



LD-1 Lightning Detector Manual

57-6043 Rev A

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I.0 NOTICES

1.1.1 Copyright

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The information in this manual has been carefully checked and is believed to be accurate. However, Dyacon, Inc. assumes no responsibility for any inaccuracies that may be contained in this manual. All information is subject to change.

Trademark Acknowledgments

Dyacon® is a registered trademark of Dyacon, Inc.

Dyacon LD-1™ and, LD™ are trademarks of Dyacon, Inc.

All other trademarks are property of their respective owners.

1.1.2 Manufacturer

Dyacon, Incorporated, a Utah corporation whose website can be found at <http://dyacon.com>.

All contact information can be found at the above URL.

1.1.3 Declarations

Dyacon LD-1™ is a low-power electronic device for industrial applications.

RoHS

All electronic and mechanical components conform to RoHS, Directive 2002/95/EC.

FCC CFR Part 15

This equipment complies with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial installation.

1.1.4 Warranty Information

Limited Hardware Warranty

Dyacon, Inc. warrants that all Dyacon products and components shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment when installed according to instruction manuals accompanying said hardware and used for the purpose for which said hardware was designed. In the event a defect in materials or workmanship is

discovered and reported to Dyacon within the warranty period, Dyacon will at its option repair the defect or replace the defective product. This warranty does not apply where the product has been operated outside the specifications of the product. Dyacon's obligation hereunder will be limited to such repair or replacement. Customers shall have the responsibility to ship the defective equipment to Dyacon at its (customer's) expense, with all cost of shipment prepaid. Dyacon will ship the repaired or replaced item at its (Dyacon's) expense using the preferred shipment method of Dyacon. On-site service will only be offered where the nature of the installation or failure requires Dyacon presence to troubleshoot or repair.

Disclaimer of Warranties

The warranties set forth above are in lieu of all other warranties of Dyacon, whether written, oral, or implied. Dyacon makes no warranties regarding its products (hardware or software), including without limitation warranties as to merchantability, fitness for a particular purpose, any warranty arising from course of performance, course of dealing or usage of trade whether any of the foregoing warranties are either expressed or implied. Dyacon specifically makes no warranties as to the suitability of its products for any particular application. Dyacon shall in no event be liable for performance, or use of any product covered by this agreement whether such claim is based upon warranty contract (express or implied), strict liability, negligence, or otherwise. Any responsibility and/or liability of Dyacon shall, in connection with a warranted product, be limited in maximum amount to the original purchase price of that product.

Removal of Serial Number

Removal of the original serial number label or reprogramming of the electronic serial number voids any warranty on the device. Dyacon will not repair or update products if the serial number label missing or legitimate ownership cannot be verified. Dyacon may not return equipment that is missing serial numbers or where legitimate ownership is in question.

Updates or Modifications

Dyacon shall be under no obligation to update or modify its products except as herein noted to correct defects or errors. Customer agrees that all representation and warranties contained herein shall be immediately null and void in the event of any incorrect installation, modification, alteration, or change in or to any product affected by or on behalf of customer except for a change made by Dyacon or other direct supervision thereof.

1.1.5 Product Limitation

LD-1 is not a lightning protection device.

LD-1 will not detect all lightning strikes.

LD-1 cannot predict lightning strikes or the potential for lightning strikes.

The probability and efficiency of strike detection is dependent on the installation, environment, user settings, and the capabilities of the equipment to which LD-1 is connected. Unit-to-unit variation may also result in differences in detection efficiency.

LD-1 should be considered an advisory instrument only, the instrument is intended to augment knowledge, skill, understanding, and judgment of the users.

Dyacon assumes no liability for damage resulting from improper use of the instrument, improper configuration, or the failure of the instrument to detect lightning strikes.

2.0 LD-1 INTRODUCTION

2.1 Scope

The content of this document is intended for integrators, installers, and users of LD-1™, which hereinafter may be referred to as “LD”, “sensor”, “detector”, or “lightning detector”.

This document includes installation instructions, technical specifications, electrical requirements, and data protocol information. Some aspects of the equipment operation may be covered in other documents. Please contact Dyacon or visit the Dyacon.com website.

2.2 Technical Support

2.2.1 Contact Information

Dyacon, Inc.

Phone: (435) 753-1002

Email: support@dyacon.com

Internet: www.Dyacon.com

Normal business hours are from 9:00 am to 5:00 pm. (Mountain Time Zone, GMT -0700)

2.2.2 Phone / Email Support

If you need technical support via the phone or email, please have the following information ready:

- Product name, model number, and serial number.

- Your name and name of the purchaser of the equipment.

- Name of company, institution, or agency.

- Phone number, email address.

- Billing and Shipping address.

- A clear description of the question or problem.

3.0 PRODUCT OVERVIEW

3.1 Product Description

Dyacon LD-1™ is an advisory instrument used for the detection of lightning strikes. The instrument indiscriminately detects cloud-to-cloud, intra-cloud, and cloud-to-ground discharges.

LD-1 is a digital output sensor, sending instrument data and receiving control commands via a digital serial port using Modbus-RTU protocol over TIA-485-A (RS-485). Consequently, there is no measurement degradation due to cable length.

LD-1 is easily mounted to the end of a 1" pipe using simple tools and standard structural pipe fittings.

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LD-1 should be considered an advisory instrument only to augment knowledge, skill, understanding, and judgment of the users.

Sensor Protocol Descriptions

Modbus-RTU (RS-485) is an electrically robust protocol used in automation systems, such as programmable logic controllers (PLCs). LD-1 uses a default data rate of 19200 bps, ensuring adequate data throughput with extended cable length capability. The bit rate and address may be configured by the user.

