LeddarTech®
MASTERING LIDAR SENSOR TECHNOLOGY

Leddar T16

Solid-State LiDAR Traffic Sensor

USER GUIDE

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Table of Contents

Version History

VERSION	DESCRIPTION	DATE (YYYY-MM-DD)
54A0043-1EN	Initial release	2019-02-06
54A0043-2EN	• Reviewed Document Conventions section. • FCC mention moved to section 1.1. • Table 6 and Table 9: Mention of 48° Traffic configuration deleted. • Table 10 and Table 11: Detection ranges modified and notes added.	2019-03-28

List of Figures

List of Tables

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Document Conventions

This document uses the following conventions.

Name of Menu > Name of Window	Shows the access path to menus under each section of Leddar™ Configuration.
Arial bold	The name of buttons, menus, and dialog boxes are presented in **bold**.
	Notes contain helpful suggestion and references to information included within this user guide.
	Warnings refers to a warning or an important information to follow.

1. Label Explanation and Safety Information

Table 1: Explanation of Labels on the Sensor

Label	Location on the Sensor	Description
Model Serial Number	On the back of the sensor	Part number (PN) starting with 75A and Serial Number (SN). This information is useful when contacting LeddarTech support.

1.1. Regulatory Compliance

Table 2: Regulatory Compliance

Ingress Protection	IP67
Ocular Safety	IEC 62471 2006 criteria: Exempt lamp classification
FCC	Part 15, Subpart B, Class A 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.
ICES-003	Class A This Class A digital apparatus complies with Canadian ICES-003.
CE	Yes

2. Introduction

2.1. Definitions

Table 3: Definitions

Term	Definition
Active grid	Sensing area of a sensor. The active grid measures the range of detected objects and must be centered on the zones that need to be monitored. It is represented by an overlay of the live video window (Traffic configuration only).
Amplitude	Measure of the signal strength.
AR	Anti-reflective
Area of interest	The area that needs to be monitored.
Camera	The camera in the sensor that provides video and images used for viewing the detection area (area of interest).
Channel	Synonym of “segment”. See the definition of the word *segment*.
Crosstalk	Phenomenon by which a signal transmitted in one segment creates an undesired effect in an adjacent segment.
Depth of the detection zone	Distance along the y axis (road) within which the sensor will detect a vehicle.
Detection	Object detected in one segment. Detections include at least the following data: Segment identification, distance measurement, and the intensity of the backscattered light of the object.
FOV	Field of View.
Opening angle	The angle of the detection zone.
Time of Flight	Refer to section **2.2 Underlying Principles and LiDAR Fundamentals** for more details.
Segment	A segment is defined by a horizontal index in the FOV. Synonym of “channel”.

2.2. Underlying Principles and LiDAR Fundamentals

Created by LeddarTech™ Inc., Leddar™ (light-emitting diode detection and ranging) is a unique sensing technology based on LED illumination (infrared spectrum) and the time-of-flight of light principle. The LED emitters illuminate the area of interest and the multi-segment sensor receiver collects the backscattered light and measures the time taken for the light to return to the sensor.

A photodetector array is used and provides multiple detection and ranging segments. Full-waveform analysis enables detection and distance measurement of multiple objects in each segment as illustrated in Figure 1, provided that foreground objects do not fully obscure objects behind them.

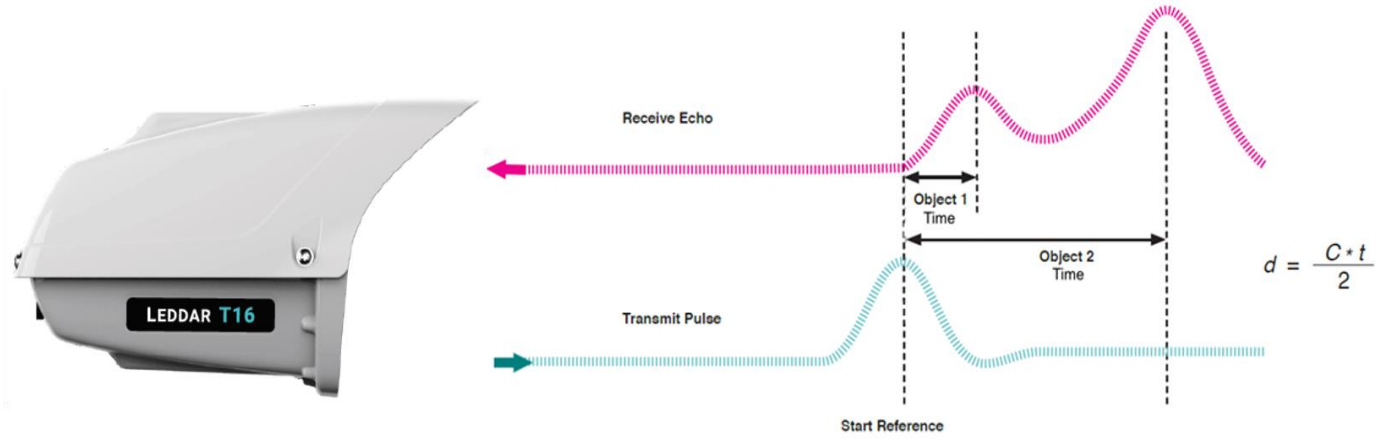


Figure 1: Time of Flight

2.3. Key Factors for Best Sensor Performance

The following factors are important to consider for obtaining the best operating performance.

Table 4: Key Factors for Best Performance

Key Factors	Description
Size of the target	The larger the target, the higher is the range. The smaller the target, the lower is the range.
Reflectivity of the target	With a high surface reflectivity, the range is higher. With a low surface reflectivity, the range is lower.
Position of the target within the FOV	With centered channels (segments), the range is higher. With outer channels (segments), the range is lower.

3. Description

This user guide is intended to provide information on and describe the Leddar™ T16 Solid-State LiDAR Traffic Sensor (hereinafter referred to as “Leddar T16”) for developers, integrators and/or engineers.

The Leddar™ T16 Traffic Sensor is a 2D solid-state LiDAR that is specifically designed for traffic management systems from city to highway applications. Packaged in a weatherproof housing, the Leddar T16 offers cost efficient and highly accurate detection for various Intelligent Transportation System (ITS) applications, such as electronic tolling, traffic monitoring and traffic law enforcement. At the heart of the sensor resides the patented Leddar digital signal processing technology, which provides superior detection, location and measurement capabilities for all types of traffic, including vehicles, pedestrians and cyclists. The Leddar T16 measures both the distance and angular positioning for each detected target. Its collected data enables functionalities, such as vehicle profiling, speed measurement, and traffic data collection.

