



Mini Micro Pulse LiDAR System

MiniMPL-532-C

Operations Manual

Version: August 2016



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Mini Micro Pulse LiDAR (MiniMPL) System: Record of Purchase

Thank you for your purchase of the Mini Micro Pulse LiDAR System from Sigma Space Corporation.

Please fill in the following system information for your records. This information may be requested by Sigma Space for obtaining service or for performing upgrades.

Customer Name: _____

Organization: _____

Model Number: **MiniMPL-532-C** _____

Serial Number: _____

Date of Purchase: _____

Configuration Notes: _____



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Precautions

Electrical Safety

- E1. Adhere to the specified operating voltage for the MiniMPL electronics at all times. The MiniMPL has a power consumption of 100 W, and the default operating voltage is AC 110-240V, 50/60 Hz. The voltage specification on custom configured units is labeled accordingly.
- E2. Use grounded plugs and receptacles for power. It is recommended to use receptacles or power strips equipped with surge suppressors to protect the electronics from damage.
- E3. All electrical connections should be verified by qualified personnel prior to operating the instrument. Incorrect or poor connections may cause damage to the equipment.
- E4. Ground straps are recommended for handling connection cables of the MiniMPL to avoid damage due to electrostatic discharge.
- E5. Startup and shutdown procedures must be followed as described in Section 4 of this Operations Manual. Do not attempt to open or move the MiniMPL while the instrument is in operation.
- E6. The user should review all procedures listed in this Operations Manual.
- E7. The MiniMPL does not have any user serviceable components. Refer any service requirements directly to Sigma Space or an authorized representative.

Mechanical, Optical, and Environmental Safety

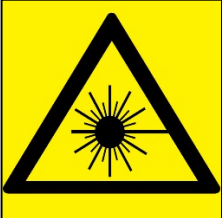
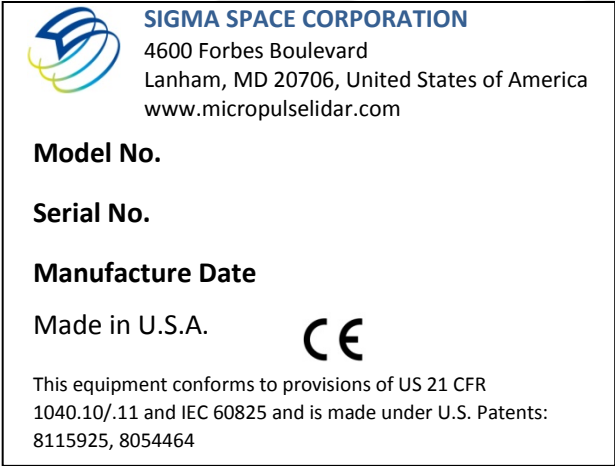


- M1. The MiniMPL is not weatherproof, and must not be exposed to rain or excessive humidity levels above 80%. The operating and storage temperature of the instrument should always be between 10°C (50°F) and 35°C (95°F).
- M2. The surface of the MiniMPL aperture should not be touched by hand or cleaned in a manner that is outside of standard optical cleaning practices (gloves, acetone, lint free cotton wipes). The aperture must remain covered when not in use to protect against dust and accidental damage. Any dust accumulating on the aperture during normal operations should be periodically cleaned using filtered, pressurized air. Care should be taken to avoid contact with the optical surfaces.
- M3. Always use the attached handle to gently move the MiniMPL. Dropping or bumping the MiniMPL may cause serious damage to the components inside.

Laser Safety

- L1. **Caution – Laser Radiation exposure may occur if the user modifies the controls or performance of the instrument with procedures other than those specified herein.**
- L2. The MiniMPL System is a Class II Laser Product as defined by the US CDRH 21CFR1040.10/.11; Class II Laser Product as defined by EN60825-1/2; and ANSI Z136.1 2000.
- L3. All operators of the MiniMPL should be trained in Laser Safety prior to operating the MiniMPL. Laser warnings should be observed at all times and direct viewing of the beam should be avoided.

L4. If the transmitted beam quality or shape changes during use, shut down the instrument and contact Sigma Space for service.

