 - Created Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden		

deleteAllLocations

Definition:	Delete all locations, including areas, rooms and locations.		
Command Code:	DELETE /v1/lproapi/location/all		
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/all"		
Path Parameters:	N/A		
Body Parameters:	N/A		
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden		

deleteArea

Definition:	Delete the specified area id.
Command Code:	DELETE /v1/lproapi/location/areas/{areaid}
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/areas/{areaid}"
Path Parameters:	Name: areaid* Description: Long (int64) <i>ID of area to modify.</i> Required
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

deleteLocation

Definition:	Delete the specified location id.
Command Code:	DELETE /v1/lproapi/location/locations/{locId}
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/locations/{locId}"
Path Parameters:	Name: locId* Description: Long (int64) <i>ID of location to modify.</i> Required
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

deleteRoom

Definition:	Delete the specified room id.
Command Code:	DELETE /v1/lproapi/location/rooms/{roomId}
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/rooms/{roomId}"
Path Parameters:	Name: roomId* Description: Long (int64) <i>ID of room to modify.</i> Required
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

getLocationAreas

Definition:	Get all defined areas.
Command Code:	GET /v1/lproapi/location/areas
Example Script (Curl):	curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ location/areas"
Path Parameters:	N/A
Body Parameters:	N/A

Responses:

```

Status: 200 - OK
[ (0..1000) {
    id: integer minimum:1
        Unique identifier of the area.

    name: string, minLength:1 maxLength:16
  }
]

Status: 401 - Unauthorized
Status: 403 - Forbidden

```

getLocationLocations

Definition: Get all defined sampling locations.

Command Code: GET
/v1/lproapi/location/locations

Example Script (Curl):
 curl -X GET\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/location/locations"

Path Parameters: N/A

Body Parameters: N/A

Responses:

```

Status: 200 - OK
[ (0..1000) {
    id: integer minimum:1
        Unique identifier of the location for the
        relative parent id (room id).

    pid: integer
        Parent identifier Id (room id). Set to 0
        when the room is not assigned.

    name: string minLength:1 maxLength:16
  }
]

Status: 401 - Unauthorized
Status: 403 - Forbidden

```

getLocationRooms

Definition: Get all defined rooms.

Command Code: GET
/v1/lproapi/location/rooms

Example Script (Curl):
curl -X GET\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/
location/rooms"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK
[(0..1000) {
 id: integer minimum:1
 *Unique identifier of the location for the
relative parent id (room id).*
 pid: integer
 *Parent identifier Id (room id). Set to 0
when the room is not assigned.*
 name: string minLength:1
 maxLength:16
 }
]
Status: 401 - Unauthorized
Status: 403 - Forbidden

Samples

deleteAllRecipe

Definition:	Delete all recipes stored in the Lasair Pro.
Command Code:	DELETE /v1/lproapi/sample/allrecipes
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ sample/allrecipes"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden

deleteRecipe

Definition:	Delete recipe.
Command Code:	DELETE /v1/lproapi/sample/recipe/{recipeId}
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ sample/recipe/{recipeId}"
Path Parameters:	Name: recipeId* Description: Long (int64) <i>ID of recipe to be deleted.</i> Required
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

deleteSampleData

Definition:	Clears the sample database from the Lasair Pro.
Command Code:	DELETE /v1/lproapi/sample/database
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ sample/database"
Path Parameters:	N/A
Body Parameters:	N/A
Responses:	Status: 204 - No Content Status: 401 - Unauthorized Status: 403 - Forbidden

getRecipe

Definition:	Get recipe's detailed description.
Command Code:	GET /v1/lproapi/sample/recipe/{recipeId}
Example Script (Curl):	curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ sample/recipe/{recipeId}"
Path Parameters:	Name: recipeId* Description: Long (int64) <i>ID of recipe to get.</i> Required
Body Parameters:	N/A

Responses:

Status: 200 - OK

```

{
  Recipe's definition.

  recipe: {
    Recipes' info.

    recid:      integer
               Recipe identifier.

    name:       string
               Recipe name.

    type:       integer
               Recipe type: 0=Normal, 1=Monitoring, 2=Statistics.
               Enum: 0, 1, 2

    samplinglocsNum: integer,
                     minimum:1 maximum:1000
                     Number of sampling locations (if Monitoring
                     /Statistics recipe, it must be greater than 1).

    assignments: [ (0..500)
                  List of recipe-locations assignment

                  [ (0..1000)
                  List of locations associated to
                  the recipe.

                  integer
                  Location identifier.
                  ]
                ]
  }

  details: undefined
  one of: {
    Normal/Monitoring recipe's details definition.

    setting: {
      setup: {
        enableCount:      boolean
                       Enable/disable continuous sampling.
                       Sampling will continue with the set
                       configuration until the user presses
                       the Stop button on the HOME screen.

```

continued on next page...

```

        numberOfSamples: integer
        Number of samples to be performed.
    }

    delays: {
        purge: string
        Initial delay before the start of sampling.
        Default: 00:00:00

        intersample: string
        Delay between samples if number of samples is > 1.
        Default: 00:00:00
    }

    sampleBy: {
        sampleType: string
        Value can be time or volume.
        Default: time
        Enum: time, volume

        time: string
        Time value when by time is selected.
        Form HH:MM:SS.
        Default: 00:00:00

        volume: number
        Volume value when by volume is selected.
    }

    units: string
    normalized particle count volume unit.
    It can be cbm, cft, l.
    Enum: cbm, cft, l

    data: string
    particle counts can be shown as either raw
    or normalized counts. The options include
    raw and normilized (normalized counts per
    volume unit: cubic meter, cubic foot, or liter).
    Enum: raw, normalized
    
```

continued on next page...

samplingStart: string

How the sampling will start. It can be “standard” with the home screen, “time of day” sampling will start based on the user-configured time, “power up” sampling will start when the instrument is powered on.

Enum: standard, time of day, power up

monitoringMode: {

Monitoring mode uses preconfigured sampling plans for locations. When enabled, changes to sampling plans and their associated locations are restricted until the monitoring plan has been completed or cancelled. This mode works best when sampling plans are saved as recipes and assigned to locations.

numberSamplingLocations: integer

minimum:2

Number of sampling locations in monitoring mode.

monitoringModeEnabled: boolean

Enables/disables the use of preconfigured sampling plans for locations.

locIds: [(0..1000) integer

Location identifiers. The number of elements of this array has to be less or equal to the value of numberSamplingLocations. If the number is less, the instrument shall generate automatically virtual locations, one per each undefined location.

]

}

continued on next page...

```

options: {
    List of options can be enabled or disabled.

    cycle:                boolean
        Enables/disables continuous collection
        of samples.

    continuousPump:       boolean
        Enables/disables pump activity outside
        of sampling operation.

    beep:                 boolean
        Enables/disables audio cue when a
        certain number of particles are counted.

    PrintAverages:        boolean
        Enables/disables average particle
        counts for each configure channel size
        in the printed report.

    printReport:          boolean
        Enables/disables print of final sample
        report using the thermal printer.

    saveUsbReport:        boolean
        Enables/disables save of final sample
        report to a PDF report.

}

particleChannels: {
    Particle channels on the instrument.

    channels: [ (2..8) {
        channel: {

            id:            integer minimum:1 maximum:8
                Channel identifier.

            size:          number
                Size of the channel in nanometers or
                micrometers.

        }
    }
    ]
}

```

continued on next page...

```
alarmGeneral: {  
  settings: {  
    enableAlarms:    boolean  
      Enables all alarms (particle,  
      environmental, and trend). When it is  
      disabled, all alarms and alarm settings  
      are disabled. Alarms are triggered after  
      warning limits are reached.  
  
    enableWarnings:  boolean  
      Enables all particle warnings. When it  
      is disabled, all warnings and warning  
      settings are disabled. Warnings are  
      triggered prior to alarms.  
  
    enableSystemAlarms: boolean  
      Enables Pump, Laser, Coincidence  
      alarms during sampling.  
  
    enableAlarmReasons: boolean  
      Enables the alarm reason feature. The  
      user may predefine up to 32 alarm  
      reasons.  
  
    enableAudibleAlarms: boolean  
      Enables or disables an audible buzzer  
      when alarm occurs.  
  }  
  reports: {  
    enablePrintReport:  boolean  
      Enables printing of the sampling report  
      on alarm to the thermal printer.  
  
    enableSaveUsbReport: boolean  
      Enables printing on alarm to an  
      attached USB key.  
  }  
}
```

continued on next page...

```
alarmParticles: {
  data:      string
             When cumulative is enabled, particle counts
             will be triggered when the cumulative count
             reaches the warning or alarm limit set.
             Cumulative counts are the number of particle
             counts of a certain size and larger in one
             sample. When differential is enabled, particle
             counts will be triggered when the differential
             count reaches the warning or alarm limit set.
             Differential counts are the number of particle
             counts of a certain size in one sample.
             Enum: cumulative, differential

  warnings: [
             List of warnings configuration.
             {
               size:      string
                       Channel's particle size. Unit
                       depends on the configuration of the
                       SystemChannels/units
                       Default: 0.5

               value:     number
                       Triggering value of the generation of a
                       warning.

               enabled:   boolean
                       If the warning trigger is enabled/
                       disabled.
             }
           ]

  alarms: [
             List of alarms configuration.
             {
               size:      string
                       Channel's particle size. Unit
                       depends on the configuration of the
                       SystemChannels/units
                       Default: 0.5
```

continued on next page...

```

        value:      number
                     Triggering value of the generation of a
                     warning.
        enabled:    boolean
                     If the warning trigger is enabled/
                     disabled.
    }
}

alarmEnvironmental:{
    channel: {
        Environmental (or analog) channel alarm
        configuration.

        enabled:    boolean
                     Enable flag of the analog channel.

        name:       string, maxLength:16
                     Name of the analog channel

        units:      string, maxLength:10
                     Unit of the analog channel

        min:        number
                     Minimum value for alarm triggering.
                     Values at or below the minimum value
                     will trigger the alarm.

        enabledMin: boolean
                     Enable/disable minimum alarm trigger.

        max:        number
                     Maximum value for alarm triggering.
                     Values at or above the maximum value
                     will trigger the alarm.

        enabledMax: boolean
                     Enable/disable maximum alarm trigger.
    }
}

```

continued on next page...

```
alarmTrend:{
  trends: {
    Trend alarm configuration of a specific
    channel size.

    enabled:    boolean
                enable/disable channel trend alarm

    value:      number
                Change the triggering value of the
                trend alarm. Unit depends on the
                SampleSetting/units.

    nSample:    integer,
                minimum:1 maximum:35
                Set the number of samples (1 to 35) to
                exceed the set VALUE before alarm is
                triggered. N is also known as Triggered
                Sample Count. This number should be
                less than or equal to the M value.

    mSample:    integer,
                minimum:1 maximum:35
                Set the number of samples (1 to 35) to
                elapse before the alarm is triggered.
                M is also known as the Last Number of
                Samples. This number should be
                greater than or equal to the N value.
  }
}

{
Statistics recipe's details definition.
  setting: {
    certificationStandard: {

      standard:    string

      class:       string

      flow:        string

      roomState:   string
    }
  }
}
```

continued on next page...

```
        standardUnits:      string
        areaUnits:          string
        particleSizes: [ (1..8)      integer]
    }
    samplingPlan: {
        area:                number
        numberOfSamples:     integer
                           minimum:1 maximum:4999
        sampleVolume:       number
    }
    delays: {
        purge:               string
                           Initial delay before the start of
                           sampling.
                           Default: 00:00:00
        intersample:         string
                           Delay between samples if number of
                           samples is > 1.
                           Default: 00:00:00
    }
    options: {
        autoTrack:           boolean
        sampleConfirmation:  boolean
    }
}
```

continued on next page...

```

particleChannels: {
  Particle channels on the instrument.

  channels: [ (2..8) {
    channel: {

      id:          integer minimum:1 maximum:8
                  Channel identifier.

      size:        number
                  Size of the channel in nanometers or
                  micrometers.

    }
  }
]
}

```

Status: 401 - Unauthorized

Status: 403 - Forbidden

Status: 404 - Not Found

getRecipeList

Definition: Get list of all recipes stored in the Lasair Pro.

Command Code: GET
/v1/lproapi/sample/allrecipes

Example Script (Curl):
 curl -X GET\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/sample/
 allrecipes"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK
 {
 List of instrument recipes.

```

  recipes: [(0..100)
    Recipes' info.
    {

```

continued on next page...

```

    recid:      integer
               Recipe identifier.

    name:       string
               Recipe name.

    type:       integer
               Recipe type: 0=Normal, 1=Monitoring, 2=Statistics.
               Enum: 0, 1, 2

    samplinglocsNum: integer,
                    minimum:1 maximum:1000
                    Number of sampling locations (if Monitoring
                    /Statistics recipe, it must be greater than 1).

    assignments: [ (0..500)
                  List of recipe-locations assignment

                  [ (0..1000)
                    List of locations associated to
                    the recipe.

                    integer
                    Location identifier.
                  ]
                ]
            }
        ]
    }

```

Status: 401 - Unauthorized

Status: 403 - Forbidden

getSampleData

Definition: Get the full sample data stored in the LasairPro.