Additional firmware and customization options are also available to VARs. Contact Dyacon, Inc. for more information.

Mechanical Design

The mechanical design for LD-1 was intended to meet the following objectives.

- Minimize installation hardware and complexity.
- Facilitate the mounting of the sensor so that it can be spaced from conductive structures that may conduct electromagnetic disturbances.
- Maintain mechanical simplicity for easy assembly and service.
- Protect electronic components from environmental conditions.

3.2 What Do You Get?

LD-1 ships with:

- Attached cable

- Optional mounting pipe (Shown below)

- Optional mounting system for attachment to 1" pipe. (Shown below.)

- Outdoor cable ties (As required.)

- Stainless steel band clamp (As required.)



Image 3.1: LD-1 Sensor



Image 3.2: LD-1 Sensor with optional mounting pipe.



Image 3.3: LD-1 sensor with mounting pipe and pipe mounting system. (Vertical pipe not included.)

3.3 What You Need

In order to utilize the LD-1 you will need the following.

5 to 24 VDC power supply.*

Modbus host device.*

* Not required if using the LD-1 with a Dyacon control module.

3.3.1 Structural Pipe Fittings

When configured with a 1" pipe, LD-1 may be used with structural pipe fittings. Standard structural pipe fittings for 1" schedule 40 pipe are available from hardware suppliers and manufacturers.

Hollaender Nu-Rail (www.nurail.com)

J.C. Denier (www.denierco.com)

Easyfit (www.easyfit.com)

Diamond Aluminum (www.diamond-aluminum.com)

KEE Systems (www.keesystems.com)

McMaster-Carr (www.mcmaster.com)

Grainger (www.grainger.com)



4.0 ASSEMBLY INSTRUCTIONS

4.1 Required Tools

Wire cutters to trim cable ties.

Other tools as required by customers mounting configuration.

4.2 Mounting

LD-1 has a 1" threaded pipe fitting on the bottom of the sensor.

Common pipe fittings may be used to attach the sensor to a number of flanges, fittings, and structures, as show in Image 3.3.

4.3 Wiring

LD-1 ships with shielded, 4-conductor, outdoor-rated instrumentation cable.

Red – 5 to 24 VDC

Orange – A (+)

Brown – B (-)

Black – Electrical ground

Bare – Earth Ground (Shield)

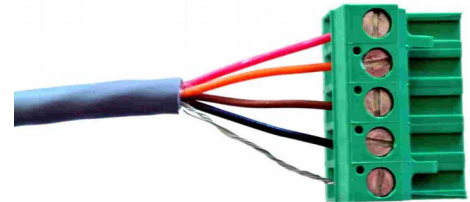


Image 4.1: Wired for Dyacon Control Module

4.4 Additional Assembly Images

Bottom View



5.0 MODBUS

5.1 Modbus Summary

Modbus is a simple protocol that can be transmitted over several modes including TCP/IP, TIA-232-A (RS-232), TIA-485-A (RS-485), TCP/IP, SMS, and many others.

Dyacon LD-1 uses Modbus-RTU over RS-485.

LD-1 is a slave device and must be connected to a host device, such as a programmable logic controller (PLC), host computer with an RS-485 adapter and Modbus software, or to the Dyacon weather station control module.

RS-485 is a robust, differential pair electrical protocol that is noise immune and capable of long cable runs. With twisted pair cabling, such as CAT-5, distances over 1200 m (4,000 ft) can be achieved. LD-1 can be configured for low bit rates to extend the range. Relatively long runs are achievable even without twisted pair cables.

The wide operating voltage range and low power of LD-1 allows for power to be injected over the same data cable without concern for excess voltage drop. (Two wires for power and two for data.)

For example, 1200 m (4000 ft) of Cat-5 cable (24 AWG) will result in a voltage drop of less than 0.2 V at an operating current of 2 mA.

LD-1 ships standard with 2 m (6.5 ft) of cable.

5.2 Modbus Utilities

The address of the sensor and other parameters are configurable. A Modbus computer utility may be required to change these settings. A number of utilities are available including:

ModBusConstructor by KurySoft (www.kurysoft.com)

Simply Modbus (www.simplymodbus.ca)

ModbusTools (www.modbustools.com)

Only ModBus Constructor and the companion Modbus Reader have been tested with the Dyacon product.

A list of Modbus software can be found at: www.modbus.org/tech.php

5.3 Modbus Commands

LD-1 is a Modbus RTU slave device, a Modbus host must request data from the sensor.

The following sections describe the Modbus commands and messages. The basic instructions should be adequate for Modbus host programming. For embedded developers, additional protocol details are contained in the Modbus Appendix.

LD-1 requires about 70 ms to read sensor elements and respond.

The default configuration:

Modbus address	03
Serial Data Parameters	19200, 8-bit data, no parity, 1 stop bit

5.3.1 Supported Functions and Exception Codes

Function	Description	Supported Error and Exception codes*
3	Read Holding Register	0x83: 01, 02, 03, 04
4	Read Input Register	0x84: 01, 02, 03, 04
6	Write Single Register	0x86: 01, 02, 03, 04
16	Write Multiple Registers	0x90: 01, 02, 03, 04

* See Error Code table below for more information.

5.3.2 Modbus Configuration and Sensor Configuration

The following commands can be used to change the serial port parameters of the lightning detector.