L5. Location of FDA/CDRH Laser labels:

Label Type	Location
	<p>One next to the emission aperture on top of the MiniMPL</p>
 <p>SIGMA SPACE CORPORATION 4600 Forbes Boulevard Lanham, MD 20706, United States of America www.micropulseidar.com</p> <p>Model No. Serial No. Manufacture Date</p> <p>Made in U.S.A. CE</p> <p>This equipment conforms to provisions of US 21 CFR 1040.10/.11 and IEC 60825 and is made under U.S. Patents: 8115925, 8054464</p>	<p>One on top of the MiniMPL</p>
	<p>One next to the emission aperture on top of the MiniMPL</p>
	<p>One on the front panel above the Sigma Space logo, and one next to the emission aperture on top of the MiniMPL</p>



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1. Introduction

The Mini Micro Pulse LiDAR (MiniMPL) is an elastic backscatter LiDAR developed at Sigma Space Corporation as a portable version of the existing Micro Pulse LiDAR (MPL). The MPL and MiniMPL have both been deployed at a number of locations worldwide for long-term, autonomous aerosol and cloud monitoring. The MiniMPL is comprised of an optical transceiver unit and a laptop computer (Figure 1). The optical transceiver houses the laser transmitter (operating at a 532 nm wavelength) and the photon counting detection system. The signal is transmitted and received using the same built-in athermal telescope. The range resolved signal is collected and displayed in real time on the data acquisition computer. The optical transceiver is integrated with the electronic system in a single box to maximize the portability of the unit. The data acquisition software provided can also be used to playback previously recorded data files.



Figure 1: MiniMPL System

The MiniMPL is a precision optical instrument and should be handled with extreme care during transportation and use. It should not be operated or stored in extreme humidity or temperature conditions. Although the laser output energy from the unit is designed to meet the ANSI Z136.1–2000 standard for eye safety, direct viewing of the laser beam for extended periods of time may damage the retina. This manual assumes that the user has fundamental working knowledge of lasers and laser safety. *All MiniMPL operators must read through this Operations Manual prior to operating the instrument.*

2. Unpacking and Installation

Table 1 shows a packing list of components included with the MiniMPL shipment. Inspect these items for any visible damage upon receiving the instrument and report any discrepancies to Sigma Space as soon as possible.

Table 1: MiniMPL Packing List

Item	Description	Quantity
1	MiniMPL Unit	1
2	Power Cable	1
3	Shielded USB-A/USB-A Cable	1
4	Data Acquisition Computer and Charger	1
5	Documentation Package and <i>SigmaMPL</i> Software	1
6	Shipping Case	1

Since the MiniMPL is a delicate instrument, extreme care must be exercised while unpacking from the shipping case. Dropping or bumping the MiniMPL may cause serious damage to the components inside.

The MiniMPL may be stored in its original shipping container when not in use between 10°C (50°F) and 35°C (95°F) in a location with low humidity.

2.1 Power Requirements at MiniMPL Site

The MiniMPL system requires an AC 110-240 V, 50/60 Hz supply with a grounded connection for proper operation, and has a power consumption of 100 W. For improved protection, a surge protected power supply is recommended.