Command Code: GET
/v1/lproapi/sample/database

Example Script (Curl):
curl -X GET\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/
sample/database"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK

```
{
  SampleHeader: {
    id:          string maxLength:64
                Customer assigned instrument ID

    serialNumber: string maxLength:16
                PMS assigned serial number

    model:       string maxLength:16
                Particle Measuring Systems assigned model

    calDate:     string
                Calibration date as MM/DD/YYYY

    particleChannels: {
      numChan:    integer minimum:2 maximum:8
                Total number of particle channels.

      units:      string
                Configured unit of the channels. It can
                be mirco or nano meters.
                Enum: um, nm

      particleCountUnits: string
                Particle count units which depends on
                the current quantitiy filter (differential
                or cumulative), volume units and if the
                normalization is enabled.
                Enum:  $\Delta m^3$ ,  $\Delta ft^3$ ,  $\Delta l$ ,  $\Delta N/m^3$ ,  $\Delta N/ft^3$ ,  $\Delta N/l$ ,  $\Sigma m^3$ ,
                 $\Sigma ft^3$ ,  $\Sigma l$ ,  $\Sigma N/m^3$ ,  $\Sigma N/ft^3$ ,  $\Sigma N/l$ 

      qntFilter:   string
                Current quantity filter type: it can be
                differential ( $\hat{I}$ ) or cumulative ( $\hat{I}$ ).
                Enum: differential, cumulative
    }
  }
}
```

continued on next page...

```

channels: [ (2..8) {
  channel: {
    id: integer minimum:1 maximum:8
      Channel identifier.

    size: number
      Size of the channel in nanometers or micrometers.
  }
} ]
}
}

```

Samples: {
(For more details about this section, contact PMS)
 monitoring: {
 samples: [
 {
 sample: {
 data: {
 packet_id: integer
Packet ID of sample

 timeStamp: string
UNIX time when sample was completed by instrument (adjusted for timezone).

 area: string
Area instrument recorded this sample in.

 room: string
Room instrument recorded this sample in.

 location: string
Room instrument recorded this sample in.

 batchId: string
Batch this sample was recorded in.

continued on next page...

```

user:                string
    User operating instrument when this
    sample was recorded.

interval:            string
    Configured interval in HH:MM:SS format.

volume: {
    Volume of air for which instrument
    sampled.
    value:            number
        Volume value.

    units:            string
        The units for volume of air in
        cubic feet, cubic meters, or liters.
        Enum: m3, ft3, l

    }

cycle:               string
    Current cycle in the format cycle/
    totalCycle.

status: {
    Status of instrument during the sample.
    isValid:          boolean
        1 = Sample is valid,
        0 = Sample is invalid.

    laserOk:          boolean
        1 = No laser error during sample,
        0 = Laser error during sample.

    flowOk:           boolean
        1 = Flow rate maintained within
        5% of nominal flow rate during
        sample,
        0 = Flow rate not maintained
        during sample.

    coincOk:          boolean
        1 = No coincidence error
        during sample,
        0 = coincidence error during
        sample.

    }

```

continued on next page...

```

particles: {
    units: string
        Particle channel units which can
        be nanometers or micrometers.
        Enum: um, nm

    samples: [
        Particle counts for each particle
        channel during sample.
        {
            size: number
                Channel size in
                micrometers or
                nanometers.

            value: integer
                Maximum:4294967295
                Raw particle counts for
                the channel instrument
                recorded during sample.

            normalizedValue: integer
                Maximum:4294967295
                Normalized value of
                particle counts respect
                to the volume.
        }
    ]
}

analogs: [
    Raw particle counts for Channel [N]
    instrument recorded during sample.
    {
        name: string
            Configured analog name.

        enable: boolean
            true = Channel enabled during
            sampling, false = Channel
            disabled during sampling.
    }
]

```

continued on next page...

```

        average:          number
                        Minimum:-9999999
                        maximum:999999
                        Average value of scaled and
                        adjusted analog channel during
                        sample. null is used to indicate
                        invalid (or unused in case of
                        channel disabled) value.

        min:              number
                        minimum:-9999999
                        maximum:999999
                        Minimum value of scaled
                        and adjusted analog channel
                        during sample. null is used to
                        indicate invalid (or unused in
                        case of channel disabled) value

        max:              number
                        minimum:-9999999
                        maximum:999999
                        Maximum value of scaled
                        and adjusted analog channel
                        during sample. null is used to
                        indicate invalid (or unused in
                        case of channel disabled) value.
    }
]

alarms: [
    State of the particle and analog alarms
    during sample.
    {
        particles: {
            warnings: [
                Particle alarms set for
                the sample.

                [
                    Particle warnings set for
                    the sample.

```

continued on next page...

```

{
  value:      number
  maximum:99999999
  Raw particle counts
  for Channel [N]
  instrument recorded
  during sample.

  enable:     boolean
  1 = This channel warning
  enabled, 0 = This
  channel warning
  disabled.
}
]
]
alarms:[
  Particle alarms set for
  the sample.

  [
    Particle warnings set for
    the sample.
    {

      value:      number
      maximum:99999999
      Raw particle counts
      for Channel [N]
      instrument recorded
      during sample.

      enable:     boolean
      1 = This channel warning
      enabled, 0 = This
      channel warning
      disabled.
    }
  ]
]
}

```

continued on next page...

```

analog: [
    Analog warnings and
    alarms set for the sample
    [
        [
            {
                name:      string

                min:        number
                minimum:-9999999
                maximum:999999
                Minimum value of
                analog channel during
                sample. Less than this
                value will trigger
                the alarm.

                minEnable:  boolean
                true = This channel
                alarm enabled,
                false = This channel
                alarm disabled.

                max:        number
                minimum:-9999999
                maximum:999999
                Maximum value of
                analog channel during
                sample. Less than this
                value will trigger
                the alarm.

                maxEnable:  boolean
                true = This channel
                alarm enabled,
                false = This channel
                alarm disabled.
            }
        ]
    ]
]

```

continued on next page...

```
trendAlarms: [  
  {  
    channel:      integer  
    maximum:100000  
  
    Particle size in nanometers of  
    the particle channel assigned to  
    this trend alarm channel [N]. 0  
    indicates a particle channel was  
    not assigned to this trend alarm  
    channel [N].  
  
    value:        number  
    maximum:99999999  
    Raw counts that triggered the  
    trend alarm when the instrument  
    recorded the sample.  
  
    enable:       boolean  
    1 = Trend alarm enabled, 0 =  
    Trend alarm disabled  
  
    n:            integer  
    maximum:40  
    The n portion of the n out of m  
    samples value of the trend (also  
    known as Triggered Sample  
    Count).  
  
    m:            integer  
    maximum:40  
    The m portion of the n out of m  
    samples value of the trend.  
  }  
]
```

continued on next page...

```

        alarmReason:      string
                          maxLength:32
                          Customer assigned
                          alarm reason for
                          triggered alarms.
      }
    ]
  }

  plan: {
    name:                string
                       Name of monitoring
                       plan. This may be blank.

    timestamp:           string
                       Date time when plan was
                       started.

    state:               string
                       Status of the plan. It can be passed,
                       failed or incomplete.
                       Enum: Failed, Passed, Incomplete

    monitoringMode: {
      startType:         integer
                       Sampling start type. NORMAL
                       is started via GUI button.
                       POWERUP is start
                       sampling on instrument power
                       up. BYTIME is instrument will
                       sample for a set period of time.
                       0="NORMAL" 1="POWERUP"
                       2="BYTIME".
                       Enum: 0, 1, 2

      count:             integer
                       Number of samples per sample
                       group for this plan. -1 means
                       continuous sampling.

      sampleByVolume:    boolean
                       true=Sample by Volume,
                       false=Sample by Time.
    }
  }

```

continued on next page...

sampleTime: integer
minimum:6 maximum:86399
Number of seconds for each sample. This value is only set if sampleByVolume is set to 0.

sampleVolume: number
Sample volume for each sample. This value is only set if sampleByVolume is set to 1.

sampleUnits: integer
Units of the sampleVolume element when sampleByVolume is set to 1. Volumetric Normalization Factor units when sampleByVolume is set to 0. 4="ft3" 5="m3" 6="l".
Enum: 4, 5, 6

isNorm: boolean
true=Display Volumetric Normalization and particle alarms are for normalized counts, false=Do not display Volumetric Normalization and particle alarms are not for normalized counts.

purgeDelay: integer
maximum:359999
Number of seconds for purge delay.

interSampleDelay: integer
maximum:359999
Number of seconds for inter-sample delay.

numMonitoringLocation: integer
maximum:1000
Number of locations to monitor.

continued on next page...

```

printSample: {
    enable:          boolean
                   true=Generate printed
                   report after each sample.
                   false=Do not generate a
                   printed report after each
                   sample.
}
printSampleUsb: {
    enable:          boolean
                   true=Generate USB
                   MHT Report after each
                   sample. false=Do not
                   generate a USB MHT
                   Report after each
                   sample.
}
printAvg: {
    Generate Average Report
    for each sample. Generate on
    USB if printSampleUSB
    enable attribute is set
    to true, print report if
    printSampleUSB enable
    attribute is set to false.

    enable:          boolean
                   true=Generate Average
                   Report. false=Do not
                   generate Average Report.
}
contPump: {
    Activate continuous pump
    mode when customer loads a
    recipe.

    enable:          boolean
                   true=Activate continuous
                   pump mode. false=Do
                   not activate continuous
                   pump mode.
}

```

continued on next page...

```

groupRepeatMode: {
    Repeat sample cycle group after
    last sample is taken.

    enable:          boolean
                    true=Repeat the sample
                    cycle group. false=Do not
                    repeat the sample cycle
                    group.

}

beepMode: {
    Load beep mode when
    customer loads a recipe.

    enable:          boolean
                    true=Load Beep Mode.
                    false=Do not load Beep
                    Mode.

}

}

}

}

}

}

statistics: {
    samples:[
        {
            sample: {
                data: { }
                (See monitoring: > samples: > sample: >data: { } above)

                plan: {
                    name:          string
                            Name of monitoring
                            plan. This may be blank.

                    timestamp:      string
                            Date time when plan was
                            started.

                    state:          string
                            Status of the plan. It can be passed,
                            failed or incomplete.
                    Enum: Failed, Passed, Incomplete

```

continued on next page...

```

statisticsMode: {
    units: integer
        The units for the selected Standard which may be square feet or square meters. 4="cubic feet" 5="cubic meters".
        Enum: 4, 5

    flow: integer
        The type of flow for the selected Standard: 0="unidirectional" 1="multidirectional".
        Enum: 0, 1

    standard: integer
        Class for this statistics plan. 0="FS209", 1="EUGMP", 2="ISO14644_2015", 3="AVERAGE", 4="EUGMP_2022"
        Enum: 0, 1, 2, 3, 4

    mode: integer
        Room state is Static or Dynamic 0="Static" 1="Dynamic".
        Enum: 0, 1

    particleSizeMask: integer
        maximum:63
        Each bit represents an activated particle size for the selected Standard.
        0x00000001="0.3"
        0x00000002="0.5"
        0x00000004="1.0"
        0x00000008="5.0"
        0x00000010="10.0"
        0x00000020="25.0".

    area: {
        Area of the room in which this statistics plan will run.
        value: number
    }

```

continued on next page...


```
samples:{
  samples:{
    data: { }
    (See monitoring: > samples: > sample: >data: { } above)
  }
}
}
```

Status: 401 - Unauthorized

Status: 403 - Forbidden

getSampleSetting

Definition: Get current sample setup configuration as for the config.

Command Code: GET
/v1/lproapi/sample/setting

Example Script (Curl):
curl -X GET\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/sample/setting"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK

```
setup: {
  enableCount:      boolean
                    Enable/disable continuous sampling.
                    Sampling will continue with the set
                    configuration until the user presses
                    the Stop button on the HOME screen.
  numberOfSamples:  integer
                    Number of samples to be performed.
}
```

continued on next page...

```

delays: {
    purge: string
        Initial delay before the start of sampling.
        Default: 00:00:00

    intersample: string
        Delay between samples if number of samples is > 1.
        Default: 00:00:00
}
sampleBy: {
    sampleType: string
        Value can be time or volume.
        Default: time
        Enum: time, volume

    time: string
        Time value when by time is selected.
        Form HH:MM:SS.
        Default: 00:00:00

    volume: number
        Volume value when by volume is selected.
}

units: string
    normalized particle count volume unit.
    It can be cbm, cft, l.
    Enum: cbm, cft, l

data: string
    particle counts can be shown as either raw or normalized counts. The options include raw and normilized (normalized counts per volume unit: cubic meter, cubic foot, or liter).
    Enum: raw, normalized

samplingStart: string
    How the sampling will start. It can be “standard” with the home screen, “time of day” sampling will start based on the user-configured time, “power up” sampling will start when the instrument is powered on.
    Enum: standard, time of day, power up

```

continued on next page...

monitoringMode: {

Monitoring mode uses preconfigured sampling plans for locations. When enabled, changes to sampling plans and their associated locations are restricted until the monitoring plan has been completed or cancelled. This mode works best when sampling plans are saved as recipes and assigned to locations.

numberSamplingLocations: integer
minimum:2
Number of sampling locations in monitoring mode.

monitoringModeEnabled: boolean
Enables/disables the use of preconfigured sampling plans for locations.

locIds: [(0..1000) integer
Location identifiers. The number of elements of this array has to be less or equal to the value of numberSamplingLocations. If the number is less, the instrument shall generate automatically virtual locations, one per each undefined location.
]
}

options: {

List of options can be enabled or disabled.

cycle: boolean
Enables/disables continuous collection of samples.

continuousPump: boolean
Enables/disables pump activity outside of sampling operation.

beep: boolean
Enables/disables audio cue when a certain number of particles are counted.

continued on next page...

PrintAverages: boolean
Enables/disables average particle counts for each configure channel size in the printed report.

printReport: boolean
Enables/disables print of final sample report using the thermal printer.

saveUsbReport: boolean
Enables/disables save of final sample report to a PDF report.

}

Status: 401 - Unauthorized

Status: 403 - Forbidden

loadRecipe

Definition: Load a saved recipe in the instrument.

Command Code: POST
/v1/lproapi/sample/recipe/load/{recipeId}

Example Script (Curl):
curl -X POST\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/sample/recipe/load/{recipeId}"

Path Parameters: Name: recipeId*
Description: Long (int64)
ID of recipe to load.
Required

Body Parameters: N/A

Responses:
Status: 201 - Created
Status: 400 - Bad Request
Status: 401 - Unauthorized
Status: 403 - Forbidden
Status: 404 - Not Found

saveRecipe

Definition: Save current settings in a recipe.