Address	Register	Access Type	Range	Data Type	Description
100	101	Read		16-bit Signed Int	MM = Product ID YY = Product Variation
101	102	Read		16-bit Unsigned Int	Serial Number
102	103	Read		16-bit Signed Int	Firmware Version
103	104	Read/Write	1-247 Default: 1	16-bit Signed Int	Modbus slave address.
104	105	Read/Write	0 = 1200 bps 1 = 2400 bps 2 = 4800 bps 3 = 9600 bps 4 = 19200 bps 5 = 38400 bps Default: 4	16-bit Signed Int	Baud rate.
105	106	Read/Write	0 = None 1 = Odd 2 = Even Default: 0	16-bit Signed Int	Parity

* Refer to Power Saving section for more details.

5.3.3 Lightning Detection Registers

Common Registers

Address	Register	Access Type	Response Range	Data Type	Description
201	202	Read	0 to 32767	16-bit Signed Int	Strike count since last read.
204	205	Read	0 to 40 63 is out of range.	16-bit Signed Int	Distance Estimate (km)
206	207	Read	0 to 32767	16-bit Signed Int	Strike Count 10 minute
206	208	Read	0 to 32767	16-bit Signed Int	Strike Count 30 minute
208	209	Read	0 to 32767	16-bit Signed Int	Strike Count 60 minute

Full Register List

Address	Register	Access Type	Response Range	Data Type	Description
200	201	Read	0 to 3	16-bit Signed Int	System Status†
201	202	Read	0 to 32767	16-bit Signed Int	Strike Count since last read.
202	203	Read	0 to 32767	16-bit Signed Int	Noise Count since last read
203	204	Read	0 to 32767	16-bit Signed Int	Disturber Count since last read
204	205	Read	0 to 40 63 is out of range.	16-bit Signed Int	Distance Estimate (km)
205	206+207	Read	0 to 32767	32-bit Signed Int	Energy of Last Strike
207	208	Read	0 to 32767	16-bit Signed Int	Strike Count 10 minute
208	209	Read	0 to 32767	16-bit Signed Int	Strike Count 30 minute
209	210	Read	0 to 32767	16-bit Signed Int	Strike Count 60 minute
210	211	Read	0 to 32767	16-bit Signed Int	Noise Count 60 minute
211	212	Read	0 to 32767	16-bit Signed Int	Disturber Count 60 min

† See System Status Code section below.

5.3.4 Lightning Configuration Registers

The following registers may be used to adjust the detection

Address	Register	Access Type	Range and Default	Data Type	Description
106	107	Read/Write	Write '1' to clear.	16-bit Signed Int	Reset to defaults.
110	111	Read/Write	0-7 Default = 0	16-bit Signed Int	Analog Front End Gain
111	112	Read/Write	0-7 Default = 2	16-bit Signed Int	Noise Floor Level
112	113	Read/Write	0-10 Default = 4	16-bit Signed Int	Watchdog Threshold
113	114	Read/Write	0 to 3 (Corresponding to: 1, 5, 9, 16) Default = 0	16-bit Signed Int	Minimum Number Lightning Strikes
114	114	Read/Write	0-11 Default = 2	16-bit Signed Int	Spike Rejection

5.3.5 Error Codes

The following error and acknowledgment codes are supported by the LD-1. Not all codes are relevant to each request or command. Supported command error codes are listed for each command.

Function	Name	Description
01	Illegal Function	Function not supported or not recognized by the sensor.
02	Illegal Addresses	Incorrect address, address does not exist, or address does not support write function.
03	Illegal Data Value	Data value is outside of allowed range.
04	Device Failure	Error occurred while attempting to perform the requested action.

5.3.6 System Status Codes

System status codes are unique to the sensor, not Modbus protocol exceptions. System codes are bit level codes representing internal functional errors. A clear (0) bit indicates no errors were detected. A set (1) bit indicates an error.

Contact customer support if system errors are encountered.

Hex Values

0x0001 - Calibration on TRCO failed
 0x0002 - Calibration on SRCO failed
 0x0004 - Cal on LCO failed, too slow
 0x0008 - Cal on LCO failed, too fast
 0x0010 - Internal communication error
 0x0080 - Lightning sensor not found

6.0 PARAMETER DESCRIPTIONS

The following is a detailed explanation of each of the sensor parameters.

6.1.1 Measurement Parameters

All of the following values are reset to zero (0) if power to the sensor is interrupted.

System Status (200)

The internal electrical architecture of the sensor uses several chips. The status message is an indication of inter-chip communication and chip error conditions.

Strike Count (201)

The strike count gives the number of detected lightning strikes. Each time the register is read, the value is reset to zero.

For example, if the register holds a value of five (5), after it is read it will be cleared to zero (0). If the register is read again, it will read zero (0).

The maximum detection rate is 1 s. Consequently, if the register is read once per second, the register value will never exceed one (1).

Noise Count (202)

High counts of this register indicate that the sensor is detecting a noisy signal environment and the signal cannot be evaluated. The Noise Floor Level should be increased if this occurs.

Disturber Count (203)

Each incoming signal that passes the noise threshold is evaluated for shape characteristic. If it is determined to be a likely lightning strike, the strike count is incremented. If it fails to meet the requirements, Disturber Count is incremented.

Following the detection of a “disturber”, the sensor is deactivated for 1.5 s. This allows the disturber to dissipate before further detections are analyzed and reduces the probability of false detections. This dead period is fixed.

Distance Estimate (204)

Once a detected signal is determined to be lightning, an energy analysis is performed. A rough approximation of the distance to the lightning strike is given. Inasmuch as lightning itself can span several miles and can range in energy, the distance value should be considered an approximation.

Devices to which LD-1 is connected can use Distance Estimate to determine whether a storm front is approaching or receding. This value is not automatically calculated on the sensor due to the uncertainty in the powered state of the sensor; a power interruption of the sensor may lead to an incorrect indication.

Energy of Last Strike (205)

The detected energy of the received signal is a relative value only and does not correlate to the actual energy dissipated by the lightning.