The Leddar T16’s flash illumination emitted by its LED sources covers the sensor’s complete field of view. Capturing the return echoes of these diffused light pulses through 16 independent active detection elements at a high acquisition rate, the Leddar T16 Traffic Sensor continuously provides rapid and accurate detection and ranging in the entire beam without any moving mechanical parts. The returned signals are digitized and processed through innovative algorithms, allowing the reliable detection and measurement of a wide range of objects under the most challenging environmental conditions, such as rain, snow and fog.

Keep this user guide for future reference.

3.1. Equipment Designation and Description

Table 5: Equipment Designation

Family Name	Leddar T16
Model	Solid-State LiDAR Traffic Sensor
Configurations	Traffic and Tolling Sensors

This document refers to all models described below unless otherwise mentioned.

Table 6: Leddar T16 Sensor Traffic and Tolling Configurations

Leddar T16 Traffic	Options
9° (75A0030-1)	• Pan and Tilt • Camera • Enclosure sunshade
19° (75A0021-1)	
26° (75A0022-1)	
36° (75A0023-1)	

Leddar T16 Tolling	Options
9° (75A0025-1)	• AR coated window • Lens shield • No enclosure sunshade • No pan and tilt • No camera
19° (75A0026-1)	
26° (75A0027-1)	
36° (75A0028-1)	
48° (75A0029-1)	

The Leddar T16 Sensor comes with the following software and accessories.

- Leddar™ Configuration and Software Development Kit (SDK)
- Ethernet connector kit. Refer to **Appendix B** for more details.

Table 7: Ethernet Cable Description

Ethernet Connector Kit	Description
	Cat5e RJ45 shielded connector (with load bars), IP67 industrial modular connector and yellow strain relief boot.

3.1.1. Key Components

Receiver	Emitter
• Receiver Lens	• Light Emitter • Diffuser lens

Figure 2, Figure 3, and Figure 4 below show the Leddar T16 Sensor key components.