2.2 MiniMPL Site Environment

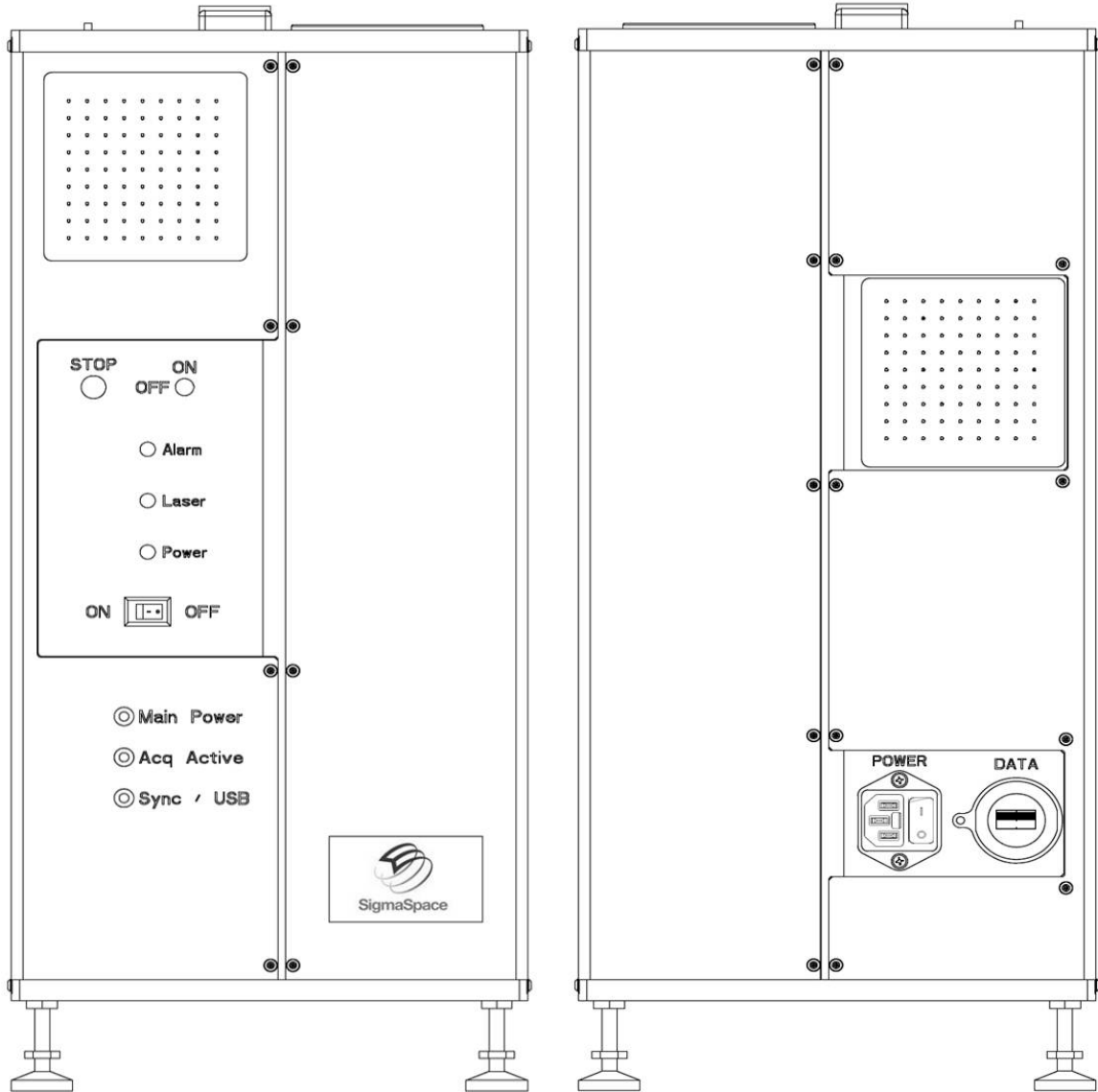
The MiniMPL system is designed to operate in a controlled environment. To ensure accurate performance over an extended period of time, the location of the MiniMPL must adhere to the following criteria:

- Operating temperature: 10°C to 35°C (50°F to 95°F)
- Relative humidity: <80%
- Well ventilated
- Dust free
- Vibration isolated
- Free from strong EMI radiation

3. Hardware Setup

This section describes the systematic installation of the MiniMPL system. Figure 2 shows the connectors and controls located on the front and rear panel views of the MiniMPL instrument.

Figure 2: MiniMPL Front (Left) and Rear (Right) Panel Views



3.1 MiniMPL Placement

1. Always use the attached handle when moving the MiniMPL.
2. Place the MiniMPL on a firm, horizontal surface that is free from vibrations.
3. Adjust the four leveling feet on the base of the MiniMPL until the unit is level. Use the BUBBLE LEVEL on the top of the MiniMPL as a guide.

4. The POWER and KEY SWITCH on the front of the unit should be set to the **OFF** position. The MAIN POWER switch on the back of the unit should also be set to **OFF**.
5. Connect the included power cord to the POWER inlet of the MiniMPL unit and to a grounded outlet.
6. Check for adequate air circulation around the MiniMPL fan located on the rear panel of the unit.