The energy value is provided as a reference to integrators.

Strike Count - 10 minute (207)

This count is a rolling value of strikes occurring over the previous 10 minutes. This value includes the Strike Count value.

Strike Count - 30 minute (208)

This count is a rolling value of strikes occurring over the previous 30 minutes. This value includes the 10 minute count.

Strike Count - 60 minute (209)

This count is a rolling value of strikes occurring over the previous 60 minutes. This value includes the 30 minute count.

Noise Count - 60 minute (210)

Accrued noise count over 60 minutes.

Disturber Count - 60 minute (211)

Accrued disturber count over 60 minutes.

6.1.2 Configuration Parameters

All of the following parameters are persistent, if changed they are retained following a power interruption.

These values are all interrelated.

Users may need to evaluate the noise and disturber count values and change each of the following values one at a time.

Analog Front End Gain (110)

This is the initial signal (front end) amplifier. All signals, noise and desired signals, are affected by this value.

The amplifier has two modes, Indoor (1) and Outdoor (0), and should be set according to the location in which LD-1 is installed. The sensor default is Outdoor (0).

Noise Floor Level (111)

Like static on the radio, the noise floor is the ambient white noise that a receiver hears. In some environments, the noise floor is higher than in others. Increasing this value tells the sensor that it is operating in a noisy environment.

Increasing this value will allow only the desired high signals to be analyzed. If it is set too high it may of decreasing sensitivity to lightning strikes.

Decreasing the value will increase sensitivity. If decreased too far, the noise may overload the signal processing or increase the probability of false detections.

When noise is detected, the sensor will deactivate signal processing for approximately 1.5 s.

If LD-1 is installed in an electrically noisy environment, the Noise Counter will be high. Users will want to increase the Noise Floor Level setting.

Watchdog Threshold (112)

The detector is constantly listening to incoming signals. When a signal exceeds the Watchdog Threshold, the signal is processed and the signal shape is evaluated to determine whether it is random noise (disturber) or a lightning strike.

Increasing the watchdog level increase the level required before the signal is evaluated.

If the disturber counter is high, increase the Watchdog Threshold.

Minimum Number Lightning Strikes (113)

Setting this register to a value above zero, a minimum number of strikes must be detected within a 15 minute period before the sensor increments Strike Counter.

When set to zero (0). Each strike detection will add one (1) to the strike count register.

When set to two (2). Five strikes must be detected within 15 minutes. Once the fifth strike is detected, one (1) will be added to Strike Count.

The following table shows the association between Minimum Number Lightning Strikes value and the required strikes before Strike Count is incremented.

Register Value	Min Number of Lightning Detections
0	1
1	5
2	9
3	16

Setting this value above zero (0) has the effect of minimizing the number of false triggers.

Spike Rejection (114)

The Spike Rejection value can be used to minimize false strikes. Spike Rejection is applied after a signal passes the Watchdog Threshold.

Larger Spike Rejection values will reduce the likelihood that a disturber will be categorized as a strike, but also increase the probability that a strike will not be detected.

7.0 SITE CONSIDERATIONS

7.1 Electromagnetic Environmental

LD-1 is essentially a specialized radio receiver, designed to receive broadband noise and evaluate it for a probable match to characteristic shapes and energy patterns of lightning. Other equipment may interfere with the desired signals and cause a desensitization of LD-1 detection capabilities or result in false detections.

Equipment that intentionally or unintentionally creates an electrical arc, such as switches, motors, and welders may interfere with LD-1.

Digital computer equipment, smart phones, and some light fixtures emit broadband noise that can be detected by LD-1.

The effect these noise sources can be seen by the Noise Count value. Adjustments to various settings described in section Parameter Descriptions section can compensate for some of these noise sources.

Just as with any radio device, nearby metal conductors can either attenuate or amplify surrounding radio signals. Metal screens, coated windows, mounting towers, electrical cables, and power lines,

For maximum detection effectiveness and efficiency, the following may be helpful.

- Mount LD-1 so that it is at least 8 inches away from metal structures.
- Install LD-1 in a location away from radio disturbers, such as those mentioned above.
- Evaluate noise and disturber counts when first installed to ensure a proper environment.

7.2 Physical Installation

LD-1 may be installed indoors or outdoors.

The enclosure protects LD-1 from weather conditions and provides convenient mounting features.

With Modbus, long cable runs are possible. 1000 ft (300 m) or more is possible with low-capacitance cable, such as CAT-5.

Use cable ties or other methods to restrain the cable. Excess strain on the cable may damage the sensor.

8.0 POWER SAVING

While LD-1 is already a low-power device, it draws less than 0.02 W (1.6 mA @ 12 VDC) when in continuous operation. However, some battery-powered applications may benefit from further power reductions. The following are some optimization suggestions that some integrators may be able to use.

Turn Power Off

If used in conjunction with weather sensors, temperature, humidity, and barometric pressure may be used to assess the probability of electrical storms.

LD-1 could be turned off when there is low probability of electrical storms, such as during cold weather.

Separate Modbus Port

Modbus devices each have unique addresses. This allows multiple slave devices to be connected to the same Modbus port.

However, each device must process the request from the Modbus master to know if it must respond to the request.

Dyacon sensors use a low-power RS-485 transceiver. The transceiver is only active when electrical activity is detected on the bus. If so, the transceiver stays on and draws slightly more power.

The potential current savings is 0.01 mA at 12 VDC or 1.5 mA average.

Reduced Request Rate

The 1.6 mA current drain value is based on a 1 second request interval. Increasing the request period to 10 seconds reduces the power to about 1.5 mA average.