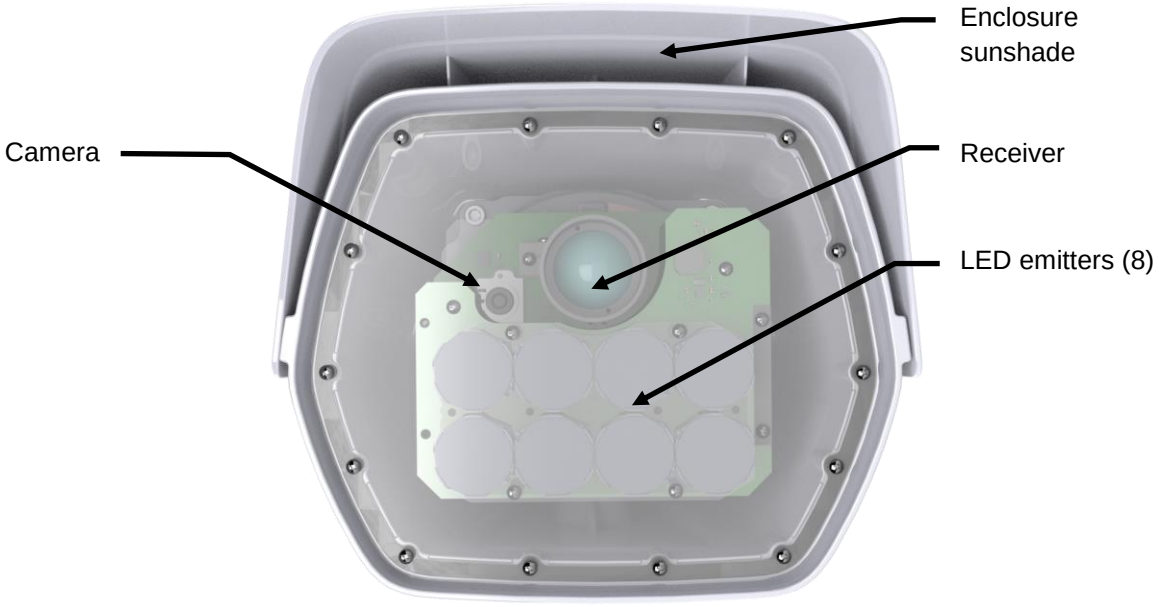


Figure 2: Front View of the Leddar T16 Traffic Sensor

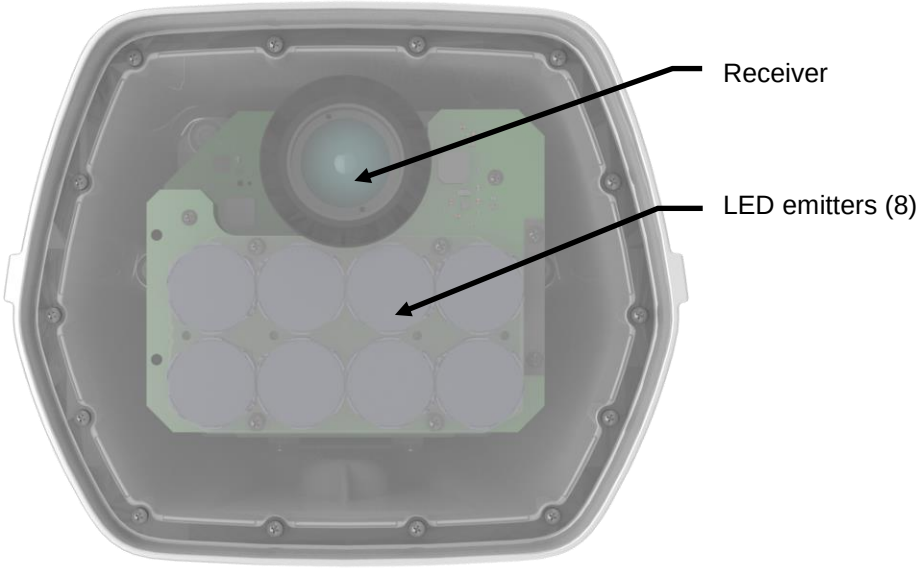


Figure 3: Front View of the Leddar T16 Tolling Sensor

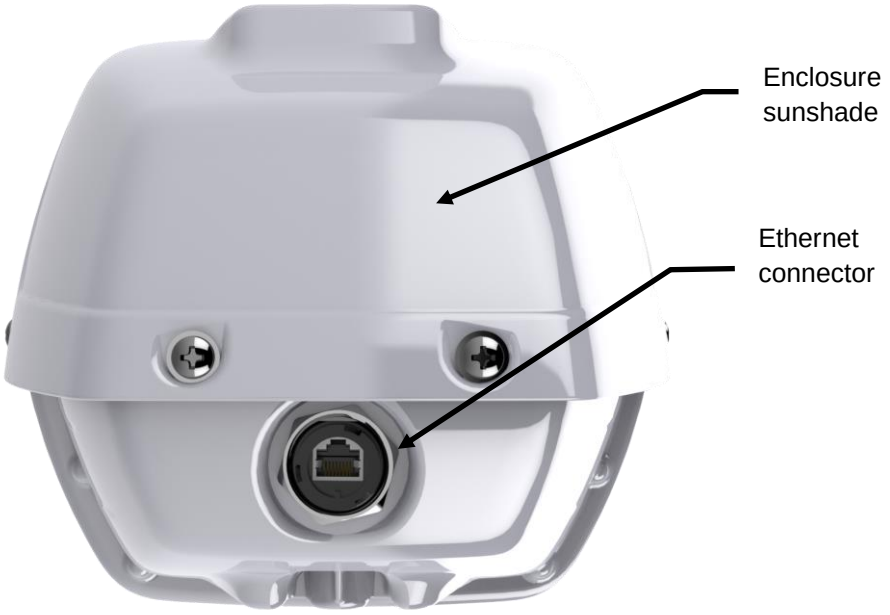


Figure 4: Back View of the Leddar T16 Traffic Sensor

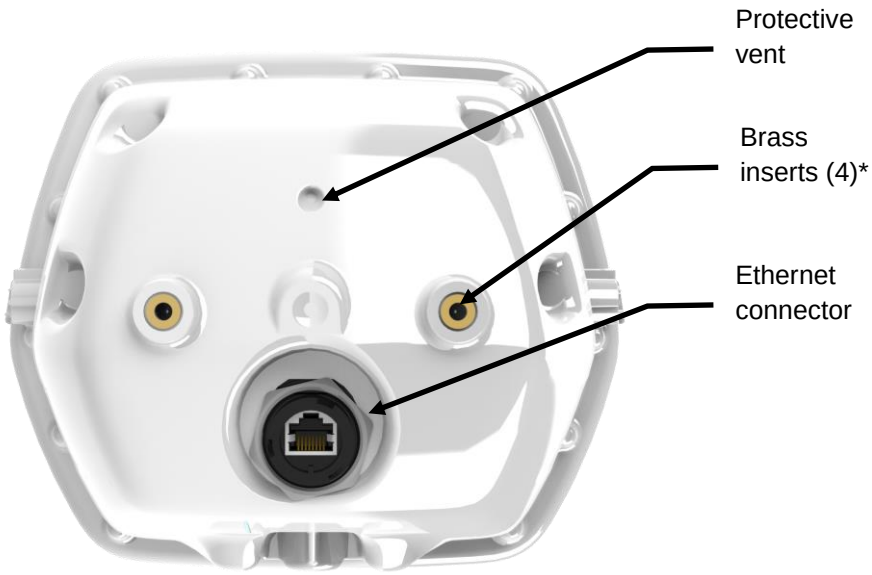


Figure 5: Back View of the Leddar T16 Tolling Sensor

* Brass inserts (two on the back and one on each side of the Tolling Sensor) serve to fix the optional enclosure sunshade only.

3.1.2. Distance Measurement

The red line indicates the distance that is measured from the screw located on the sides of the Leddar T16 Sensor as shown in Figure 6.

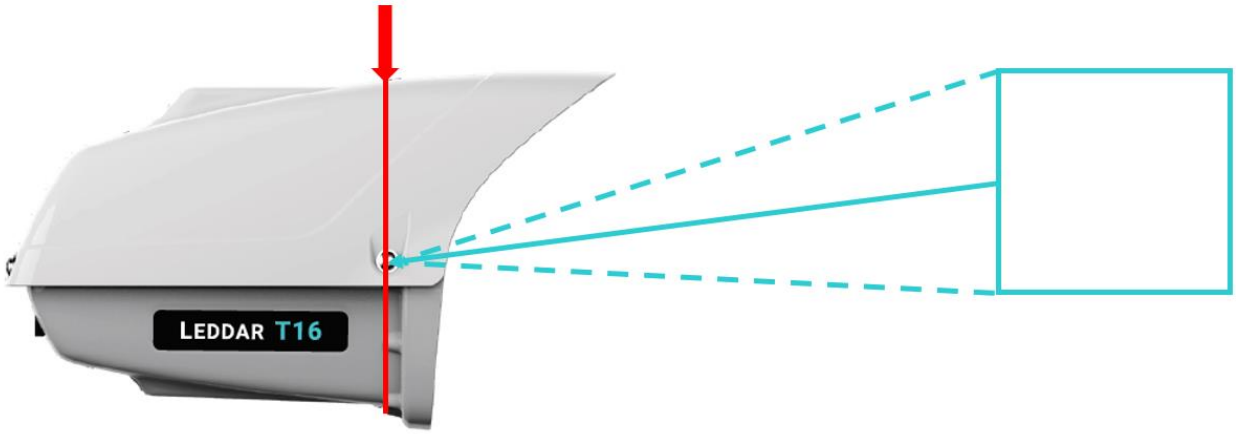


Figure 6: Distance Measurement with the Leddar T16 Sensor

The blue dashed lines illustrate one segment and the solid line indicates the distance measured by the sensor in that segment.