Command Code: POST
/v1/lproapi/sample/recipe/save

Example Script (Curl):
curl -X POST\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
-H "Content-Type: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/sample/
recipe/save"

Path Parameters: N/A

Body Parameters: Name: body *
Description: {
 name: string
 Recipe name.

 overwrite: boolean
 *If recipe already exists, allow overwrite
 of recipe.*

 assignments: [(0..500)
 List of recipe-locations assignment
 [(0..1000)
 *List of locations associated to
 the recipe.*
 integer
 Location identifier.
]
]
}

Responses:
Status: 201 - Created
Status: 400 - Bad Request
Status: 401 - Unauthorized
Status: 403 - Forbidden

setRecipe

Definition:	Set recipe's name and assigned locations.
Command Code:	PUT /v1/lproapi/sample/recipe/{recipeId}
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ sample/recipe/{recipeId}"
Path Parameters:	Name: recipeId* Description: Long (int64) <i>ID of recipe to modify.</i> Required
Body Parameters:	Name: body * Description: { name: string <i>Recipe name.</i> overwrite: boolean <i>If recipe already exists, allow overwrite of recipe.</i> assignments: [(0..500) <i>List of recipe-locations assignment</i> [(0..1000) <i>List of locations associated to the recipe.</i> integer <i>Location identifier.</i>

setupMonitoringSetting

Definition:	Setup current monitoring settings.		
Command Code:	PUT /v1/lproapi/sample/monitoring		
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/ sample/monitoring"		
Path Parameters:	N/A		
Body Parameters:	Name:	body *	
	Description:	{ enable: boolean <i>Enables/disables the use of preconfigured sampling plans for locations.</i> locationsIds: [(0..1000) integer <i>Locations identifiers. The number of elements of this array has to be less or equal to the value of numberSamplingLocations. If the number is less, the instrument shall generate automatically virtual locations, one per each undefined location.</i>] }	
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden		

setupSampleSetting

Definition:	Setup current sample settings.
Command Code:	PUT /v1/lproapi/sample/setting

Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/sample/setting"
Path Parameters:	N/A
Body Parameters:	Name: body * Description: { setup: { enableCount: boolean <i>Enable/disable continuous sampling.</i> <i>Sampling will continue with the set configuration until the user presses the Stop button on the HOME screen.</i> numberOfSamples: integer <i>Number of samples to be performed.</i> delays: { purge: string <i>Initial delay before the start of sampling.</i> Default: 00:00:00 intersample: string <i>Delay between samples if number of samples is > 1.</i> Default: 00:00:00

sampleBy: {

sampleType: string

Value can be time or volume.
Default: time
Enum: time, volume

time: string

Time value when by time is selected.
Form HH:MM:SS.
Default: 00:00:00

volume: number

Volume value when by volume is selected.

continued on next page...

units: string
normalized particle count volume unit.
It can be cbm, cft, l.
Enum: cbm, cft, l

data: string
particle counts can be shown as either raw or normalized counts. The options include raw and normalized (normalized counts per volume unit: cubic meter, cubic foot, or liter).
Enum: raw, normalized

samplingStart: string
How the sampling will start. It can be “standard” with the home screen, “time of day” sampling will start based on the user-configured time, “power up” sampling will start when the instrument is powered on.
Enum: standard, time of day, power up

monitoringMode: {

Monitoring mode uses pre-configured sampling plans for locations. When enabled, changes to sampling plans and their associated locations are restricted until the monitoring plan has been completed or canceled. This mode works best when sampling plans are saved as recipes and assigned to locations.

numberSamplingLocations: integer
minimum:2
Number of sampling locations in monitoring mode.

monitoringModeEnabled: boolean
Enables/disables the use of preconfigured sampling plans for locations.

continued on next page...

```

    locsIds: [ (0..1000)          integer
               Location identifiers. The number
               of elements of this array has to
               be less or equal to the value of
               numberSamplingLocations. If the
               number is less, the instrument shall
               generate automatically virtual
               locations, one per each undefined
               location.
             ]
  }
  options: {
    List of options can be enabled or disabled.

    cycle:          boolean
               Enables/disables continuous collection
               of samples.

    continuousPump:  boolean
               Enables/disables pump activity outside
               of sampling operation.

    beep:           boolean
               Enables/disables audio cue when a
               certain number of particles are counted.

    PrintAverages:   boolean
               Enables/disables average particle
               counts for each configure channel size
               in the printed report.

    printReport:     boolean
               Enables/disables print of final sample
               report using the thermal printer.

    saveUsbReport:   boolean
               Enables/disables save of final sample
               report to a PDF report.
  }
}

```

Responses:

- Status: 204 - No Content
- Status: 400 - Bad Request
- Status: 401 - Unauthorized
- Status: 403 - Forbidden

Security

addSecurityUser

Definition:	Create a new user.				
Command Code:	POST /v1/lproapi/security/users				
Example Script (Curl):	curl -X POST\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/security/users"				
Path Parameters:	N/A				
Body Parameters:	<table><tr><td>Name:</td><td>body *</td></tr><tr><td>Description:</td><td>{ enableUser: boolean <i>Allows to enable or disable specific users of the Lasair Pro.</i> userName: string minLength:3 maxLength:32 <i>Allows to edit the user name. Each user name is unique. When adding or editing a username, the firmware will prevent duplicate entries.</i> accessLevel: string <i>User's access level. It can be administrator, supervisor or operator. If the NFC device is present, then the relative NFC level are defined.</i> Enum: Operator, Administrator, Supervisor, Administrator NFC, Supervisor NFC, Operator NFC password: string minLength:4 maxLength:16 <i>User password.</i> }</td></tr></table>	Name:	body *	Description:	{ enableUser: boolean <i>Allows to enable or disable specific users of the Lasair Pro.</i> userName: string minLength:3 maxLength:32 <i>Allows to edit the user name. Each user name is unique. When adding or editing a username, the firmware will prevent duplicate entries.</i> accessLevel: string <i>User's access level. It can be administrator, supervisor or operator. If the NFC device is present, then the relative NFC level are defined.</i> Enum: Operator, Administrator, Supervisor, Administrator NFC, Supervisor NFC, Operator NFC password: string minLength:4 maxLength:16 <i>User password.</i> }
Name:	body *				
Description:	{ enableUser: boolean <i>Allows to enable or disable specific users of the Lasair Pro.</i> userName: string minLength:3 maxLength:32 <i>Allows to edit the user name. Each user name is unique. When adding or editing a username, the firmware will prevent duplicate entries.</i> accessLevel: string <i>User's access level. It can be administrator, supervisor or operator. If the NFC device is present, then the relative NFC level are defined.</i> Enum: Operator, Administrator, Supervisor, Administrator NFC, Supervisor NFC, Operator NFC password: string minLength:4 maxLength:16 <i>User password.</i> }				
Responses:	Status: 201 - Created Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden				

configSecurityAudit

Definition:	Update audit configuration.
Command Code:	PUT /v1/lproapi/security/audit
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/security/audit"
Path Parameters:	N/A
Body Parameters:	Name: body * Description: { enableAudit: boolean <i>Enable audit trail of all user activity.</i> numberAudit: integer minimum:2000 maximum:30000 <i>Setting of the maximum number of audit trail records.</i> Default: 2000 }

deleteAllSecurityUsers

Definition:	Delete all users.
Command Code:	DELETE /v1/lproapi/security/allusers
Example Script (Curl):	curl -X DELETE\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/security/allusers"
Path Parameters:	N/A
Body Parameters:	N/A

Responses: Status: 204 - No Content
 Status: 401 - Unauthorized
 Status: 403 - Forbidden

deleteSecurityUser

Definition: Delete a user by user id.

Command Code: DELETE
 /v1/lproapi/security/users/{userId}

Example Script (Curl): curl -X DELETE\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/security/users/
 {userId}"

Path Parameters: Name: userId*
 Description: String
 User id of user to delete.
 Required

Body Parameters: N/A

Responses: Status: 204 - No Content
 Status: 401 - Unauthorized
 Status: 403 - Forbidden
 Status: 404 - Not Found

getSecurityAudit

Definition: Get current audit configuration.

Command Code: GET
 /v1/lproapi/security/audit

Example Script (Curl): curl -X GET\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/security/audit"

Path Parameters: N/A

Body Parameters: Name: body *

 Description: {

 enableAudit: boolean

Enable audit trail of all user activity.

 numberAudit: integer

 minimum:2000 maximum:30000

Setting of the maximum number of audit trail records.

Default: 2000

 }

Responses: Status: 200 - OK

 Status: 401 - Unauthorized

 Status: 403 - Forbidden

getSecurityGeneral

Definition: Get current security setting configuration.

Command Code: GET

 /v1/lproapi/security/settings

Example Script (Curl): curl -X GET\

 -H "Authorization: Bearer {accessToken}"\

 -H "Accept: application/json"\

 "https://{lpro_device_address}:{port}/v1/lproapi/security/settings"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK

 {

 general: {

 enableSecurity: boolean

Enables/disables all security features. Security cannot be enable if there is no administrator account has been enabled.

 autoLogout: boolean

Enables/disables the Lasair Pro counter to automatically log the user out at the end of a specified time period.

continued on next page...

```

        logoutPeriod:          integer
                               minimum:1 maximum:1440
                               Enables the Lasair Pro counter to
                               automatically log the user out at the end of a
                               specified time period.
                               Default: 1
    }
password: {
    enableExpiration:          boolean
                               Activates password expiration after a set
                               number of days.

    periodBeforeExpiration:    integer
                               minimum:1 maximum:365
                               Sets the number of days before passwords
                               expire. Counts down after the password is set.
                               Default: 1

    enableMinLength:           boolean
                               Activates a minimum password length.

    minPasswordLength:         integer
                               minimum:4 maximum:16
                               Sets the minimum number of password
                               characters.
                               Default: 4

    enableRepetition:          boolean
                               Activates the option to use repeat passwords.

    differentPasswordCount:     integer
                               minimum:1 maximum:5
                               Sets the amount of passwords before the same
                               password can be reused again.
                               Default: 1

    enableUserPassword:        boolean
                               When activated, this setting allows the user to
                               set their own password. When deactivated,
                               passwords are created by the administrator.
    }
}

```

Status: 401 - Unauthorized

Status: 403 - Forbidden

getSecurityUsers

Definition: Get the list of all configured users.

Command Code: GET
/v1/lproapi/security/users

Example Script (Curl):
curl -X GET\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/security/users"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK
[(0..100)
{
 userId: integer
 User id
 enableUser: boolean
 Allows to enable or disable specific users of the Lasair Pro.
 userName: string
 minLength:3 maxLength:32
 Allows to edit the user name. Each user name is unique. When adding or editing a username, the firmware will prevent duplicate entries.
 accessLevel: string
 User's access level. It can be administrator, supervisor or operator. If the NFC device is present, then the relative NFC level are defined.
 Enum: Operator, Administrator, Supervisor, Administrator NFC, Supervisor NFC, Operator NFC
}

Status: 401 - Unauthorized
Status: 403 - Forbidden

setupSecurityGeneral

Definition:	Setup security setting configuration.		
Command Code:	PUT /v1/lproapi/security/settings		
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/security/ settings"		
Path Parameters:	N/A		
Body Parameters:	Name:	body *	
	Description:	{ general: { enableSecurity: boolean <i>Enables/disables all security features. Security cannot be enable if there is no administrator account has been enabled.</i> autoLogout: boolean <i>Enables/disables the Lasair Pro counter to automatically log the user out at the end of a specified time period.</i> logoutPeriod: integer minimum:1 maximum:1440 <i>Enables the Lasair Pro counter to automatically log the user out at the end of a specified time period.</i> Default: 1 } password: { enableExpiration: boolean <i>Activates password expiration after a set number of days.</i>	
		<i>continued on next page...</i>	

```

periodBeforeExpiration:    integer
                           minimum:1 maximum:365
                           Sets the number of days before passwords
                           expire. Counts down after the password is set.
                           Default: 1

enableMinLength:           boolean
                           Activates a minimum password length.

minPasswordLength:         integer
                           minimum:4 maximum:16
                           Sets the minimum number of password
                           characters.
                           Default: 4

enableRepetition:          boolean
                           Activates the option to use repeat passwords.

differentPasswordCount:    integer
                           minimum:1 maximum:5
                           Sets the amount of passwords before the same
                           password can be reused again.
                           Default: 1

enableUserPassword:        boolean
                           When activated, this setting allows the user to
                           set their own password. When deactivated,
                           passwords are created by the administrator.
    }
}

```

Responses:

- Status: 204 - No Content
- Status: 400 - Bad Request
- Status: 401 - Unauthorized
- Status: 403 - Forbidden

setupSecurityUser

Definition:	Modify a user by user id.
Command Code:	PUT /v1/lproapi/security/users/{userId}
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/security/ users/{userId}"
Path Parameters:	Name: userId* Description: String <i>User id of user to modify.</i> Required
Body Parameters:	Name: body * Description: { enableUser: boolean <i>Allows to enable or disable specific users of the Lasair Pro.</i> password: string <i>New password value.</i> accessLevel: string <i>New access level value.</i> Enum: Operator, Administrator, Supervisor, Administrator NFC, Supervisor NFC, Operator NFC }
Responses:	Status: 204 - No Content Status: 400 - Bad Request Status: 401 - Unauthorized Status: 403 - Forbidden Status: 404 - Not Found

System Configuration

configSystemChannels

Definition:	Setup system channels.		
Command Code:	PUT /v1/lproapi/system/channel		
Example Script (Curl):	<pre>curl -X PUT \ -H "Authorization: Bearer {accessToken}" \ -H "Accept: application/json" \ -H "Content-Type: application/json" \ "https://{lpro_device_address}:{port}/v1/lproapi/system/channel"</pre>		
Path Parameters:	N/A		
Body Parameters:	Name:	body *	
	Description:	{ mode: string <i>Allows the user to switch between "All Channels mode" and "Pharmaceuticals mode". In "All Channels mode", all eighth particle size channels can be used. In "Pharmaceuticals mode" only the 0.5 and 5.0 particle size channels can be adopted.</i> Default: All Channels mode Enum: All Channels mode, Pharmaceuticals mode	
	units:	string <i>Channels size units can be changed between micrometers (um) and nanometers (nm).</i> Default: um Enum: um, nm	
	channels:	[{ id: integer minimum:1 maximum:8 <i>Channel identifier. It can vary between 1 and 8.</i>	

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```
        size:      number
                  minimum:0.3 maximum:25
                  The size range is 0.30 to 25.00 with a
                  resolution of 0.01 for sizes less than
                  0.50, 0.05 for sizes between 0.50
                  and 1.00, 0.5 for sizes between 1.00 and
                  3.00, and 1 for sizes between 3.00 and
                  25.00.
      }
    ]
  }
```

Responses:

- Status: 280 - Reboot
- Status: 400 - Bad Request
- Status: 401 - Unauthorized
- Status: 403 - Forbidden

configSystemConfiguration

Definition: Setup system language and media type.

Command Code: PUT
/v1/lproapi/system/configuration

Example Script (Curl):
curl -X PUT\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
-H "Content-Type: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/system/
configuration"

Path Parameters: N/A

Body Parameters:

Name:	body *	
Description:	{	
	medium: {	
	gas:	string
	}	
	language: {	
	interface:	string
	}	

continued on next page...