9.0 SOFTWARE

9.1 Introduction

LD-1 is a digital sensor with on-board firmware. The firmware provides critical functions including sensor element interface, sensor value processing, interrupt management, power management, and Modbus operation. The firmware also includes a boot loader for in-field firmware changes.

9.2 Modbus Reader

Users may find it helpful for configuration and testing to use a PC program.

An RS-485 to USB adapter can be used to power LD-1 and connect it to a computer.

Dyacon uses Kury Software ModbusCreator and ModbusReader for production testing. KurySoft ModbusReader is free to use. When used with the Dyacon LD-1 configuration files, the user can see LD-1 registers and configure the settings.

Serial Settings

LD-1 default serial parameters

Address: 3

Data: 19200, N, 8, 1

These settings may be changed using Modbus commands.

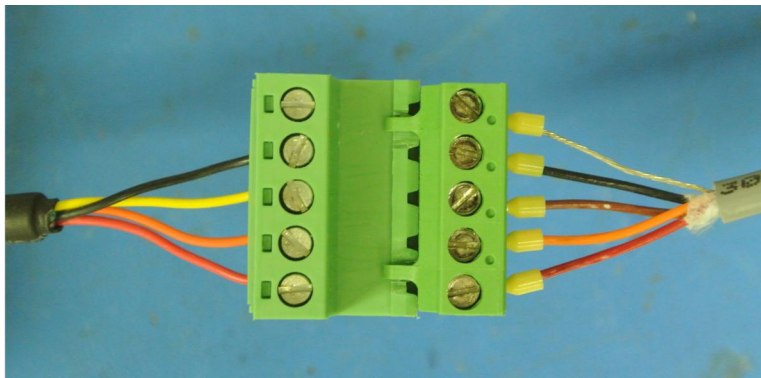
9.2.1 Materials

Description	Notes
FTDI USB to RS485 converter or equivalent.	FTDI part number: USB-RS485-WE-1800-BT Converters are available from Dyacon or many other electronic distributors, such as Mouser.com.
Cable to Cable connectors	When the converter is purchased from Dyacon, connectors are provided.
Modbus Reader software	Available from Dyacon.com or Kury Software, http://kurysoft.com/ .

9.2.2 Wiring the Converter

Wire the FTDI converter according to the following table and image.

FTDI Converter	Dyacon Sensor	Signal
Red	Red	Power
Orange	Orange	RS485+
Yellow	Brown	RS485-
Black	Black	Ground
—	Drain Wire	Shield Ground



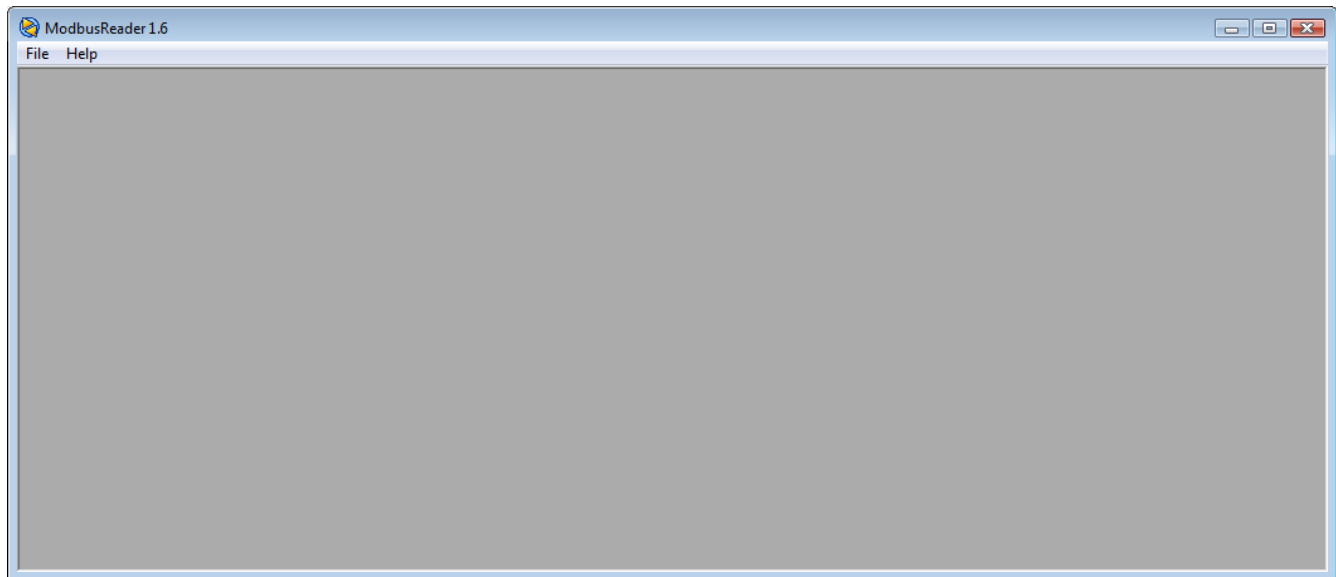
9.2.3 Connecting to a Computer

Attach the FTDI USB to RS485 cable to a USB port on a Windows PC. Wait for the driver to install.