4. Specifications

4.1. General Characteristics

Table 8: Leddar T16 Characteristics

Number of Segments	16
Horizontal x Vertical FOV	48° x 7.5° 36° x 5.9° 26° x 4.2° 19° x 3.0° 9° x 1.6°
Resolution	3.00°, 2.25°, 1.63°, 1.19°, 0.56°
Wavelength	940 nm
Photodetector Array Size	1 x 16
Measurement Rate	Fixed at 196 Hz
Accuracy	± 5 cm

Table 9: Test Conditions and Detection Range (Traffic)

Leddar T16 Traffic			**Detection Range (m)**			
Configuration	**Horizontal FOV (°)**	**Vertical FOV (°)**	**Retro-reflector[1]**	**White 90% Reflectivity[2]**	**Gray 18% Reflectivity[3]**	**NCAP Pedestrian 40%**
75A0030-1	9	1.6	49	39	19	49
75A0021-1	19	3.0	49	36	18	47
75A0022-1	26	4.2	49	18	12	27
75A0023-1	36	5.9	49	15	8	20

1. Retro-reflector reference target corresponds to a 5 cm x 7 cm band of retro-reflective tape.
2. White reference target corresponds to a 20 cm x 25 cm Kodak Greycard with 90% reflectivity.
3. Gray reference target corresponds to a 20 cm x 25 cm Kodak Greycard with 18% reflectivity.

Table 10: Test Conditions and Detection Range (Tolling)

Leddar T16 Tolling			Detection Range (m)			
Configuration	Horizontal FOV (°)	Vertical FOV (°)	Retro-reflector[1]	White 90% Reflectivity[2]	Gray 18% Reflectivity[3]	NCAP Pedestrian 40%
75A0025-1	9	1.6	49	36	17	46
75A0026-1	19	3.0	49	32	16	42
75A0027-1	26	4.2	49	17	11	24
75A0028-1	36	5.9	49	13	7	18
75A0029-1	48	7.5	49	11	6	15

1. Retro-reflector reference target corresponds to a 5 cm x 7 cm band of retro-reflective tape.
2. White reference target corresponds to a 20 cm x 25 cm Kodak Greycard with 90% reflectivity.
3. Gray reference target corresponds to a 20 cm x 25 cm Kodak Greycard with 18% reflectivity.

4.2. Mechanical Specifications

Table 11: Leddar T16 Mechanical Specifications

	Leddar T16 Traffic	Leddar T16 Tolling
Height	226 mm / 9 in.	208.7 mm / 8.2 in.
Length	386 mm / 15.2 in.	277 mm / 10.9 in.
Width	259 mm / 10.2 in.	252.4 mm / 9.9 in.
Weight	3 kg (6.6 lbs)	2.3 kg (5 lbs)
Mounting Threads	M6 x 1.0	
Mounting	Compatible with standard traffic hardware	