```
input: [ (9..9)
  Input keyboard languages to enable.
  It can be english, french, italian,
  spanish, german, portuguese, polish,
  russian, chine-cht, chinese-chs,
  japanese, korean.
  {
    language:      string
    Keyboard input language.
    Enum: english, french, italian,
    spanish, german, portuguese,
    polish, russian, chinese-cht,
    chinese-chs, japanese, korean

    enable:        boolean
    Enabling status of the input
    language.
  }
]
```

Responses:

- Status: 204 - No Content
- Status: 400 - Bad Request
- Status: 401 - Unauthorized
- Status: 403 - Forbidden

configSystemDatetime

Definition:	Setup system date/time settings.
Command Code:	PUT /v1/lproapi/system/datetime
Example Script (Curl):	curl -X PUT\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ -H "Content-Type: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/system/ datetime"
Path Parameters:	N/A

Body Parameters:

Name:	body *
Description:	<pre> { date: string <i>Calendar date to be setup manually.</i> Default: 01/01/2000 dateFormat: string <i>Calendar date format. It can be dd/</i> <i>mm/yyyy, mm/dd/yyyy, or</i> <i>yyyy/mm/dd.</i> Enum: dd/mm/yyyy, mm/dd/yyyy, yyyy/mm/dd time: string <i>Clock time to be setup manually. The</i> <i>format is HH:MM:SS, hours, minutes,</i> <i>and seconds.</i> Default: 00:00:00 useNtp: boolean <i>Enable/disable the usage of</i> <i>Network Time Protocol (NTP).</i> <i>Use if you are synchronizing the time</i> <i>display of multiple Lasair Pro counters</i> <i>and other NTP-linked devices.</i> primaryServer: string <i>IP address of the primary NTP server.</i> Default: 0.0.0.0 backupServer: string <i>IP address of the backup NTP server.</i> Default: 0.0.0.0 updateInterval: integer <i>Time interval in minutes that the date</i> <i>and time will be updated.</i> Default: 240 timeZone: string <i>Time zone of the instrument location.</i> <i>The format is HH:MM, hours and</i> <i>minutes.</i> }</pre>

Responses: Status: 204 - No Content
 Status: 400 - Bad Request
 Status: 401 - Unauthorized
 Status: 403 - Forbidden

configSystemSettings

Definition: Setup system settings.

Command Code: PUT
 /v1/lproapi/system/settings

Example Script (Curl): curl -X PUT\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 -H "Content-Type: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/system/
 settings"

Path Parameters: N/A

Body Parameters: Name: body *
 Description: {
 instrumentId: string maxLength:16
 *Particle counter identification. Character limit
 is 16.*
 Default: Lasair Pro
 enableCalibrationWarning: boolean
 Enable/disable calibration warning.
 calibrationTime: integer
 *When a calibration waring is due: it can be 6 or
 12 months.*
 Enum: 6, 12
 }

Responses: Status: 204 - No Content
 Status: 400 - Bad Request
 Status: 401 - Unauthorized
 Status: 403 - Forbidden

getSystemChannels

Definition: Get current system channels settings.

Command Code: GET
/v1/lproapi/system/channel

Example Script (Curl):
curl -X GET\
-H "Authorization: Bearer {accessToken}"\
-H "Accept: application/json"\
"https://{lpro_device_address}:{port}/v1/lproapi/system/
channel"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK

```
{  
  mode:      string  
    Allows the user to switch between "All  
    Channels mode" and "Pharmaceuticals mode".  
    In "All Channels mode", all eighth particle size  
    channels can be used. In "Pharmaceuticals  
    mode" only the 0.5 and 5.0 particle size  
    channels can be adopted.  
    Default: All Channels mode  
  
    Enum: All Channels mode, Pharmaceuticals  
    mode  
  
  units:      string  
    Channels size units can be changed between  
    micrometers (um) and nanometers (nm).  
    Default: um  
    Enum: um, nm  
  
  channels: [  
    {  
      id:      integer minimum:1 maximum:8  
        Channel identifier. It can vary between  
        1 and 8.
```

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```

size:      number
           minimum:0.3 maximum:25
           The size range is 0.30 to 25.00 with a
           resolution of 0.01 for sizes less than
           0.50, 0.05 for sizes between 0.50
           and 1.00, 0.5 for sizes between 1.00 and
           3.00, and 1 for sizes between 3.00 and
           25.00.
    }
  ]
}
Status: 401 - Unauthorized
Status: 403 - Forbidden

```

getSystemDatetime

Definition: Get current system date/time settings.

Command Code: GET
/v1/lproapi/system/datetime

Example Script (Curl):
 curl -X GET\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/system/
 datetime"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK

```

{
  date:      string
             Calendar date to be setup manually.
             Default: 01/01/2000

  dateFormat: string
               Calendar date format. It can be dd/mm/yyyy,
               mm/dd/yyyy, or yyyy/mm/dd.
               Enum: dd/mm/yyyy, mm/dd/yyyy, yyyy/mm/dd

  continued on next page...

```

```

time:                string
    Clock time to be setup manually. The format is
    HH:MM:SS, hours, minutes, and seconds.
    Default: 00:00:00

useNtp:              boolean
    Enable/disable the usage of Network Time Protocol
    (NTP). Use if you are synchronizing the time display of
    multiple Lasair Pro counters and other NTP-linked
    devices.

primaryServer:       string
    IP address of the primary NTP server.
    Default: 0.0.0.0

backupServer:        string
    IP address of the backup NTP server.
    Default: 0.0.0.0

updateInterval:      integer
    Time interval in minutes that the date and time will
    be updated.
    Default: 240

timeZone:            string
    Time zone of the instrument location. The format is
    HH:MM, hours and minutes.
}

```

Status: 401 - Unauthorized

Status: 403 - Forbidden

getSystemSettings

Definition: Get current general system settings.

Command Code: GET
/v1/lproapi/system/general

Example Script (Curl):
 curl -X GET\
 -H "Authorization: Bearer {accessToken}"\
 -H "Accept: application/json"\
 "https://{lpro_device_address}:{port}/v1/lproapi/system/
 general"

Path Parameters: N/A

Body Parameters: N/A

Responses: Status: 200 - OK

```
{
  settings: {
    instrumentId: string maxLength:16
      Particle counter identification. Character limit is 16.
      Default: Lasair Pro
    enableCalibrationWarning: boolean
      Enable/disable calibration warning.
    calibrationTime: integer
      When a calibration waring is due: it can be 6 or 12 months.
      Enum: 6, 12
  }
  medium: {
    gas: string
      Setup gas medium. It can be air (1.205 kg/cbm), co2 (1.842 km/cbm), argon (1.661 kg/cmb) or nitrogen (1.165 kg/cmb).
      Enum: air, co2, argon, nitrogen
  }
  language: {
    interface: string
      Keyboard input language. It can be english, french, italian, spanish, german, portuguese, polish, russian, chine-cht, chinese-chs, japanese, korean.
      Enum: english, french, italian, spanish, german, portuguese, polish, russian, chinese-cht, chinese-chs, japanese, korean
```

continued on next page...

```
input: [ (9..9)
  Input keyboard languages to enable.
  It can be english, french, italian,
  spanish, german, portuguese, polish,
  russian, chine-cht, chinese-chs,
  japanese, korean.
  {
    language:      string
                  Keyboard input language.
                  Enum: english, french, italian,
                  spanish, german, portuguese,
                  polish, russian, chinese-cht,
                  chinese-chs, japanese, korean

    enable:        boolean
                  Enabling status of the input
                  language.
  }
]
```

Status: 401 - Unauthorized
Status: 403 - Forbidden

getSystemStatus

Definition:	Get current system status.
Command Code:	GET /v1/lproapi/system/status
Example Script (Curl):	curl -X GET\ -H "Authorization: Bearer {accessToken}"\ -H "Accept: application/json"\ "https://{lpro_device_address}:{port}/v1/lproapi/system/status"
Path Parameters:	N/A
Body Parameters:	N/A

Responses:

Status: 200 - OK

```
{
  instrument: {
    model: string
    instrumentId: string
    serialNumber: string
    firmware: string
    lastCalibrated: string
  }
  laserCurrent: {
    reference: number
    last: number
    externalPdRef: number
    externalPdLast: number
  }
  battery: {
    chargeLevel: number
    timeToDischarge: string
    battery1: string
    capacity1: string
    capacity1cycles: number
    battery2: string
    capacity2: string
    capacity2cycles: number
  }
  hourMeter: {
    instrument: number
    pump: number
    laser: number
  }
}
```

Status: 401 - Unauthorized

Status: 403 - Forbidden

BIDI-API Guide Examples

Generate Token (login)

Prerequisites:

- Have at least one administrator user created
- Security enabled (to be set on the GUI)
- No user logged into the instrument

Retrieve Token

Perform a POST request with the following Path Parameters:

- URL: `https://<ip>:<port>/lproapi/oauth/token`
- Headers = {
 Accept: "application/json",
 Content-Type: "application/json",
 Authorization: "Basic <Base64 encode of
username:password>"
}

Example of a user with username=Admin and password=12345

- Headers = {
 Accept: "application/json",
 Content-Type: "application/json",
 Authorization: "Basic QWRtaW46MTIzNDU="

Response code: 200 OK

Response example:

```
{
  "access_token":
    "673ecc341639fae39a8b77e024a8fbd8b66b285dfbb4d360d3ed2fcd5ef647ab",
  "expiration_time": 3600,
  "token_type": "bearer"
}
```

Instrument information (calibration date, S/N, Instrument ID)

Prerequisites:

- Token has been generated, i.e. a user is logged in throw the Bidirectional interface.

Perform GET request for system status with the following Path Parameters:

- URL: `https://<ip>:<port>/v1/lproapi/system/status`
- Headers = {
 "Authorization": "Bearer <token>"
}

Response code: 200 OK

Response example:

```
{
  "instrument": {
    "model": "LasairPro_310C",
    "instrumentId": "Lasair Pro 1",
    "serialNumber": "S/N",
    "firmware": "01.XX.XX",
    "lastCalibrated": "6/16/2020"
  },
  "laserCurrent": {
    "reference": 1.4501949548721313,
    "last": 1.4501949548721313,
    "externalPdRef": 13.816800117492676,
    "externalPdLast": 14.392499923706055
  },
  "battery": {
    "chargeLevel": 94,
    "timeToDischarge": "443",
    "battery1": "installed",
    "capacity1": 5864,
    "capacity1cycles": 29,
    "battery2": "not installed",
    "capacity2": "N/A",
    "capacity2cycles": "N/A"
  },
  "hourMeter": {
    "instrument": 2357.281005859375,
    "pump": 111.73833465576172,
    "laser": 113.68305969238281
  }
}
```

Location handling (creation of area/room/locations)

Prerequisites:

- Token has been generated, i.e. a user is logged in throw the Bidirectional interface.

Perform GET request for areas/rooms/locations with the following parameters to retrieve the available areas/rooms/locations:

- URL: `https://<ip>:<port>/v1/lproapi/location/areas`
- Headers = {
 Accept: `application/json`,
 Content-Type: `"application/json"`,
 Authorization: `"Bearer <token>"`
}

Response code: 200 OK

Response example:

```
{ [
  {
    "id": 1,
    "name": "TestArea"
  },
  {
    "id": 2,
    "name": " TestArea 2"
  }
]}
```

Same applies for Rooms and locations using their specific URL that are the following:

Rooms: `https://<ip>:<port>/v1/lproapi/location/rooms`

Locations: `https://<ip>:<port>/v1/lproapi/location/locations`

Response code : 200 OK

Response example (rooms and locations share the same type of response structure reporting id, pid and name):

```
{ [
  {
    "id": 1,
    "pid": 1,
    "name": "TestRoom"
  },
  {
    "id": 2,
    "pid": 2,
    "name": " TestRoom 2"
  }
]}
```

Release Token (logout)

Prerequisites:

- Token has been generated, i.e. a user is logged in throw the Bidirectional interface.

Release token performing a POST request with the following Path Parameters:

- URL: `https://<ip>:<port>/v1/lproapi/hostcontrol/releaseToken`
- Headers = {
 "Accept": "application/json",
 "Content-Type": "application/json",
 "Authorization": "Bearer <token>"
 }

Response code: 204 No Content

Response example: {}

Bidirectional HTTP Status Codes

Table E-1. Bidirectional HTTP Status Codes

HTTP Status Code	Message	Description
200	OK	HTTP requested accepted, executed correctly, and response body not empty. Used for: GET requests.
201	Created	HTTP requested accepted, resource is created correctly, and response body is empty. Used for: POST requests.
202	Accepted	HTTP requested accepted, but not completed. It can have a response body.
204	No Content	HTTP requested accepted, executed correctly, and response body is empty. Used for: PUT requests. DELETE requests.
280	Sys Reboot	Custom code to inform client that the system is going to reboot
400	Bad Request	The server cannot or will not process the request due to an apparent client error (e.g., malformed request syntax, size too large, invalid request message framing, or deceptive request routing). For specific error codes see Bidirectional Error Codes below

Table E-1. Bidirectional HTTP Status Codes

HTTP Status Code	Message	Description
401	Unauthorized	The client's request lacks valid authentication credentials, and the server is refusing to grant access. For specific error codes see Bidirectional Error Codes below
403	Forbidden	Access to the resource is forbidden since token is wrong, username or password is incorrect, restrictions rules, etc.. For specific error codes see Bidirectional Error Codes below
404	"Not Found"	The server cannot find the resource requested by the client. This usually means the requested URL doesn't exist or is unavailable. For specific error codes see Bidirectional Error Codes below.
500	Internal Server Error	The server encountered an unexpected condition that prevented it from fulfilling the client's request. It's a generic error, signaling a problem on the server-side, but not specifying the exact cause. For specific error codes see Bidirectional Error Codes below.

Schema for 4XX Status Responses

```

{
  Required: code,message
  code:      integer
             A unique identifier for the specific error.
  message:   string
             A human-readable message describing the error.
}

```

Bidirectional Error Codes

Table E-2. Bidirectional Error Codes

HTTP Status Code	Error Code Value	Error message	Note
400	400004	JSON parsing error: ...	All errors starts with JSON parsing error:
400	400005	Maximum number of locations reached.	
400	400006	Location already exists.	