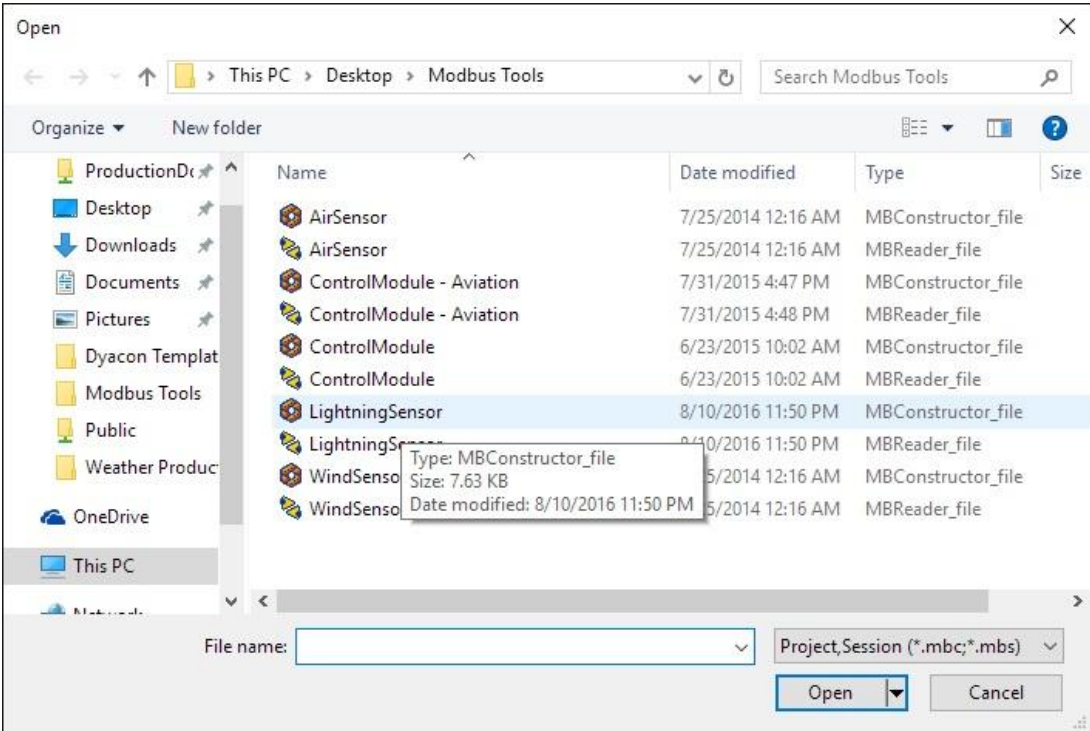
Install Modbus Reader.

Copy the LightningSensor.mbc and LightningSensor.mbc files provided by Dyacon to a convenient location on your computer.

Start ModbusReader and close any sample files that are running.

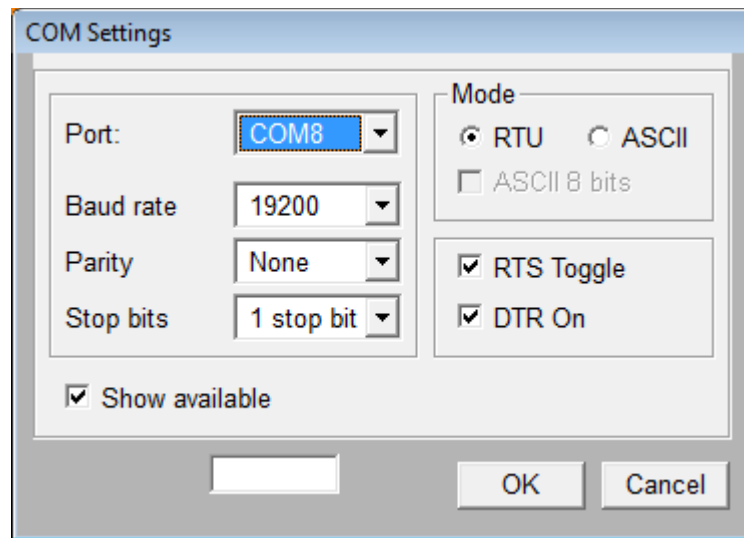


Open LightningSensor.mbc



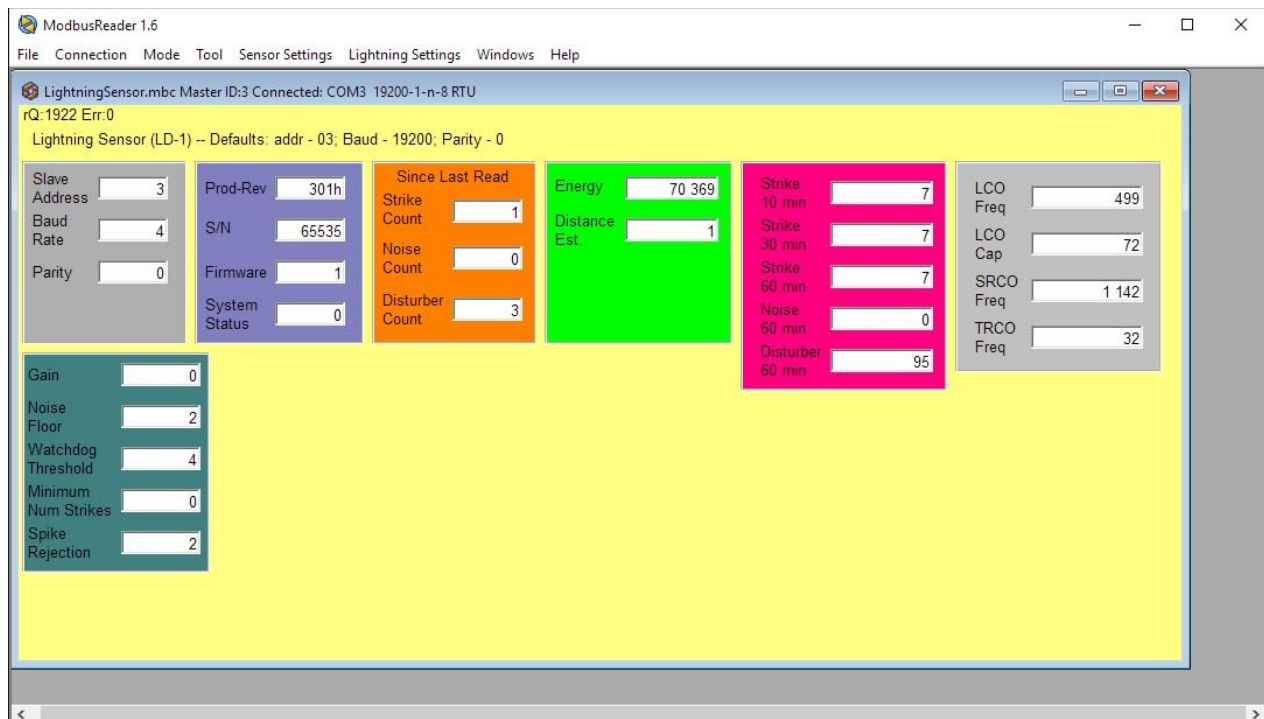
Select the COM port for the USB to RS485 converter under the Connection menu.