4.2.1. Leddar T16 Traffic Dimensions

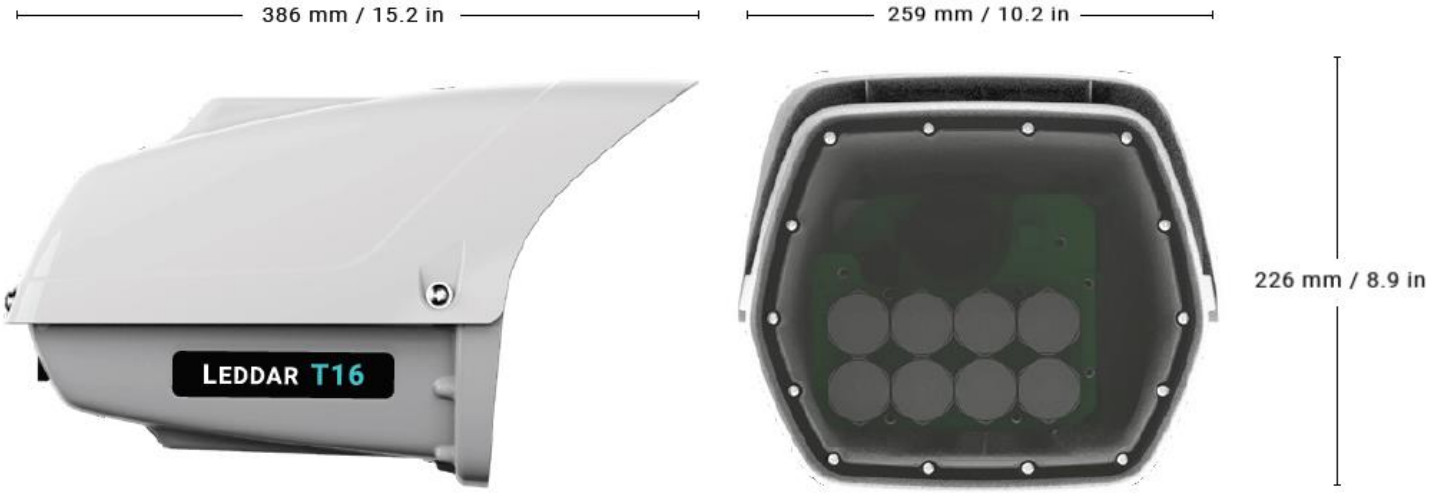


Figure 7: Leddar T16 Traffic Sensor Dimensions

4.2.2. Leddar T16 Tolling Dimensions

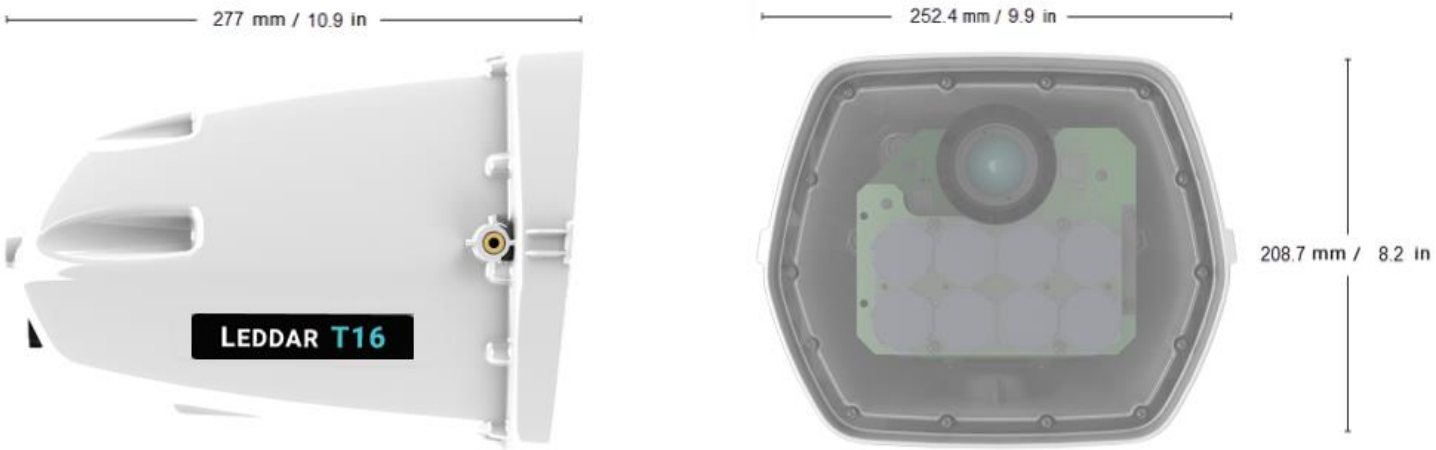


Figure 8: Leddar T16 Tolling Sensor Dimensions

4.2.3. Distance Screw

Figure 9, Figure 10, and Figure 11 below shows the measurements between the mounting threads of the Traffic and Tolling Sensors.

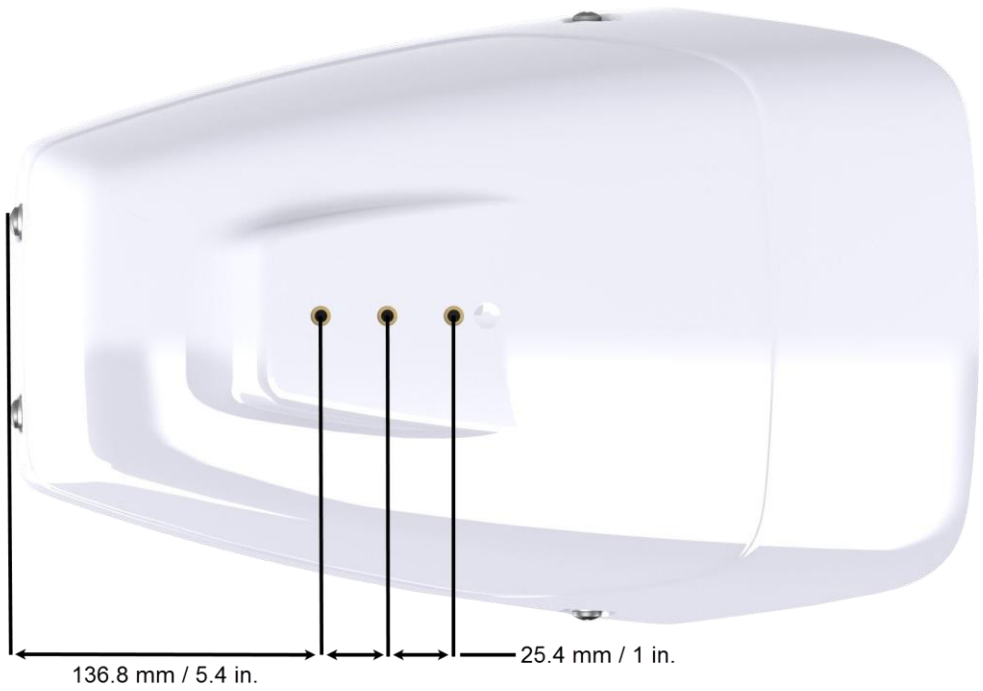


Figure 9: Leddar T16 Traffic Top View – Measurements Between Mounting Threads

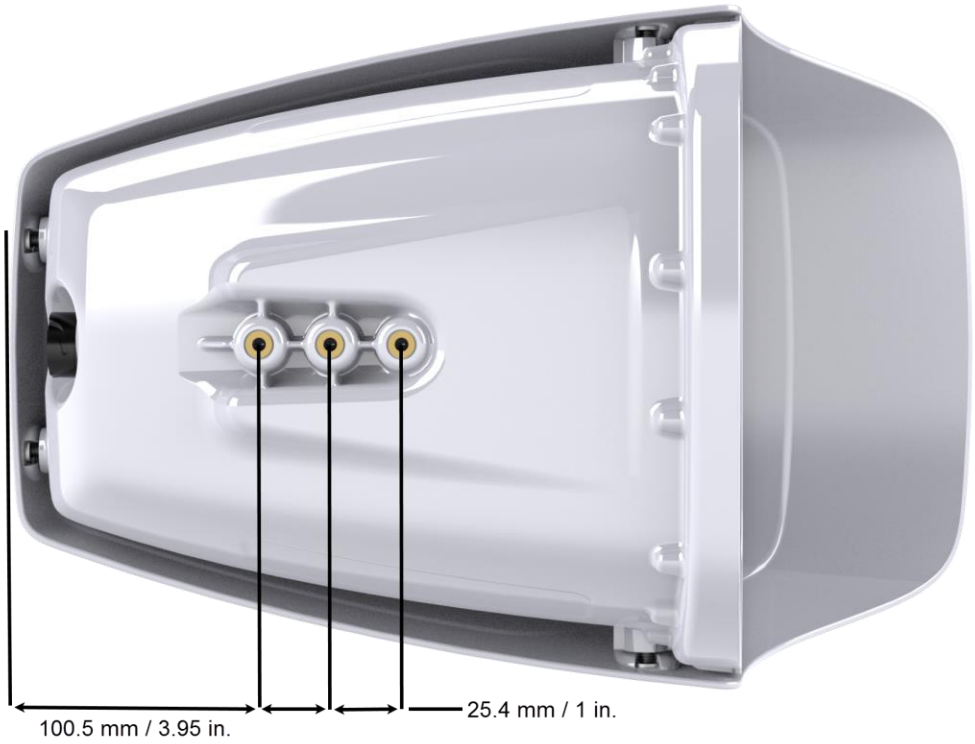


Figure 10: Leddar T16 Traffic Bottom View – Measurements Between Mounting Threads