Table E-2. Bidirectional Error Codes

HTTP Status Code	Error Code Value	Error message	Note
400	400007	Location name is too long.	>16 characters
400	400008	Location name is too short.	0 characters
400	400009	Location PID does not exist.	
400	400010	Location name contains only blank spaces.	
400	400013	Particle data is not valid .	
400	400014	Out of range analog minimum value.	
400	400015	Out of range analog maximum value.	
400	400016	Analog maximum value less than minimum value.	
400	400017	Invalid channel name.	
400	400018	Invalid unit name.	
400	400019	Out of range sum value.	
400	400020	Out of range N sample value.	
400	400021	Out of range M sample value.	
400	400022	M sample value less than N sample value.	
400	400023	Invalid trend channel.	
400	400024	Reason text length is out of range.	
400	400025	Out of range instrument id value.	
400	400026	Out of range date value.	
400	400027	Out of range time value.	
400	400028	Out of range timezone value.	
400	400029	Out of range IP value.	
400	400030	Out of range update interval value.	
400	400031	Out of range mode value.	
400	400032	Out of range units value.	
400	400033	Out of range channel size value.	
400	400034	Invalid channel size: Channel size must increment with channel ID.	
400	400035	Maximum number of channels is 8.	
400	400036	Out of range channel ID value.	
400	400037	Invalid sample setting: ...	Sample setting options/ parameters are not coherent.

Table E-2. Bidirectional Error Codes

HTTP Status Code	Error Code Value	Error message	Note
400	400038	Invalid sample volume = <number>	
400	400039	Invalid sample time = <number>	
400	400040	Changing sampling locations' number (<number> to <number>) is not allowed in Monitoring mode.	
400	400041	Recipe name contains only blank spaces.	
400	400042	Location does not exist.	
400	400043	Duplicated location in input array (id= <number>).	
400	400044	Total recipes' number limit has been reached.	
400	400045	Recipe already exists.	
400	400046	Unexpected RPM data.	
400	400047	Out of range audit number value.	
400	400048	Out of range username value.	
400	400049	Out of range password value.	
400	400050	Out of range access level value.	
400	400051	Out of range logout period value.	
400	400052	Out of range expiration value.	
400	400053	Out of range min password length value.	
400	400054	Out of range repetition value.	
400	400055	Locations' sets are in the same area/room.	
400	400056	Recipe does not exist.	
400	400057	User-Id already exists in the DB.	
400	400058	Logged user cannot be deleted.	
400	400059	Instrument is already sampling.	
401	401001	Unauthorized access.	
403	403001	A GUI user is logged in.	
403	403002	Security is not enabled.	
403	403003	Invalid credentials.	Wrong username or password when token is generated, or request performed with token missing character/wrong token

Table E-2. Bidirectional Error Codes

HTTP Status Code	Error Code Value	Error message	Note
403	403004	A user is already connected.	
403	403005	Token has expired.	
403	403006	Invalid authentication type.	
404	404001	Invalid location id.	
404	404002	Invalid alarm particle id.	
404	404003	Invalid alarm environmental id.	
404	404004	Invalid alarm trend id.	
404	404005	Invalid alarm reason id.	
404	404006	Invalid recipe id.	
404	404007	Invalid user id.	
404	404008	No alarm trend available.	
404	404009	Invalid channel id.	
404	404010	Malformed URL	This situation occurs when a URL is received that includes a request for a specific resource, but the URL should not include any such resource. For example, a request is made with GET lpro/rest/api/1 , but the correct request should be GET lpro/rest/api since no additional resources are expected or associated.
500	500001	Invalid request.	
500	500002	Internal error occurred.	This is just the default message. Message can be different from case to case: a) Unexpected JSON length = 0.
500	500007	Not allowed while sampling	

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Appendix F

Serial Commands

? or help	Displays a list of commands available to the user.
reset	Resets the sensor.
status	Displays all the current settings of the instrument, including the serial number, the software version, model, TCP/IP parameters and options.
write	Saves parameters in permanent memory and resets.
version	display version information
default	set the TCP/IP parameters to default values
memShow	show memory information
checkStack	check stack
dir	get a directory listing of the USB device
chkdsk	chkdsk theUSB device
ping	ping an ip Address
format	DOS format the USB device
get battery status	get the battery system level status
get battery data	get the battery detailed status
get buffer	get size of buffer dump on TCP/IP reconnect
get flow status	get the flow system status
get hours	get the hour meters of the subsystems
get laser status	get the laser system status
get net status	get the net config status

get channels	get the channels
get channels table	get the channels table
get analogs	get the Analog data from driver
get rawanalogs	get the Analog data from SPI
get din	get the Din pin value
get bvoltage	get the Battery Voltage
get nfc info	get NFC information
get modbusdisconnect	get Modbus disconnect information
set blower {on off}	turn blower controller on or off
set buffer {0-3000}	set size of buffer dump on TCP/IP reconnect
set gateway d.d.d.d	set the gateway address of this instrument
set ip d.d.d.d	set the ip address of this instrument
set laser {on off}	turn laser on or off
set mask d.d.d.d	set the net mask of this instrument
set multicast d.d.d.d	set the multicast address of this instrument
set dout {on off}	set dout on or off
set time hh:mm:ss	set system Time
set date mm/dd/yyyy	set system Date
set modbusdisconnect	set Modbus disconnect information
lasair	Lasair mode
flash program	Program device from vxWorks.tar
flash copy <source>	Copy all binaries to correct locations from /bd0:1 <source> is optional
flash flang	Copy language and fonts from /bd0:1 to /sd1:1
printscreen <file>	Create a screenshot in <file>

log	Display current log file
test savecard	Create tar file for Support
enable data	Display Realtime Sample Data
disable data	stop Display Realtime Sample Data
debug help	Display Debug command Help message
wifi help	Display WiFi Help message

Lasair Mode Serial Interface Commands

AALARM	analog-ch min [0 1] max [0 1] Set analog channel (1-4) alarm min, max and enables
ANID	analog-ch name Set analog channel (1-4) identifier
ANENABLE	analog-ch [0 1] Enable/disable analog channel (1-4)
ANLIMITS	analog-ch min maxSet analog channel (1-4) limits (min and max)
ANSCALE	analog-ch scale Set analog channel (1-4) scale
ANOFFSET	analog-ch offset Set analog channel (1-4) offset
ANUNITS	analog-ch units Set analog channel (1-4) units (eg 'mA', '', etc)
AUTOSTART [0 1]	Enable/disable sampling autostart at power on
BATCHID identifier	Set batch identifier
BEEP [0 1]	Turn beep mode on or off
BUZZER [0 1]	Turn buzzer mode on or off
C [n] [p]	Set parameter [n] equal to value [p] 'HELP C' for detailed help
CLEARALL	Deletes all sample data and all location names
CONTPUMP [0 1]	Turn continuous pump mode on or off
DATAEN [0 1]	Enable/disable data display (not persistent)

DS	Get number of data samples
ERASEDATA	Erase all data samples in the instrument
ES	Stop sampling
GALARM [0 1]	Enable/disable global alarm
GWARNING [0 1]	Enable/disable global warning
GRPRPT [0 1]	Enable/disable group repeat mode
ID identifier	Set instrument identifier
ISAVAIL	Determine if serial control is available
ISDELAY sec	Set inter-sample delay The maximum value is 359999 seconds (99:59:59)
ISON	Return sampling state
ITYPE	Get instrument type
IVER	Get firmware version
KB [0 1]	Enable/disable keypad lockout (retained through power cycle)
KG [0 1]	Enable/disable keypad lockout (not retained through power cycle)
LOCID [location] [, room] [, area]	Set location
NORMDATA [0 1]	Set normalized/raw particle display
NUMSAMP num	Sets the number of samples for the sample group cycle
OPER identifier	Set operator identifier
PALARM channel threshold [0 1]	Enable/disable particle alarm threshold for specified channel (1-6)
PWARNING channel threshold [0 1]	Enable/disable particle alarm threshold for specified channel (1-6)
PALARMTYPE [C D]	Set particle alarm type: C - cumulative ; D - differential
PDELAY sec	Set the purge delay The maximum value is 359999 seconds (99:59:59)

POP	Erase the oldest sample in data buffer
PRALARM [0 1]	Enable/disable print on alarm feature
PRUSBALARM [0 1]	Enable/disable USB-print on alarm feature
SAMPBYVOL [0 1]	Enable/disable sampling by volume
SAMPFORMAT [0 1]	Enable/disable data format (not persistent) 1 = Lasair III , 0 = Lasair Pro
SERVICE	Service mode
SS	Start sampling
SN	Set continuous sampling
SPRINT [0 1]	Enable/disable print after sampling
SPRINTAVG [0 1]	Enable/disable print averages feature
SPRINTUSB [0 1]	Enable/disable USB-print after sampling
SVOL cf_volume	Set sample volume in feet ³ The smallest sample volume is 01 The largest sample volume is 1440 (1 cfm units)
TI secs	Set sample interval (seconds) Minimum value is 1, maximum value is 359999 seconds (99:59:59)
TIME	Get time
TD YYYY/MM/DD HH:MM[:SS]	Set date and time
TF	Transmit first data sample (ie earliest time)
TL	Transmit the last data sample (ie latest time)
TN n	Transmit data sample n
UNITS [F M L]	Set particle volume units: F - feet ³ (F), meters ³ (M), or liters (L)

Change Setup Parameters Command Help

C 0 yy	Set Date-Year (two digits year).
C 1 mm	Set Date-Month (1-12).
C 2 dd	Set Date-Day (1-31).

C 3 hh	Set Time-Hour (24 hour format).
C 4 mm	Set Time-Minute (0-59).
C 5 sec	Set Time-Second (0-59).
C 6 identifier	Set instrument identifier.
C 7 num	Set number of samples.
C 8 hh	Set sample time-Hour.
C 9 min	Set sample time-minutes.
C 10 sec	Set sample time-seconds.
C 11 [0 1]	Enable/disable print after sample.
C 12 hh	Set intersample delay time-hours (delay between samples).
C 13 min	Set intersample delay time-minutes (delay between samples).
C 14 sec	Set intersample delay time-seconds (delay between samples).
C 16 [0 1]	Enable/disable continuous (repeat) mode.
C 21 analog-channel name	Set analog channel (1-4) identifier (15 character max).
C 22 analog-channel min	Set analog channel (1-4) 4 mA value.
C 23 analog-channel max	Set analog channel (1-4) 20 mA value.
C 24 analog-channel units	Set analog channel (1-4) units.
C 25 analog-channel [0 1]	Enable/disable analog channel.
C 32 hh	Set purge delay time-hours.
C 33 min	Set purge delay time-minutes.
C 34 sec	Set purge delay time-seconds.
C 38 [0 1]	Start sampling on power up.

Appendix G

Configuring the Wi-Fi

-- NOTICE --

Change the Wi-Fi country code to the appropriate country setting prior to Wi-Fi use.

Wireless Connection is available with some Lasair Pro instruments.

If your unit has Wifi hardware installed the network page will show the Wireless tab not greyed out.



Figure H-1. COMM Menu without WiFi enabled (Left) and with WiFi enabled (Right)

Clicking on WIRELESS on the top of the COMM Menu will display the settings that are available for the WiFi on the Lasair Pro instruments

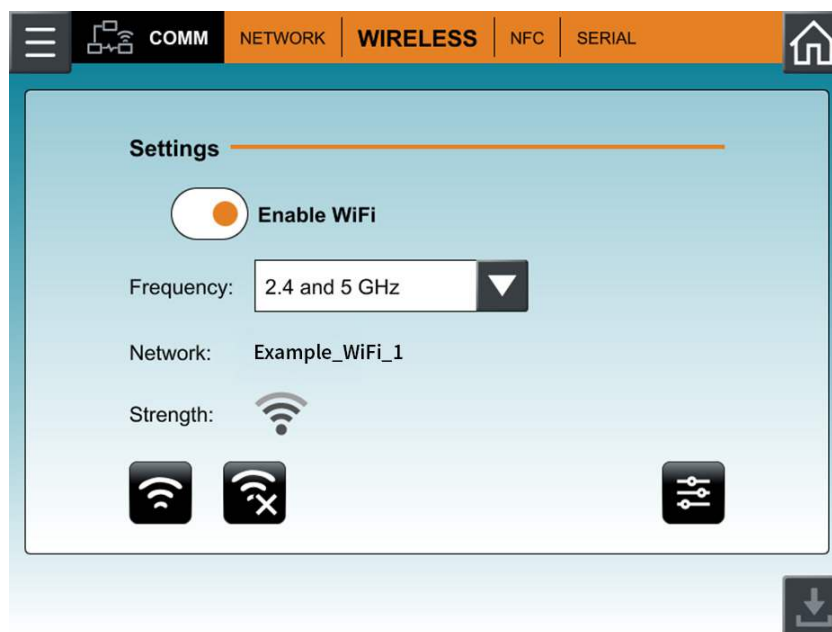
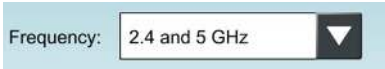
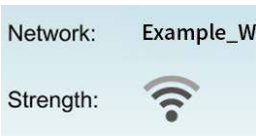


Figure H-2. Wireless Tab of COMM Menu

Image	Name	Description
	Enable WiFi	Switch to Enable Wireless . When you enable or disable the Wifi, you will need to reboot by pushing the reboot button in the lower right corner of the screen.
	Frequency	The Frequency can be changed to 2.4 GHz, 5 GHz, or both Changing this setting does not require rebooting.
	Network and Strength	Information about what Network the instrument is connected to and the strength of the WiFi.
	Connect to Access Point	Brings up the Available Networks page, and allows users to connect the unit to an access point.
	Disconnect from Access Point	Disconnects the instrument from a connected access point.
	Used Networks	Displays Access Points that have been successfully connected to.
	Save	Saves current channel configuration. This will cause the Lasair Pro to reboot and reconfigure itself. All existing data is deleted.
Table H-1. WIRELESS tab, COMM		

Networks

To connect to an **Access Point**, press the wireless button in lower left of the screen. This will bring up the Available Networks page.