Select the COM Parameters under the Connection menu and use the settings in the image.



Press F2 or select Connection > Connect to start the automatic sensor communication.

The red and green LEDs on the converter will begin to flash. Red indicates that a message was sent and green indicates that a response was received.



9.2.4 Changing Configuration Settings

There are two menus, Sensor Settings and Lighting Settings. Both categories of settings are changed in a similar manner.

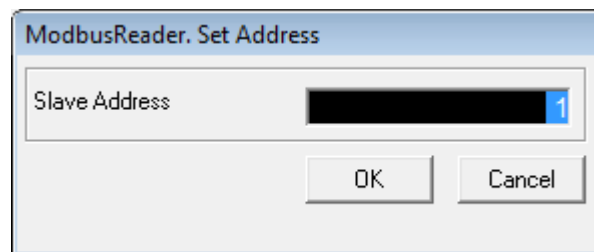
The following is an example of changing the sensor address.

Setting Address

With the sensor actively communicating, the sensor parameters can be changed.

Select Sensor Settings.

Select one of the options, such as Set Address.



Enter the new value and press OK.

Reset the sensor by unplugging the sensor and plugging it back in. This will cause the setting on the sensor to change.

The settings on ModbusReader will need to be updated in order to restore communication with the sensor. The baud rate and parity can be set under Connection > COM Parameters.

The address is set under Mode > Master Settings.

9.3 Boot Loader

LD-1 firmware may be updated in the field through the RS-485 serial data lines using a command-line program.

9.3.1 Required Equipment

RS-485 to USB (or RS-232) converter.

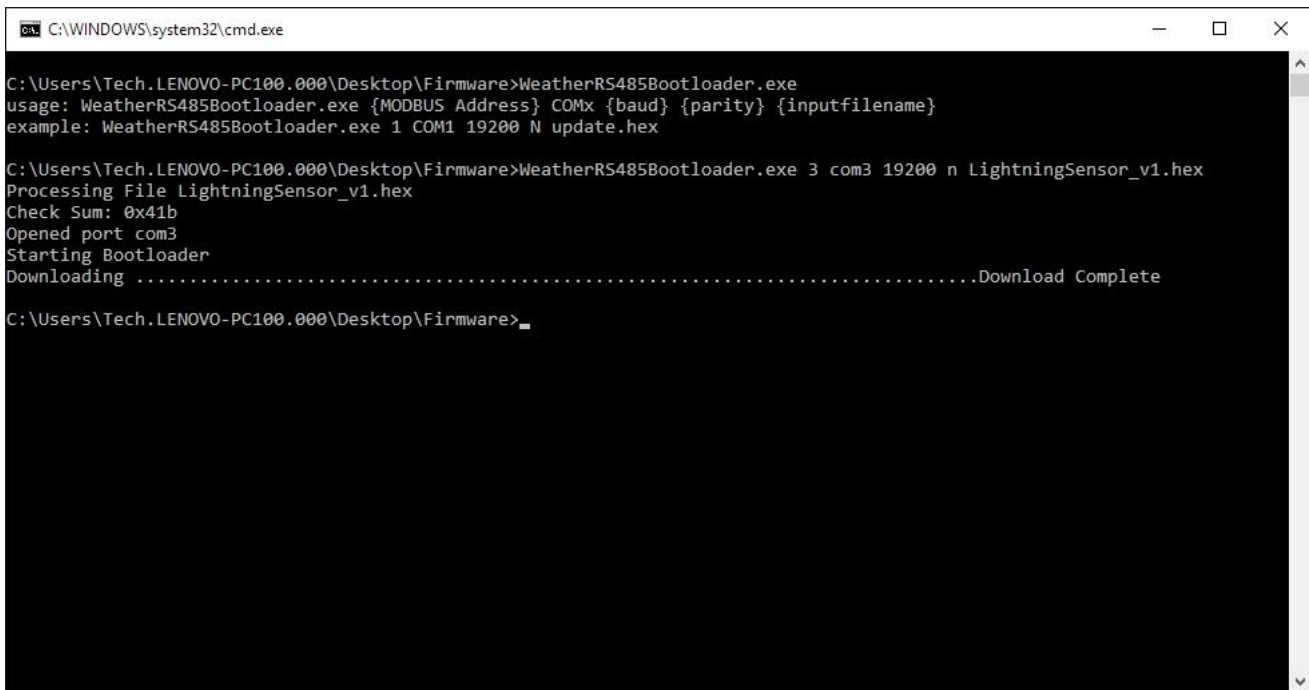
12 VDC power supply.

Dyacon Boot Loader PC utility.

LD-1 firmware (.hex) file.