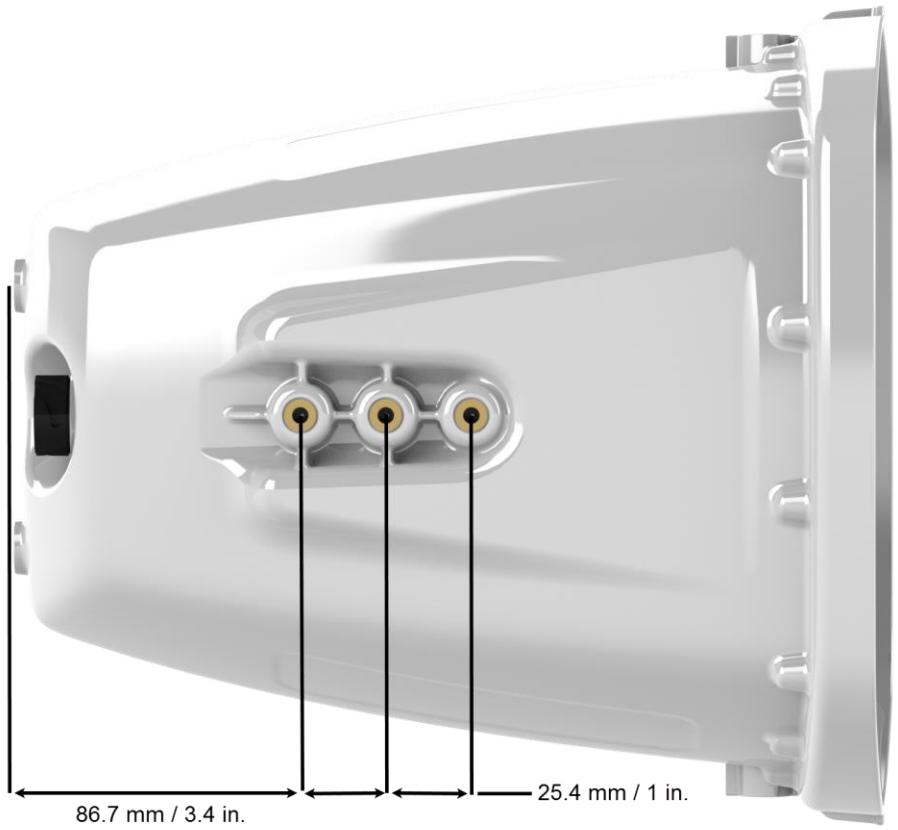


Figure 11: Leddar T16 Tolling Bottom View – Measurements Between Mounting Threads

4.3. Electrical Specifications

Table 12: Leddar T16 Electrical Specifications

Power Supply	IEEE 802.3at PoE+ (Power over Ethernet Plus), 56 VDC
Power Supply Tolerance	54 V to 57 V (56 V nominal)  It is strongly recommended not to exceed this range as there is a surge protection at 58 V.
Power Consumption (total)	15 W (without heater) 30 W (with heater)

4.4. Environmental Specifications

Table 13: Leddar T16 Environmental Specifications

Operating Temperature Range	−40° C to + 60° C (−40° F to +140° F)
Humidity	100%
Water Tightness	IP67

4.5. Software System Requirements

Table 14: Leddar™ Configuration System Requirements

Operating System	Windows 7 and up
Memory	1 GB
Disk Space	150 MB
Communication Interface	100BASE-T Ethernet

5. Installing the Leddar T16 Sensor

This section provides information and procedures to install and start the Leddar T16 Sensor.

5.1. Installing and Orienting the Sensor

This section presents how to install and orient the sensor. The mounting bracket can be attached to the top or bottom of the Leddar sensor as shown in the examples below.

Figure 12: Mounting Position Examples

Required tools and materials

- 10 mm wrench
- Mounting brackets (of customer-supplied)

To install and orient the sensor:

1. Use the provided hardware to attach the sensor to the mounting bracket. The supplied lock washers must be installed between the bolt head and the bracket. Do not over tighten. The recommended torque is 60 in.-lb. (6 Nm).

2. Orient the sensor so that the first segment is located on the side of the detection zone and that the active grid (green) is centered in depth with two reference marks (blue circle) you have placed on the side of the road (see Figure 13).

Figure 13: Orienting the Sensor with Reference Marks

The sensor has three position controls: pan, tilt, and roll (see Figure 14).

The pan and tilt are adjustable using the sensor motor (Traffic configuration only); the roll can only be adjusted by hand using the mounting bracket.

These adjustments vary according to the side of the road on which the sensor is installed.

Figure 14: Sensor Position Adjustments

Refer to section **7.3.4 Orientation Control** to know how to change the sensor orientation.

5.2. Connecting the Leddar T16 Sensor

Once Leddar™ Configuration is installed, you can connect the sensor.

The sensor is in DHCP mode by default.

Refer to **Appendix A** (part A or part B) for the detailed procedure on how to configure the network with either a static IP or DHCP connection.

6. Installing Leddar™ Configuration

1. Download LeddarInstall.exe via the provided link or LeddarTech's support portal.
2. Double-click the file to start the installation.
3. If the Windows Security dialog box opens, click the **Install** button to accept the installation of the drivers from LeddarTech during the process.

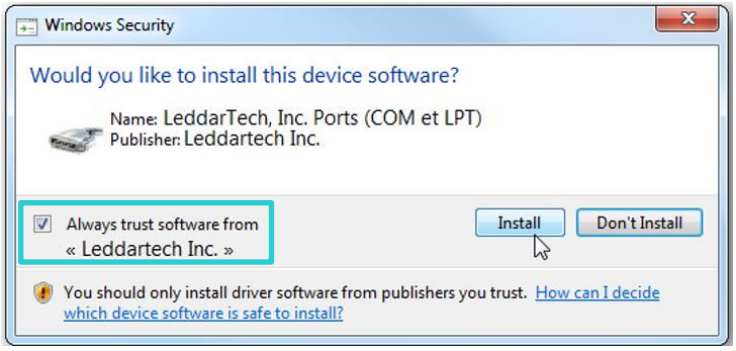


Figure 15: Windows Security Dialog Box

The first time the sensor is connected to a computer, about 30 seconds are required for Windows™ to detect it and complete the installation.

4. Follow the steps in the Welcome to the Leddar™ Configuration Software Setup Wizard.
5. On your computer desktop, click the Leddar™ Configuration icon  to open the software.

Refer to **Appendix A** (part A or part B) for the detailed procedure on how to configure the network with either a static IP or DHCP connection.