3.2 Data Acquisition Computer Connections

The MiniMPL system includes a laptop computer with the *SigmaMPL* software installed on the hard drive. An alternate computer (desktop, rack-mounted etc.) may be used with the software programs and drivers configured for MiniMPL operation using the supplied *SigmaMPL* software.

1. Using the provided laptop charger, plug in the laptop to a grounded outlet.
2. Using the shielded USB-A/USB-A cable provided, connect the USB port of the computer to the DATA port of the MiniMPL. **NOTE:** User-supplied cables or extenders greater than 2.0 m in length are not recommended as they could create disruptions in data transmission.

4. MiniMPL Operation Procedures

The MiniMPL should be located with an unobstructed view of the atmosphere and the aperture lid should be opened carefully to avoid touching the lens.

NOTE: All personnel in the vicinity of the MiniMPL should be clear of the beam path before the laser is turned on.

4.1 Power up Sequence

1. Turn on the POWER switch located on the rear panel. The red **Main Power** LED on the front panel will turn on.
2. Turn on the RED ROCKER SWITCH and KEY SWITCH located on the front panel. The red **Main Power** LED for the laser will turn on. The green **Laser** LED will be illuminated, even though there is no visible laser emission. **NOTE:** Laser emission is enabled from the hardware control tab in *SigmaMPL* software.
3. Turn on the laptop. The default username and password are as follows:

Username:	mpluser
Password:	mpluser
4. Locate the *SigmaMPL* shortcut on the desktop and launch the program by double clicking on the icon.

4.2 *SigmaMPL*: MiniMPL Control and Data Acquisition Software

The *SigmaMPL* data acquisition software allows for real time operation of the instrument and data playback of previously stored data. This section describes the *Real Time Hardware Control* mode. For *File*

Playback mode and other software and data processing features, refer to the *SigmaMPL Software Manual*.