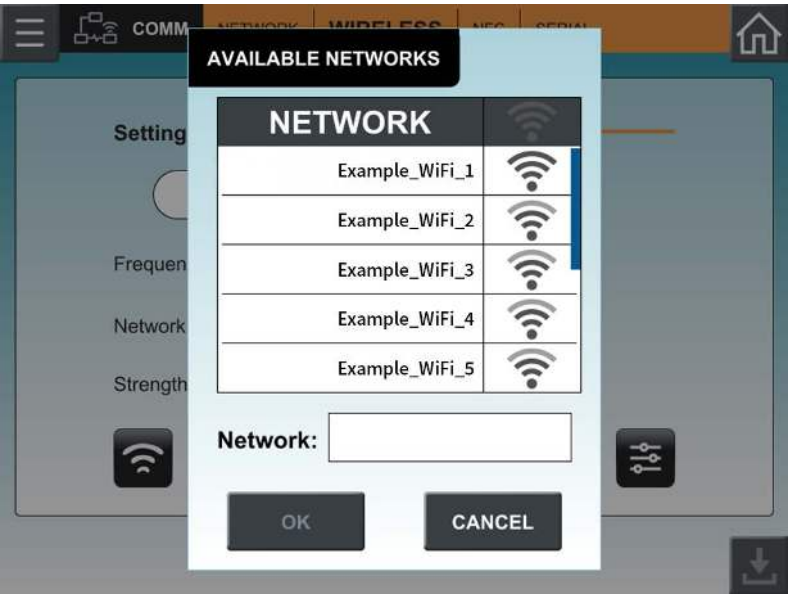


Figure H-3. Available Networks

Select the Network you want to connect to, if it is the Used networks list you will be connected automatically. If it is not in the list the connect to network menu will be displayed.



Figure H-4. Connect to Network Menu

Fill in the correct password and security type (None, WPA, WPA2, ...etc.) from the security menu then hit **OK** to connect to the Access Point. When you enable or disable the Wifi, you will need to reboot by pushing the save button in the lower right corner of the screen.

To disconnect from an access point that the instrument is connected to, use the disconnect button (the wireless button with the x in the lower right hand corner).

To view the Used Networks, press the Used Networks button in the lower right of the screen.

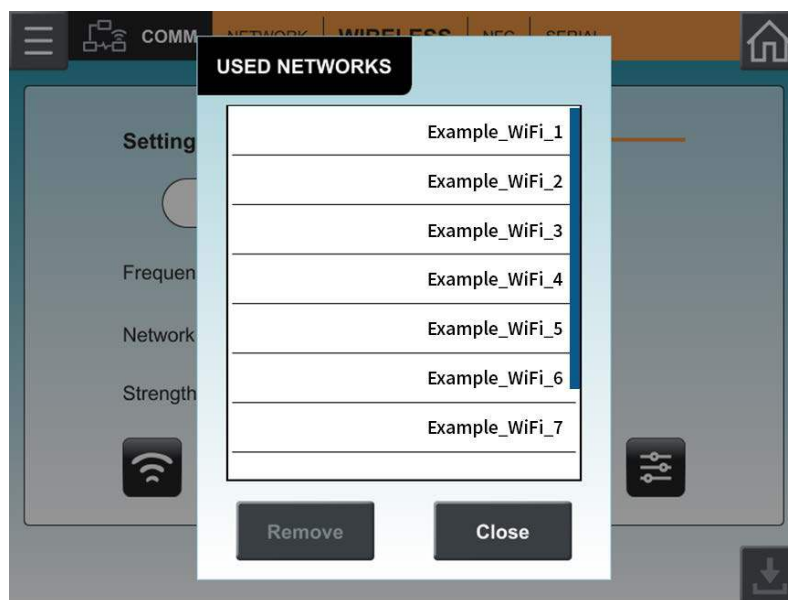


Figure H-5. Used Networks

Used networks can be deleted from the list if needed. The list holds 10 entries, which are added to the list when a successful log in to an Access Point has occurred.

If there are 10 entries in the list, you will need to manually delete one before a new entry can be added. In a future release, it will automatically delete the least used entry before adding.

USB serial port Wifi commands:

Several WiFi related commands are available on the USB serial port at 9600 baud. They are:

LasairPro> wifi help

WiFi commands:

wifi hardware	displays hardware status
wifi disconnect	disconnects from AP
wifi connect	connects to configured AP
wifi set ssid	sets ssid
wifi set frequency	sets frequency
wifi set password	sets password
wifi set enable	enable/disable wifi
wifi set security	set wifi security
wifi set country	set wifi country
wifi set clonemac	set wifi clonemac
wifi get ssid	displays ssid
wifi get frequency	gets frequency
wifi get password	displays password
wifi get enable	displays enable status
wifi get security	displays wifi security
wifi get country	displays wifi country
wifi get clonemac	get wifi clonemac
wifi display list	displays list of Access points
wifi display firmware	displays firmware information
wifi display stat	displays statistics
wifi display data	displays DataRate
wifi display strength	displays Signal Strength
wifi status	displays wifi status

Basic WiFi Setup Procedure

This explains how to correctly use the Lasair Pro Wi-Fi enabling hardware. The hardware necessary to provide the Wi-Fi consists of a separate microprocessor controlled electronics module inside the Lasair Pro instrument.

This procedure explains the basic process of using the Lasair Pro Wi-Fi module. The Wi-Fi module is preconfigured by Particle Measuring Systems to operate such that parameters are set via the Lasair Pro front panel display.

1. Press , then  (**COMM**).
2. Go to the **WIRELESS** tab and select the WiFi taggle at the top of the screen. The orange dot will appear when the WiFi is enabled. A gray dot indicates the setting has not been enabled.

When you enable or disable the Wifi, you will need to reboot by pushing the reboot button in the lower right corner of the screen.

3. Select the WiFi icon below Strength 
A list of available networks will appear



4. Select your network and enter the password as prompted.
The instrument will then be connected to the network of choice



American Certification Body Inc.
313 Park Avenue, Suite 300, Falls Church, VA 22046

REF No. ► ATCB030883

TECHNICAL ACCEPTANCE CERTIFICATE

CERTIFICAT D'ACCEPTABILITÉ TECHNIQUE

CERTIFICATION No. ► 31142-LPRO (New Family Certification)
NUMÉRO DE CERTIFICATION

ISSUED TO ► Particle Measuring Systems
DÉLIVRÉ A 5475 Airport Blvd
Boulder, CO 80301
U.S.A.

TYPE OF EQUIPMENT ► RFID
TYPE DE MATÉRIEL

PRODUCT MARKETING NAME (PMN): ► Lasair Pro
NOM DU PRODUIT MARKETING

HARDWARE VERSION IDENTIFICATION NUMBER (HVIN): ► 310, 350 and 5100
MATÉRIEL NUMÉRO D'IDENTIFICATION DE VERSION

FIRMWARE VERSION IDENTIFICATION NUMBER (FVIN): ► <Not Specified>
FIRMWARE NUMÉRO D'IDENTIFICATION DE VERSION

FREQUENCY RANGE ► 13.56 MHz
BANDE DE FRÉQUENCES

EMISSION DESIGNATION, R.F. POWER RATING, AND ANTENNA ► ** See Annex 1 for Complete Detail **
DESIGNATION D'ÉMISSION, PUISSANCE NOMINALE H.F., ET L'ANTENNE

CERTIFIED TO : SPECIFICATION / ISSUE ► ** See Annex 1 for Complete Detail **
CERTIFIÉ SELON LE : CAHIER DES CHARGES / ÉDITION

TEST LABORATORY ► Laird Connectivity, Inc
LABORATOIRE D'ESSAI W66 N 220 Commerce Court
Cedarburg, WI 53012 USA
Contact: Adam Alger
email: adam.alger@lairdconnect.com

COMPANY NUMBER ► 3088A
NUMÉRO DE COMPAGNIE

Certification of equipment means only that the equipment has met the requirements of the above noted specification. License applications, where applicable to use certified equipment, are acted on accordingly by the ISDE issuing office and will depend on the existing radio environment, service and location of operation.

This certificate is issued on condition that the holder complies and will continue to comply with the requirements of the radio standards specifications and procedures issued by ISDE. The equipment for which this certificate is issued shall not be manufactured, imported, distributed, leased, offered for sale, or sold unless the equipment complies with the applicable technical specifications and procedures issued by ISDE.

I hereby attest that the subject equipment was tested and found in compliance with the above-noted specification.

ORIGINAL DATE OF ISSUE: October 25, 2023
REVISED DATE OF ISSUE: N/A

La certification du matériel signifie seulement que le matériel a satisfait aux exigences de la norme indiquée ci-dessus. Les demandes de licences nécessaires pour l'utilisation du matériel certifié sont traitées en conséquence par le bureau de délivrance d'ISDE et dépendent des conditions radio ambiantes, du service et de l'emplacement d'exploitation.

Le présent certificat est délivré à condition que le titulaire satisfasse et continue de satisfaire aux exigences et aux procédures d'ISDE. Le matériel à l'égard duquel le présent certificat est délivré ne doit pas être fabriqué, importé, distribué, loué, mis en vente ou vendu à moins d'être conforme aux procédures et aux spécifications techniques applicables publiées par ISDE.

J'atteste, par la présente, que le matériel a fait l'objet d'essai et a été jugé conforme à la spécification ci-dessus.

Michael F. Violette
Director



TECHNICAL ACCEPTANCE CERTIFICATE (ANNEX 1)

Technical Features and Characteristics

The device includes the following features and characteristics:

	RSS Standard		Frequency Band (MHz)	Modulation Method	Maximum RF Field Strength	Emission Designator
	RSS #	Issue #				
	210	10	13.56	ASK	60.5 dB μ V/m @3m 39.1 dB μ V/m @ 30m*	22H0K1D

*Value listed on REL

ANTENNA INFORMATION	
ANTENNA DESCRIPTION	GAIN (dBi) or Integral
PCB Trace	Integral

Contains Additional Pre-Approved Module	
IC ID:3147A-60SIPT	MIMO 802.11b/g/n 2.4GHz, 5GHz Bluetooth Low Energy Bluetooth 5.1 MIMO FlexPiFA Antenna EDF2455A3S-10MH4L (2.5 dBi/2.4GHz; 3.0 dBi/5 GHz)

ORIGINAL DATE OF ISSUE: October 25, 2023
REVISED DATE OF ISSUE: N/A

GRANT OF EQUIPMENT
AUTHORIZATION

Certification
Issued Under the Authority of the
Federal Communications Commission
By:

ACB, Inc.
313 Park Avenue Suite 300
Falls Church, VA 22046

Date of Grant: 10/25/2023
Application Dated: 10/20/2023

Particle Measuring Systems
5475 Airport Blvd.
Boulder, CO 80537

Attention: Joan Legerski

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER: 2BCDH-LPRO
Name of Grantee: Particle Measuring Systems
Equipment Class: Part 15 Low Power Communication Device Transmitter
Notes: Airborne Particle Counter Implementing 2.4GHz and 5GHz WLAN and NFC

<u>Grant Notes</u>	<u>FCC Rule Parts</u>	<u>Frequency Range (MHZ)</u>	<u>Output Watts</u>	<u>Frequency Tolerance</u>	<u>Emission Designator</u>
	15C	13.56 - 13.56			

RF exposure compliance is addressed for 1.1310 and 2.1091 MPE limits at the distance specified in the filing, therefore, this device may be used in mobile configurations. Installers and end-users must be provided with transmitter installation and operation conditions for satisfying RF exposure compliance. The antenna(s) used for this transmitter must not transmit simultaneously with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures. Grantee must provide installation and operating instructions for complying with FCC multi-transmitter product procedures and RF exposure compliance.



関 通 波 環 第 3 8 5 号

スペクトリス株式会社

令和6年7月22日付けで申請の誘導式読み書き通信設備の型式について、電波法施行規則第46条の2第1項の規定により、次のとおり指定する。

令和6年8月6日

総 務 大 臣



型 式 名

指 定 番 号

L a s a i r P r o 5 1 0 0

第AC-24098号

L a s a i r P r o 3 5 0

第AC-24099号

L a s a i r P r o 3 1 0

第AC-24100号

방송통신기자재등의 적합등록 필증

Registration of Broadcasting and Communication Equipments

상호 또는 성명 Trade Name or Registrant	Particle Measuring Systems
기자재명칭(제품명칭) Equipment Name	Lasair Pro
기기부호/추가 기기부호 Equipment code /Additional Equipment code	RFID3 / LARN5,LARN8
기본모델명 Basic Model Number	Lasair Pro 5100
파생모델명 Series Model Number	Lasair Pro 310, Lasair Pro 350
등록번호 Registration No.	R-R-Pm4-LasairPro5100
제조사/제조국가 Manufacturer/Country of Origin	Particle Measuring Systems/미국
등록연월일 Date of Registration	2024-04-29
기타 Others	인증받은 무선모듈의 인증번호: MSIP-CRM-LAI-60-2230C

위 기자재는 「전파법」 제58조의2 제3항에 따라 등록되었음을 증명합니다.
It is verified that foregoing equipment has been registered under the Clause 3, Article 58-2 of Radio Waves Act.

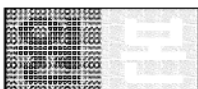
2024년(Year) 04월(Month) 29일(Day)

국립전파연구원장



Director General of National Radio Research Agency

※ 적합등록 방송통신기자재는 반드시 "적합성평가표시" 를 부착하여 유통하여야 합니다.
위반시 과태료 처분 및 등록이 취소될 수 있습니다.





Federative Republic of Brazil
Telecommunications National Agency

Certificate of Equipment Authorization (Not Transferable)

Nº **03288-25-17850**
Expires: **Indeterminada**
Date of Certificate: **02/06/2025**

Applicant:
CNPJ: 43.948.215/0001-41
SPECTRIS DO BRASIL INSTRUMENTOS ELETRONICOS LTDA

Manufacturer:
PARTICLE MEASURING SYSTEMS
5475 AIRPORT BOULEVARD, BOULDER, 80301, CO, USA
Nº
80301
ESTADOS UNIDOS DA AMÉRICA

This document approves, in accordance with the Telecommunication Rules and Regulations, the Certificate of Conformity number Versys 4631, issued by **Associação Versys de Tecnologia**. This approval is issued on behalf of the applicant here identified and is valid only for the product described below for use under the Anatel's Rules and Regulations.