6.1. Connecting to Leddar™ Configuration

1. Open Leddar™ Configuration. The following window appears:

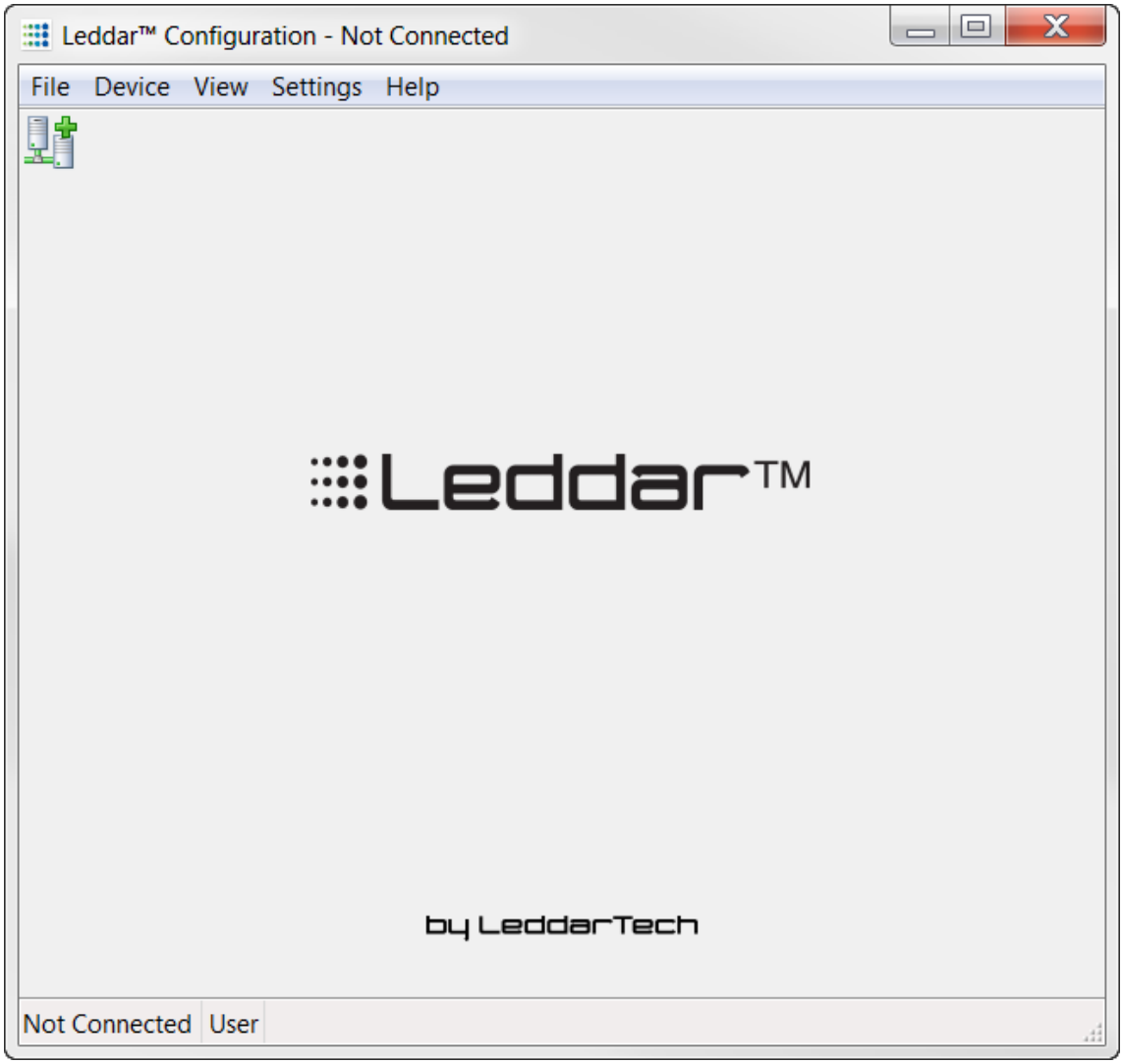


Figure 16: Leddar™ Configuration Opening Window

2. Click  to connect to the sensor.

The first time the sensor is connected to a computer, about 30 seconds are required for Windows™ to detect it and complete the installation.

3. In the **Connection** window, select a sensor in the list. Information about that sensor will appear under the list box.

The sensor list displays all the sensors that are currently recognized by the network.

The color of items in the list indicates the status of a sensor.

- Black: This sensor is available, and no user is connected to it.
- Blue: There is a user connected to this sensor.
- Red: Incapable of communicating. After a certain delay, if the sensor does not respond to requests, it is displayed in red.