4.2.1 Real Time Hardware Control

1. From the opening screen of *SigmaMPL*, press **Ctrl+R** or select **File→Real Time Hardware Control** (Figure 3).

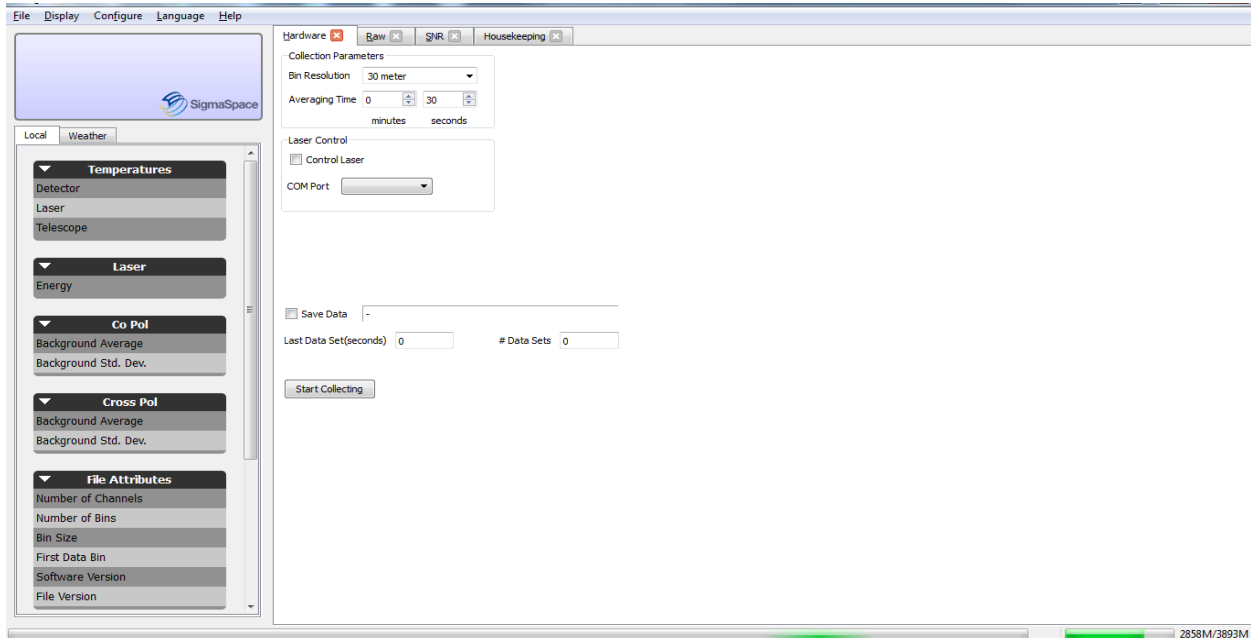


Figure 3: SigmaMPL Real Time Hardware Control Window

2. Tabs for Hardware, Raw Data, R² Corrected, SNR, and Housekeeping will appear in the plot area to the right of the left sidebar. A tab for NRB will be displayed only if the three configuration files for the MiniMPL are loaded. See the *SigmaMPL Software Manual* for more information.
3. The software must be configured for the MiniMPL before collecting data. To access configuration options, press **Ctrl+K+L**. This will enable the Collection Parameters to be adjusted in the Hardware tab. To configure the software for MiniMPL, select **Configure→Algorithm Setup** and select **Default MiniMPL Parameters**. Click **Apply** followed by **OK** to save the changes.
4. Select the desired **Bin Resolution** and **Averaging Time**.
5. Check the **Save Data** box to record the data. Data does not have to be saved. The saved files are automatically named using an YYYYMMDDHHmm.mpl format and can be found in **C:\Program Files (x86)\SigmaMPL\DATA**.
6. Toggle the **Start Collecting** button to begin collection.
 - a. Laser emission will occur within 10 seconds of collection.
7. The yellow **Acq Active** LED and green **Sync/USB** LED's will both be illuminated. The **Sync/USB** LED will flash while data is being collected.
8. To stop collecting data toggle the **Stop Collecting** button.

The MiniMPL displays signal and other instrument data as shown in Figure 4. For a more detailed explanation, refer to the *SigmaMPL Software Manual*.