Figure H-10. Brazilian Certificates

Type - Category:
Transceptor de Radiação Restrita - II

Model - Commercial Name (s)
Lasair Pro 310 - (Lasair® Pro Aerosol Particle Counter 310)

Basic technical characteristics:

Designação de Emissões	Tecnologias	Potência Máxima de Saída (W)	Tipo de Modulação	Faixa de Frequências Tx (MHz)
9M81X9D	SEQÜÊNCIA DIRETA	0,09506	CCK, DBPSK, DQPSK	2.400,0 a 2.483,5
16M5X9D	OFDM	0,29174	BPSK, QPSK, 16QAM, 64QAM	2.400,0 a 2.483,5
16M5X9D	OFDM	0,31842	BPSK, QPSK, 16QAM, 64QAM	2.400,0 a 2.483,5
-	OFDM	0,04853	BPSK, QPSK, 16QAM, 64QAM	5.150,0 a 5.350,0
-	OFDM	0,05358	BPSK, QPSK, 16QAM, 64QAM	5.150,0 a 5.350,0
-	OFDM	0,06698	BPSK, QPSK, 16QAM, 64QAM	5.470,0 a 5.725,0
-	OFDM	0,07551	BPSK, QPSK, 16QAM, 64QAM	5.470,0 a 5.725,0
16M5X9D	OFDM	0,3027	BPSK, QPSK, 16QAM, 64QAM	5.725,0 a 5.850,0
17M8X9D	OFDM	0,32961	BPSK, QPSK, 16QAM, 64QAM	5.725,0 a 5.850,0

O produto incorpora Sistema de Identificação por Radiofrequências com as seguintes características:

Intensidade de Campo (µV/m)	Faixa de Frequências (MHz)	Distância da Medida (m)	Tipo de Modulação
1,39	13,56 a 13,56	30	ASK

Ensaio de SAR não aplicável.

Os valores de potências indicados nas faixas de 5150-5350 MHz e 5470-5725 MHz referem-se à potência média em E.I.R.P.

Comments

Este produto destina-se ao uso profissional, manuseado por pessoal devidamente qualificado, não sendo destinado ao uso do público em geral para acesso a serviço de telecomunicações de interesse coletivo.

Na instalação do produto devem ser observadas as condições de uso conforme estabelecido no Regulamento sobre Equipamentos de Radiocomunicação de Radiação Restrita.

Constitutes an obligation of the manufacturer or supplier of the product in Brazil to identify all approved products with Anatel's mark before its distribution to the market, as well as observe and maintain the technical characteristics which motivated the original certification.

The information in this Approval Certificate can be confirmed in the Certification and Approval Management System - SCH, available on Anatel's website. (www.anatel.gov.br).

Marcos Vieira Baeta Neves
Gerente de Certificação e Numeração



Federative Republic of Brazil
Telecommunications National Agency

Certificate of Equipment Authorization

(Not Transferable)

Nº **03292-25-17850**
Expires: **Indeterminada**
Date of Certificate: **02/06/2025**

Applicant:
CNPJ: 43.948.215/0001-41
SPECTRIS DO BRASIL INSTRUMENTOS ELETRONICOS LTDA

Manufacturer:
PARTICLE MEASURING SYSTEMS
5475 AIRPORT BOULEVARD, BOULDER, 80301, CO, USA
Nº
80301
ESTADOS UNIDOS DA AMÉRICA

This document approves, in accordance with the Telecommunication Rules and Regulations, the Certificate of Conformity number Versys 4632, issued by **Associação Versys de Tecnologia**. This approval is issued on behalf of the applicant here identified and is valid only for the product described below for use under the Anatel's Rules and Regulations.

Type - Category:
Transceptor de Radiação Restrita - II

Model - Commercial Name (s)
Lasair Pro 350 - (Lasair® Pro Aerosol Particle Counter 350)

Basic technical characteristics:

Tecnologias	Faixa de Frequências Tx (MHz)	Potência Máxima de Saída (W)	Designação de Emissões	Tipo de Modulação
SEQÜÊNCIA DIRETA	2.400,0 a 2.483,5	0,09506	9M81X9D	CCK, DBPSK, DQPSK
OFDM	2.400,0 a 2.483,5	0,29174	16M5X9D	BPSK, QPSK, 16QAM, 64QAM
OFDM	2.400,0 a 2.483,5	0,31842	16M5X9D	BPSK, QPSK, 16QAM, 64QAM
OFDM	5.150,0 a 5.350,0	0,04853		BPSK, QPSK, 16QAM, 64QAM
OFDM	5.150,0 a 5.350,0	0,05358		BPSK, QPSK, 16QAM, 64QAM
OFDM	5.470,0 a 5.725,0	0,06698		BPSK, QPSK, 16QAM, 64QAM
OFDM	5.470,0 a 5.725,0	0,07551		BPSK, QPSK, 16QAM, 64QAM
OFDM	5.725,0 a 5.850,0	0,3027	16M5X9D	BPSK, QPSK, 16QAM, 64QAM
OFDM	5.725,0 a 5.850,0	0,32961	17M8X9D	BPSK, QPSK, 16QAM, 64QAM

O produto incorpora Sistema de Identificação por Radiofrequências com as seguintes características:

Intensidade de Campo (µV/m)	Faixa de Frequências (MHz)	Distância da Medida (m)	Tipo de Modulação
1,39	13,56 a 13,56	30	ASK

Ensaio de SAR não aplicável.

Os valores de potências indicados nas faixas de 5150-5350 MHz e 5470-5725 MHz referem-se à potência média em E.I.R.P.

Comments

Este produto destina-se ao uso profissional, manuseado por pessoal devidamente qualificado, não sendo destinado ao uso do público em geral para acesso a serviço de telecomunicações de interesse coletivo.

Na instalação do produto devem ser observadas as condições de uso conforme estabelecido no Regulamento sobre Equipamentos de Radiocomunicação de Radiação Restrita.

Constitutes an obligation of the manufacturer or supplier of the product in Brazil to identify all approved products with Anatel's mark before its distribution to the market, as well as observe and maintain the technical characteristics which motivated the original certification.

The information in this Approval Certificate can be confirmed in the Certification and Approval Management System - SCH, available on Anatel's website. (www.anatel.gov.br).

Marcos Vieira Baeta Neves
Gerente de Certificação e Numeração



Federative Republic of Brazil
Telecommunications National Agency

Certificate of Equipment Authorization (Not Transferable)

Nº **03295-25-17850**
Expires: **Indeterminada**
Date of Certificate: **30/05/2025**

Applicant:
CNPJ: 43.948.215/0001-41
SPECTRIS DO BRASIL INSTRUMENTOS ELETRONICOS LTDA

Manufacturer:
PARTICLE MEASURING SYSTEMS
5475 AIRPORT BOULEVARD, BOULDER, 80301, CO, USA
Nº
80301
ESTADOS UNIDOS DA AMÉRICA

This document approves, in accordance with the Telecommunication Rules and Regulations, the Certificate of Conformity number Versys 4633, issued by **Associação Versys de Tecnologia**. This approval is issued on behalf of the applicant here identified and is valid only for the product described below for use under the Anatel's Rules and Regulations.

Type - Category:
Transceptor de Radiação Restrita - II

Model - Comercial Name (s)
Lasair Pro 5100 - (Lasair® Pro Aerosol Particle Counter 5100)

Basic technical characteristics:

Tipo de Modulação	Faixa de Frequências Tx (MHz)	Potência Máxima de Saída (W)	Designação de Emissões	Tecnologias
CCK, DBPSK, DQPSK	2.400,0 a 2.483,5	0,09506	9M81X9D	SEQUÊNCIA DIRETA
BPSK, QPSK, 16QAM, 64QAM	2.400,0 a 2.483,5	0,29174	16M5X9D	OFDM
BPSK, QPSK, 16QAM, 64QAM	2.400,0 a 2.483,5	0,31842	16M5X9D	OFDM
BPSK, QPSK, 16QAM, 64QAM	5.150,0 a 5.350,0	0,04853	-	OFDM
BPSK, QPSK, 16QAM, 64QAM	5.150,0 a 5.350,0	0,05358	-	OFDM
BPSK, QPSK, 16QAM, 64QAM	5.470,0 a 5.725,0	0,06698	-	OFDM
BPSK, QPSK, 16QAM, 64QAM	5.470,0 a 5.725,0	0,07551	-	OFDM
BPSK, QPSK, 16QAM, 64QAM	5.725,0 a 5.850,0	0,3027	16M5X9D	OFDM
BPSK, QPSK, 16QAM, 64QAM	5.725,0 a 5.850,0	0,32961	17M8X9D	OFDM

Incorpora Sistemas de Identificação por Radiofrequências (NFC):

Intensidade de Campo ($\mu\text{V/m}$)	Distância da Medida (m)	Potência Máxima de Saída (W)	Tipo de Modulação	Faixa de Frequências (MHz)
1,39	30	0,0	ASK	13,56 a 13,56

- Ensaio de SAR não aplicável: o equipamento não é estação terminal portátil.
- O produto possui antenas externas (MIMO 2x2) com om ganho máximo de 3dBi.

Comments

Na instalação do produto devem ser observadas as condições de uso conforme estabelecido no Regulamento sobre Equipamentos de Radiocomunicação de Radiação Restrita.

Constitutes an obligation of the manufacturer or supplier of the product in Brazil to identify all approved products with Anatel's mark before its distribution to the market, as well as observe and maintain the technical characteristics which motivated the original certification.

The information in this Approval Certificate can be confirmed in the Certification and Approval Management System - SCH, available on Anatel's website. (www.anatel.gov.br).

Marcos Vieira Baeta Neves
Gerente de Certificação e Numeração

歐陸電子通訊檢測股份有限公司

電信管制射頻器材型式認證證明

證照字號：型式字第 AK 號

- 一、申請者：Particle Measuring Systems, Inc.
二、地址：5475 Airport Boulevard, Boulder, CO 80301, USA
三、製造廠商：Particle Measuring Systems, Inc.
四、器材名稱：Lasair Pro
五、廠牌：Particle Measuring Systems
六、型號：Lasair Pro 310
七、發射功率（電場強度）：詳見附件二
八、工作頻率：不含Wi-Fi 6E (5.925 GHz~7.125 GHz)，詳見附件二表格
九、審驗日期：114 年 07 月 16 日

十、審驗合格標籤式樣：  CCAK25LP1271T9

十一、警語或標示要求：

- 電信管制射頻器材取得審驗證明者、被授權使用審驗合格標籤或符合性聲明標籤者，應依下列規定辦理，始得販賣：
 - 於本體明顯處標示審驗合格標籤或符合性聲明標籤及其型號，並於包裝盒標示主管機關標章。
 - 依主管機關或相關技術規範規定於指定位置標示正體中文警語。
- 於網際網路販賣取得審驗證明之電信管制射頻器材者，應於該網際網路網頁提供審驗合格標籤或符合性聲明標籤資訊。
- 使用手冊應包含所有必要之資訊以指導使用者正確的安裝及操作該電機，內容包括：
 - 所有控制、調整及開關之使用方法。
 - 取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前述合法通信，指依電信管理法規定作業之無線電通信。低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。
- 應避免影響附近雷達系統之操作。

十二、特殊記載事項：

- 取得審驗證明之電信管制射頻器材或非隨插即用射頻模組（組件），變更原申請者、廠牌、型號、硬體、射頻功能、外觀、顏色、材質、電源供應方式、配件或天線時，除本辦法另有規定外，應重新申請審驗。
- 電信管制射頻器材或非隨插即用射頻模組（組件）之取得審驗證明者，於相關技術規範修正，並限期重新申請審驗時，應申請重新審驗，並得使用原審驗合格標籤或符合性聲明標籤。
- 取得型式認證證明、符合性聲明證明或簡易符合性聲明證明者，應妥善保管申請審驗之電信管制射頻器材或非隨插即用射頻模組（組件）、外接電源、配件、外接天線、與檢驗報告或測試報告相符之測試治具及與檢驗報告或測試報告使用相同版本之測試軟體至該器材停止生產或停止輸入後五年。
- 取得型式認證證明或符合性聲明證明者得授權他人於同廠牌同型號之電信管制射頻器材或非隨插即用射頻模組（組件）使用審驗合格標籤或符合性聲明標籤；授權他人使用審驗合格標籤或符合性聲明標籤由取得審驗證明者於主管機關指定網站登錄或委託原驗證機關（構）登錄。
- 本器材之審驗範圍僅限無線射頻硬體功能，不及於器材之資通安全檢測。
- 本公司僅對無線射頻特性（技術規格）辦理型式認證，其他仍須依本國相關法規辦理。

說明：1. 本公司係經主管機關委託之驗證機構（機構地址：桃園市八德區長安街140-1號、電話：03-2710188），核發本型式認證證明。
2. 請依上列型號、標籤式樣於電信管制射頻器材本體明顯處標示其型號及審驗合格標籤，並於包裝盒標示主管機關標章。但最終產品應於本體明顯處標示最終產品型號及上列標籤式樣，並於包裝盒標示主管機關標章。
3. 本器材之製造、輸入或販賣須遵守電信管理法相關規定。

外接電源：詳見附件一；配件：詳見附件一；天線：詳見附件一

備註：詳見附件一：本器材符合低功率射頻器材技術規範(LP0002)之規定

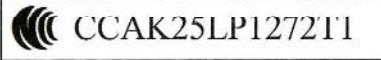


中 華 民 國 114 年 07 月 16 日

歐陸電子通訊檢測股份有限公司

電信管制射頻器材型式認證證明

證照字號：型式字第 AK 號

- 一、申請者：Particle Measuring Systems, Inc.
二、地址：5475 Airport Boulevard, Boulder, CO 80301, USA
三、製造廠商：Particle Measuring Systems, Inc.
四、器材名稱：Lasair Pro
五、廠牌：Particle Measuring Systems
六、型號：Lasair Pro 350
七、發射功率（電場強度）：詳見附件二
八、工作頻率：不含Wi-Fi 6E (5.925 GHz~7.125 GHz)，詳見附件二表格
九、審驗日期：114 年 07 月 16 日
十、審驗合格標籤式樣：
十一、警語或標示要求：