9.3.2 Procedure

1. Disconnect LD-1 from the host equipment.
2. Connect the LD-1 to the PC with an RS-485 converter. (Available from Dyacon.)
3. Connect LD-1 to a 12 VDC power source.
4. Run the Dyacon Boot Loader Utility. (See image below.)
5. Configure the port settings and specify the hex file.
6. Watch for program completion.
7. Disconnect and return the LD-1 to service.



```
C:\WINDOWS\system32\cmd.exe

C:\Users\Tech.LENOVO-PC100.000\Desktop\Firmware>WeatherRS485Bootloader.exe
usage: WeatherRS485Bootloader.exe {MODBUS Address} COMx {baud} {parity} {inputfilename}
example: WeatherRS485Bootloader.exe 1 COM1 19200 N update.hex

C:\Users\Tech.LENOVO-PC100.000\Desktop\Firmware>WeatherRS485Bootloader.exe 3 com3 19200 n LightningSensor_v1.hex
Processing File LightningSensor_v1.hex
Check Sum: 0x41b
Opened port com3
Starting Bootloader
Downloading .....Download Complete

C:\Users\Tech.LENOVO-PC100.000\Desktop\Firmware>
```

10.0 REPAIR AND SERVICE

10.1 Repair

Return Authorization

All equipment sent to Dyacon for calibration, warranty, or service should have a return material authorization (RMA) number indicated on the outside of the package. Include a detailed description of the problem and any to be performed on the returned unit.

An RMA number may be requested by phone or email.

Phone: 1-435-753-1002

Email: support@Dyacon.com

Normal business hours are 8 am to 5 pm. (Mountain Time Zone, GMT -0700)

II.O SPECIFICATIONS

DETECTION

Sensor	AMS AS3935
Stormhead Range Estimate	15 values from 0 km to 40 km (0 miles to 24 miles)
Consecutive Strike Span	1 s
Detection Efficiency*	Approximately 40%
Response Time	<1 s

*Detection efficiency is dependent on the use environment and the level of ambient, man-made electromagnetic noise. Detection thresholds are user configurable and may be increased to reduce the false detection rate at industrial environments, but this will also impact lightning detection.

DATA

Protocol	Modbus slave with configurable data rate and address.	
Detection Parameters	Strike Count Since Last Read Noise Count Since Last Read Disturber Count Since Last Read Distance Estimation Energy of Last Strike (relative)	Strike Count 10 minute Strike Count 30 minute Strike Count 60 minute Noise Count 60 minute Disturber Count 60 minute
Configuration Parameters	Front-end Amplifier Gain Noise Floor Level Watchdog Threshold	Minimum Number Lightning Strikes Spike Rejection Level

ELECTRICAL

Power Input	5 VDC to 24 VDC
Current	1.6 mAavg at 12 VDC†
Circuit Protection	Gas discharge tube and transient suppression on signal and power wires.

† Full run mode, reading 200 range registers once per second.

MECHANICAL

Material	White Delrin® enclosure
Diameter x Length	4 cm x 12.7 cm (1.6" x 5") Not including optional mounting pipe.
Cable	4 conductor, 24 AWG, stranded Foil shield w/ drain wire Outdoor rated cable
Total Weight	226 g (8 oz) Not including optional mounting pipe.

ENVIRONMENTAL

Operating Temperature	-40°C to 80°C
Storage Temperature	-40°C to 80°C
Humidity	up to 100%

I2.0 MODBUS APPENDIX

Dyacon LD-1 lightning detector uses Modbus RTU format. The following are the protocol details required for embedded devices to communicate with the Modbus sensor.

- Modbus data uses “big-endian” data format, 0x1234 is sent as 0x12 then 0x34.
- The CRC uses “little-endian” data format, 0x1234 is sent as 0x34 then 0x12.
- The idle time between frames must be greater than or equal to 3.5 characters. The frame inter character delay must be less than 1.5 characters.
- The PDU Registers are addressed starting at zero. Therefore a register numbered as 201 is addressed as 200.

The following is an example of a multi-register read of the air temperature, humidity, and pressure starting at register number 202.

Detailed protocol information is available at www.modbus.org.

Request Frame

The following is an example of a read of the air temperature, humidity, and pressure with one request.

Field Name	Length (bytes)	Function	Example Data
Slave Address	1	Device address.	0x02
Function	1	Read holding register.	0x03
Register Start Address	2	Sensor address (201).	0x00C9
Quantity of Registers	2	Number of 16-bit registers to read.	0x0003
CRC	2	Error check.	0xC6D5

TX String (0x): 02 03 00 C9 00 03 D5 C6

Response Frame

Field Name	Length (bytes)	Function	Example Data
Slave Address	1	Device address.	0x02
Function	1	Read holding register.	0x03
Byte Count	1	Number (N) of data bytes.	0x06
Register Data	N	Register data, upper byte first. Register 202 (Temp): 325 (32.5 °C) Register 203 (Rel. Hum.): 689 (68.9%) Register 204 (Pressure): 8526 (852.6 mbar)	0x0145 0x02B1 0x214E
CRC	2	Error check.	0x6030

RX String: 02 03 06 01 45 02 B1 21 4E 30 60

Error Frame

Field Name	Length (bytes)	Function	Example Data
Slave Address	1	Device address.	0x02
Error Code	1	Error code value.	0x83
Exception Code	1	Error code values (01, 02, 03, 04)	0x01
CRC	2	Error check	0xF070

TX String: 02 83 01 70 F0

I3.0 FIRMWARE REVISION HISTORY

Version	Description of Changes	Date
v1	Initial release	12 Aug 2016

I4.0 DOCUMENT REVISION HISTORY

Rev	Description	Author	Date
A	Initial Release	E. Bodrero	16 Aug 2016