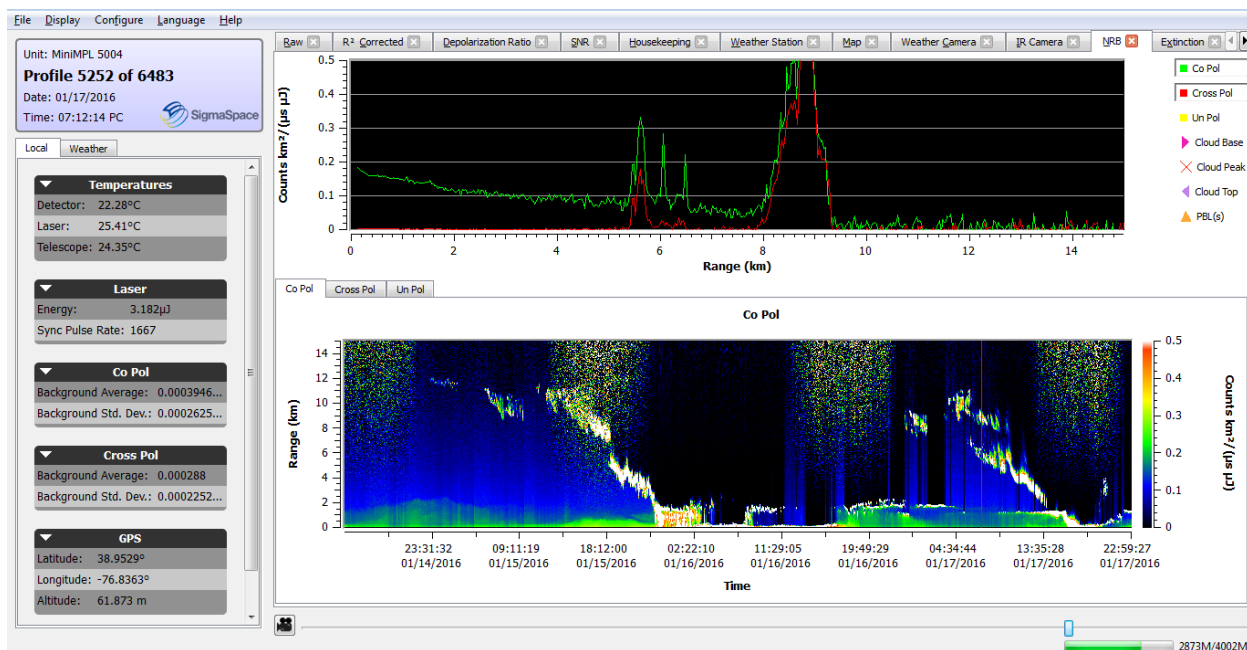


Figure 4: *SigmaMPL* Plot Display

5. System Shutdown

The MiniMPL system should be shut down in the following sequence:

1. Click the **Stop Collecting** button in the *SigmaMPL* program to stop data acquisition.
2. Exit the *SigmaMPL* program.
3. Turn off the KEY SWITCH on the laser power supply (Front Panel).
4. Turn off the RED ROCKER SWITCH on the laser power supply (Front Panel).
5. Turn off the LiDAR/MAIN POWER SWITCH (Rear Panel).
6. Shut down the laptop computer.
7. Carefully replace the lid on the MiniMPL without touching the optics.

6. MiniMPL Specifications

Table 2: Nominal MiniMPL Specifications

Dimensions	
Size	318 mm x 216 mm x 495 mm (12.52" x 8.50" x 19.49")
Weight	13 kg (29 lbs.)
Power	
Supply	AC 110-240V, 50/60 Hz, Power Consumption: 100 W
Transmitter	
Laser Wavelength	532 nm Nd: YAG
Pulse Repetition Frequency	2,500 Hz
Pulse Energy	3-4 μ J
Laser Product Compliance	ANSI: Z136.1-2000 IEC: EN60825 USFDA/CDRH: 21 CFR 1040.10/.11
Receiver	
Telescope Type	Galilean Telescope
Focal Length	500 mm
Diameter	80 mm
Field of View	220 μ rad
Data	
Detector	Avalanche Photodiode, Photon Counting Mode
Range Resolution	5m, 15m, 30m, 75m (Programmable)
Maximum Range	30 km
Multichannel Scaler	Two-channel photon counting, A/D converters for temperature and energy monitors, USB interface to computer

7. Mini Micro Pulse LiDAR System Standard Product Warranty

Sigma Space Corporation certifies that the Mini Micro Pulse LiDAR (MiniMPL) conforms to all product specifications and is free from any defects for a period of twelve months (Warranty Period) from the date of shipping. If Sigma Space is notified of any component failure or defects in workmanship or performance of the LiDAR instrument within this warranty period, it will make any necessary repairs and/or replacement of parts with the exceptions listed below.

The exceptions to this warranty are the laser and the detector. The laser and detector both include original manufacturer's twelve-month warranties that will be extended to the buyer. Any repairs or service related to the laser and detector within the Warranty Period may incur additional costs as assessed by the respective manufacturer, after evaluating any defect or performance deviations. The buyer is deemed liable for these charges.

The buyer is responsible for shipping the instrument to the Sigma Space facility for warranty repairs. It is recommended that the buyer insure the instrument at their expense. Sigma Space may levy a reasonable assessment fee for evaluating the problem and scope of repairs and the buyer must submit written authorization for these repairs/replacement of parts based on this evaluation.

The product warranty does not apply to damage to the instrument caused by product mishandling, improper installation, failure to comply with the provided operating instructions, operation by unauthorized or unqualified personnel, or neglect. In addition, Sigma Space assumes no responsibility or liability for personal injury or property damage arising from misuse of the instrument. The buyer has the burden of providing evidence of defective components or workmanship leading to the instrument's degraded performance or failure.

All warranty related service must be obtained directly from Sigma Space. Any repairs or service performed by any other source, or evidence of instrument tampering voids this warranty.

For all MiniMPL service, please contact:

Sigma Space Corporation

4600 Forbes Blvd, Lanham, MD 20706, United States of America

Telephone: +1 301.552.6000

Fax: +1 301.552.6411

<http://micropulselidar.com>

<http://www.sigmaspace.com>