1. 電信管制射頻器材取得審驗證明者、被授權使用審驗合格標籤或符合性聲明標籤者，應依下列規定辦理，始得販賣：
(1) 於本體明顯處標示審驗合格標籤或符合性聲明標籤及其型號，並於包裝盒標示主管機關標章。
(2) 依主管機關或相關技術規範規定於指定位置標示正體中文警語。
2. 於網際網路販賣取得審驗證明之電信管制射頻器材者，應於該網際網路網頁提供審驗合格標籤或符合性聲明標籤資訊。
3. 使用手冊應包含所有必要之資訊以指導使用者正確的安裝及操作該電機，內容包括：
(1) 所有控制、調整及開關之使用方法。
(2) 取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前述合法通信，指依電信管理法規規定作業之無線電通信。低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。
4. 應避免影響附近雷達系統之操作。
- 十二、特殊記載事項：
1. 取得審驗證明之電信管制射頻器材或非隨插即用射頻模組（組件），變更原申請者、廠牌、型號、硬體、射頻功能、外觀、顏色、材質、電源供應方式、配件或天線時，除本辦法另有規定外，應重新申請審驗。
2. 電信管制射頻器材或非隨插即用射頻模組（組件）之取得審驗證明者，於相關技術規範修正，並限期重新申請審驗時，應申請重新審驗，並得使用原審驗合格標籤或符合性聲明標籤。
3. 取得型式認證證明、符合性聲明證明或簡易符合性聲明證明者，應妥善保管申請審驗之電信管制射頻器材或非隨插即用射頻模組（組件）、外接電源、配件、外接天線、與檢驗報告或測試報告相符之測試治具及與檢驗報告或測試報告使用相同版本之測試軟體至該器材停止生產或停止輸入後五年。
4. 取得型式認證證明或符合性聲明證明者得授權他人於同廠牌同型號之電信管制射頻器材或非隨插即用射頻模組（組件）使用審驗合格標籤或符合性聲明標籤；授權他人使用審驗合格標籤或符合性聲明標籤由取得審驗證明者於主管機關指定網站登錄或委託原驗證機關（構）登錄。
5. 本器材之審驗範圍僅限無線射頻硬體功能，不及於器材之資通安全檢測。
6. 本公司僅對無線射頻特性（技術規格）辦理型式認證，其他仍須依本國相關法規辦理。
- 說明：1. 本公司係經主管機關委託之驗證機構（機構地址：桃園市八德區長安街140-1號、電話：03-2710188），核發本型式認證證明。
2. 請依上列型號、標籤式樣於電信管制射頻器材本體明顯處標示其型號及審驗合格標籤，並於包裝盒標示主管機關標章。但最終產品應於本體明顯處標示最終產品型號及上列標籤式樣，並於包裝盒標示主管機關標章。
3. 本器材之製造、輸入或販賣須遵守電信管理法相關規定。

外接電源：詳見附件一；配件：詳見附件一；天線：詳見附件一

備註：詳見附件一：本器材符合低功率射頻器材技術規範(LP0002)之規定



中 華 民 國 114 年 07 月 16 日

歐陸電子通訊檢測股份有限公司

電信管制射頻器材型式認證證明

證照字號：型式字第 AK 號

- 一、申請者：Particle Measuring Systems, Inc.
二、地址：5475 Airport Boulevard, Boulder, CO 80301, USA
三、製造廠商：Particle Measuring Systems, Inc.
四、器材名稱：Lasair Pro
五、廠牌：Particle Measuring Systems
六、型號：Lasair Pro 5100
七、發射功率（電場強度）：詳見附件二
八、工作頻率：不含Wi-Fi 6E (5.925 GHz~7.125 GHz)，詳見附件二表格
九、審驗日期：114 年 07 月 16 日
十、審驗合格標籤式樣：
十一、警語或標示要求：



- 電信管制射頻器材取得審驗證明者、被授權使用審驗合格標籤或符合性聲明標籤者，應依下列規定辦理，始得販賣：
(1) 於本體明顯處標示審驗合格標籤或符合性聲明標籤及其型號，並於包裝盒標示主管機關標章。
(2) 依主管機關或相關技術規範規定於指定位置標示正體中文警語。
- 於網際網路販賣取得審驗證明之電信管制射頻器材者，應於該網際網路網頁提供審驗合格標籤或符合性聲明標籤資訊。
- 使用手冊應包含所有必要之資訊以指導使用者正確的安裝及操作該電機，內容包括：
(1) 所有控制、調整及開關之使用方法。
(2) 取得審驗證明之低功率射頻器材，非經核准，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。低功率射頻器材之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前述合法通信，指依電信管理法規定作業之無線電通信。低功率射頻器材須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。
- 應避免影響附近雷達系統之操作。

十二、特殊記載事項：

- 取得審驗證明之電信管制射頻器材或非隨插即用射頻模組（組件），變更原申請者、廠牌、型號、硬體、射頻功能、外觀、顏色、材質、電源供應方式、配件或天線時，除本辦法另有規定外，應重新申請審驗。
 - 電信管制射頻器材或非隨插即用射頻模組（組件）之取得審驗證明者，於相關技術規範修正，並限期重新申請審驗時，應申請重新審驗，並得使用原審驗合格標籤或符合性聲明標籤。
 - 取得型式認證證明、符合性聲明證明或簡易符合性聲明證明者，應妥善保管申請審驗之電信管制射頻器材或非隨插即用射頻模組（組件）、外接電源、配件、外接天線、與檢驗報告或測試報告相符之測試治具及與檢驗報告或測試報告使用相同版本之測試軟體至該器材停止生產或停止輸入後五年。
 - 取得型式認證證明或符合性聲明證明者得授權他人於同廠牌同型號之電信管制射頻器材或非隨插即用射頻模組（組件）使用審驗合格標籤或符合性聲明標籤；授權他人使用審驗合格標籤或符合性聲明標籤由取得審驗證明者於主管機關指定網站登錄或委託原驗證機關（構）登錄。
 - 本器材之審驗範圍僅限無線射頻硬體功能，不及於器材之資通安全檢測。
 - 本公司僅對無線射頻特性(技術規格)辦理型式認證，其他仍須依本國相關法規辦理。
- 說明：
- 本公司係經主管機關委託之驗證機構（機構地址：桃園市八德區長安街140-1號、電話：03-2710188），核發本型式認證證明。
 - 請依上列型號、標籤式樣於電信管制射頻器材本體明顯處標示其型號及審驗合格標籤，並於包裝盒標示主管機關標章。但最終產品應於本體明顯處標示最終產品型號及上列標籤式樣，並於包裝盒標示主管機關標章。
 - 本器材之製造、輸入或販賣須遵守電信管理法相關規定。

外接電源：詳見附件一；配件：詳見附件一；天線：詳見附件一

備註：詳見附件一：本器材符合低功率射頻器材技術規範(LP0002)之規定



中 華 民 國 114 年 07 月 16 日

编号: 2025-15519

Certificate No.

无线电发射设备型号核准证

Radio Transmission Equipment Type Approval Certificate

美国 PARTICLE MEASURING SYSTEMS. INC.:

根据《中华人民共和国无线电管理条例》, 经审查, 下列设备
准予颁发无线电发射设备型号核准证。

In accordance with the Radio Regulations of the People's Republic of China,
after examination, the Radio Transmission Equipment Type Approval Certificate
is granted to the following equipment.

设备名称: 5.8GHz/5.1GHz/2.4GHz无线局域网设备
Equipment Name

设备型号: Lasair Pro 310
Equipment Type

核准代码: 25J995SE5903
CMIIT ID

主要功能: 数据传输
Main Functions

有效期: 五年
Validity

其他事项载于附页。
Additional Items as Seen in Attachments.



中华人民共和国工业和信息化部统一制作

Issued by the Ministry of Industry and Information Technology of the People's Republic of China

编号: 2025-15557
Certificate No.

无线电发射设备型号核准证

Radio Transmission Equipment Type Approval Certificate

美国 PARTICLE MEASURING SYSTEMS. INC.:

根据《中华人民共和国无线电管理条例》, 经审查, 下列设备
准予颁发无线电发射设备型号核准证。

In accordance with the Radio Regulations of the People's Republic of China,
after examination, the Radio Transmission Equipment Type Approval Certificate
is granted to the following equipment.

设备名称: 5.8GHz/5.1GHz/2.4GHz无线局域网设备
Equipment Name

设备型号: Lasair Pro 350
Equipment Type

核准代码: 25J995SEB516
CMIIT ID

主要功能: 数据传输
Main Functions

有效期: 五年
Validity

其他事项载于附页。
Additional Items as Seen in Attachments.



Sealed by Issuing Authority
2025 年 07 月 25 日
Year Month Date

中华人民共和国工业和信息化部统一制作
Issued by the Ministry of Industry and Information Technology of the People's Republic of China

编号: 2025-15537

Certificate No.

无线电发射设备型号核准证

Radio Transmission Equipment Type Approval Certificate

美国 PARTICLE MEASURING SYSTEMS. INC.:

根据《中华人民共和国无线电管理条例》，经审查，下列设备
准予颁发无线电发射设备型号核准证。

In accordance with the Radio Regulations of the People's Republic of China,
after examination, the Radio Transmission Equipment Type Approval Certificate
is granted to the following equipment.

设备名称: 5.8GHz/5.1GHz/2.4GHz无线局域网设备
Equipment Name

设备型号: Lasair Pro 5100
Equipment Type

核准代码: 25J995SEY969
CMIIT ID

主要功能: 数据传输
Main Functions

有效期: 五年
Validity

其他事项载于附页。
Additional Items as Seen in Attachments.



中华人民共和国工业和信息化部统一制作

Issued by the Ministry of Industry and Information Technology of the People's Republic of China

Appendix H

有毒或有害的物质和元素

Part Name 部件名称	有毒或有害的物质和元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴联苯醚 (PBDE)
电源供应	X	O	X	O	O	O
印刷电路 装配	X	O	X	O	O	O
光学元件	X	O	X	O	O	O
激光	X	O	X	O	O	O
机械部件	X	O	X	O	O	O
电缆	X	O	X	O	O	O
机电	X	O	X	O	O	O
显示器	X	O	X	O	O	O
电池	X	O	X	O	O	O
O: 表示用于部件的所有同族物质中所含的有毒或有害物质低于SJ/T11363-2006规定的限度要求。						
X: 表示用于部件的至少一种同族物质中所含的有毒或有害物质高于SJ/T11363-2006规定的限度要求。						

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Index

SYMBOLS

4-20 mA input
 sensor **4-6**
21 CFR Part 11 compliant **3-1**
 audit **6-16**
 security **6-2**

A

accessories
 adapters **5-15**
 tripods **5-14-5-15**
alarm **3-11, 7-2**
 alarm reasons **7-10-7-12**
 alarm siren **10-3**
All channels mode **12-14**
analog **4-6**
 input **4-6**
 probe **3-15**
 output **4-11**
applications **1-1**
areas **8-2**
audio **5-7, 10-3**
audit **6-15**
 report **6-17**
Auto-MDIX **4-22**

B

back panel **4-1**
Backup NTP Server **12-13**
battery **3-13**
 about **4-4**
 disposal **13-4**
 specs **2-3**
beep **5-7**

buttons
 alarm/warning acknowledgement **7-10-7-12**
 front panel **1-1**

C

calibration **2-1**
 reminder **13-4-13-5**
channels **2-1**
China GMP **11-23**
cleaning **2-3**
clone export **12-9**
clone file **12-11**
clone import **12-10**
communication **2-1, 4-16**
 network configuration **4-17**
continuous pump **5-7**
continuous sampling **5-2**
counting efficiency **2-1**
CSV
 audit **6-15**
 non-standard characters **12-3**
cycle **5-7**

D

data
 report **10-11**
 table **10-15**
data storage **2-1**
date/time **12-12**
deleting users **6-6**
digital
 in/out **4-14**
display and printer **2-2**
disposal

battery **iii**

E

electrical connections **4-6**

environmental information **iii-iv**

environmental sensors **2-2**

Ethernet **4-17**

setup **4-22**

troubleshooting **C-1-C-2**

EU GMP Annex 1 **11-23**

F

filtering **2-3**

FS-209E **11-24**

G

gas sampling **12-3**

gateway address **4-20**

graph **10-16**

box plot **10-17**

frequency polygon **10-17**

historical histogram **10-17**

historical trend **10-17**

H

hazard symbols **A-2-A-3**

HHIPA **3-15**

histogram

scale **10-8**

HOME screen **1-4, 3-4**

icons and buttons **3-6**

I

installation **1-3, 2-4**

international warning **A-1**

IP address **4-19, 4-22, 4-25**

ISO 14644-1:2015 **11-22**

L

languages **2-2, 12-3**

laser **2-4, A-1**

locations **8-2**

assignments **8-5**

deletion and recovery **8-7**

hierarchy of area, room and location **8-2**

new **8-3**

report **8-10**

login and logout **6-5**

M

MAC address **4-20-4-21**

maintenance

cleaning **13-1-13-2**

agents **13-2**

call for advice **13-2**

manual conventions **iv-v**

Modbus TCP **B-3**

monitoring mode **5-8**

multicast address **4-20**

N

native serial interface **4-17**

Navigation panel **3-3-3-5**

network mask **4-19-4-20**

NFC cards **3-2, 3-17, 4-15, 9-5**

NTP **12-13**

number of samples **5-2**

O

operating environment **2-3**

P

particle channels **12-14**

passwords **6-2**

patent information **iii**

Pharmaceuticals mode **12-14**

power **1-7-1-10, 2-3, 4-4**

AC power **4-5**

Primary NTP Server **12-13**

print averages **5-7**

printer paper **13-3**

probes **5-14**

Q

Quality Statement **ii**

quick guide **1-1**

R

recipes **9-1**
 database **9-10-9-11**
 import/export **9-10**
 NFC **9-5**
 saved info **9-10**
 statistics data **9-12**
reports **2-2, 10-9**
 example **5-5, 10-11, 11-17**
restore factory settings **12-10**
rooms **8-2**

S

sampling
 configuration **5-2-5-6**
 continuous sampling **5-2**
 start **5-6**
sampling setup report **5-5**
save
 network settings **4-21**
 recipe **9-2**
screen saver **10-3**
security
 enable/disable users **6-3**
 NFC **6-6**
 overview **6-2**
Service mode **B-2**
 commands **B-3**
software **4-16, 4-17**
specifications **2-1-2-3**
 dimensions **2-3**
 weight **2-3**
storage **2-4**
substance hazards **D-1**
switch mode **5-9**

T

take a quick sample **3-1-3-20**
temperature
 environment **2-3**
 operating **2-4**
 storage and transportation **2-4**
terminal emulation **4-22**
text color of recipes **9-1**
thermal paper **3-15, 3-16, 5-15**
touchscreen display **10-2**
trademarks **ii**
trend

 settings **10-4**
tubing **1-3, 2-3, 5-16**

U

unpacking **3-19**
USB ports **1-7, 4-2**
 control software **4-17**
user access levels **6-3**
users **6-2**
User Setup Report **6-14**

W

warnings **3-11**
warning symbols **A-1-A-4**
write channels command **B-6**

X

XML
 audit **6-16**
 facilities and locations **8-9**

Z

zero count **2-1**

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