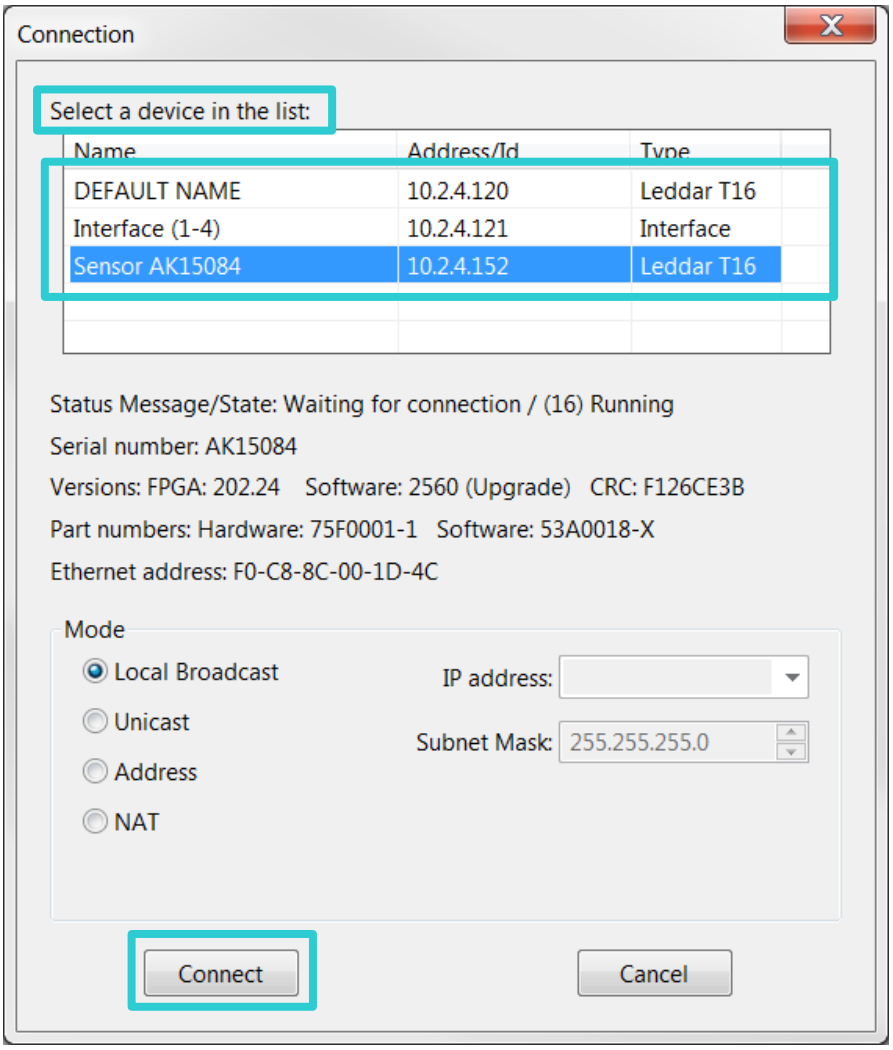


Figure 17: Connection Window

4. a) If the sensor is automatically detected. Click on the available sensor in the list.

   b) Otherwise, enter the IP address **192.168.0.20** and Port number **48630**.

5. Click **Connect** to connect to the available sensor.

6. To disconnect from the sensor, click  in the toolbar or go to **Device > Disconnect**.

7. To quit Leddar™ Configuration, go to **File > Quit**.

Table 15: Connection Window Information

Connection Details and Feature	Description
Status Message/State	The status message is the connection status for a sensor, which indicates for example if a sensor is available or in use. The most common status messages are: • Waiting for connection • Connected • Connected and busy • Running • Running | Connected • Running | Connected | Busy
Serial Number	The serial number of the sensor as attributed by LeddarTech.
Versions	FPGA: Firmware version of the sensor. Software: Software version of the sensor. CRC: Software Cyclic Redundancy Check for integrity validation.
Part Numbers	Indicates the hardware and software part numbers of the sensor as attributed by LeddarTech.
Ethernet Address	Also called the Ethernet MAC address, this is a unique identifier of the sensor on the network.
Mode - Local Broadcast	Local Broadcast enumerates the sensors by sending a directed broadcast to the local subnet broadcast address. For example, if the IP address of the computer is 192.158.50.20 and the subnet mask is 255.255.255.0, the local broadcast address 192.168.50.255 will be used. This address will enumerate local sensors; additionally, in a wide area network (WAN) the routers can be configured to route this directed broadcast, enabling sensors on a remote subnet to be enumerated.

Connection Details and Feature	Description
Mode - Unicast	Unicast enumerates the sensors by sending unicast messages to every address defined by the IP Address and Subnet Mask boxes. For example, if 192.168.60.0 is entered as an IP address and 255.255.255.0 as a subnet, then unicast messages will be sent to every address from 192.168.60.1 to 192.168.60.254 to verify if there is a sensor present. If there is, then the sensor will appear in the connection list.
Mode - Address	Address is used to connect to a precise IP address when too many addresses are present in the network connection used. It is also used to connect to sensors located behind a router acting as a network address translation (NAT) gateway.
Mode - NAT	The network address translation (NAT) feature is typically used to access sensors via the Internet, where the individual sensors share a single public IP address. To access sensors behind a NAT gateway, prior configuration of the gateway is required to forward the appropriate ports to the individual sensors. Up to 10 sensors can be supported.

7. Leddar™ Configuration

The Leddar™ Configuration software allows the user to view the detection measurements provided by the connected sensor. The detections may vary based on the configuration of the parameters.

The main window can be resized manually or set to full-screen view.

When a dialog box or a window is already open a checkmark appears next to the command on the menu.

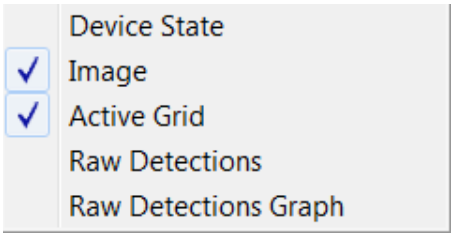


Figure 18: Opened Window Check Mark Example

When parameters such as the name of the sensor or acquisition settings are modified, a warning message in red appears in the main window. Click  in the toolbar to save your changes.

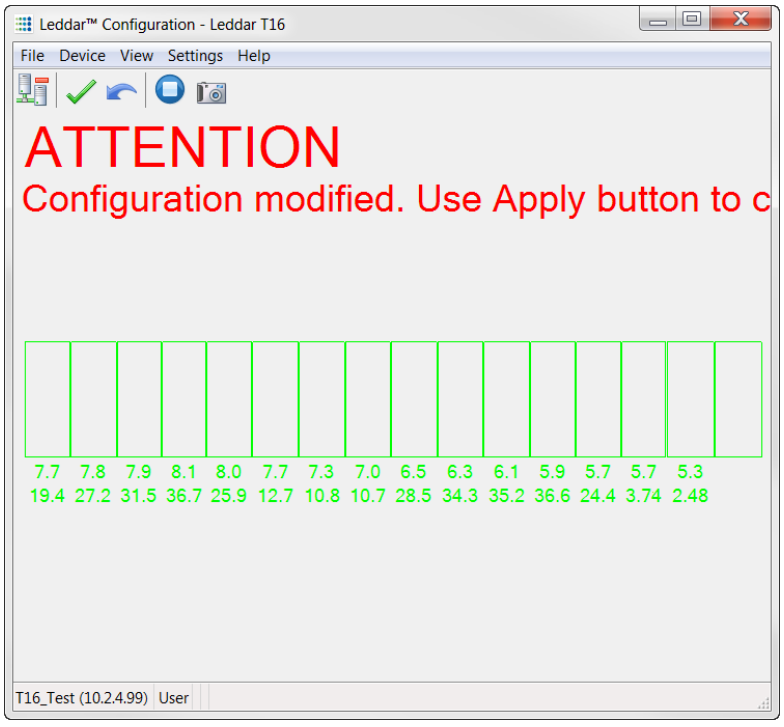


Figure 19: Warning Message Example

7.1. Main Windows, Menus and Buttons

Once connected to the sensor, the main window of Leddar™ Configuration displays the following menus, toolbar and view. See their description below.

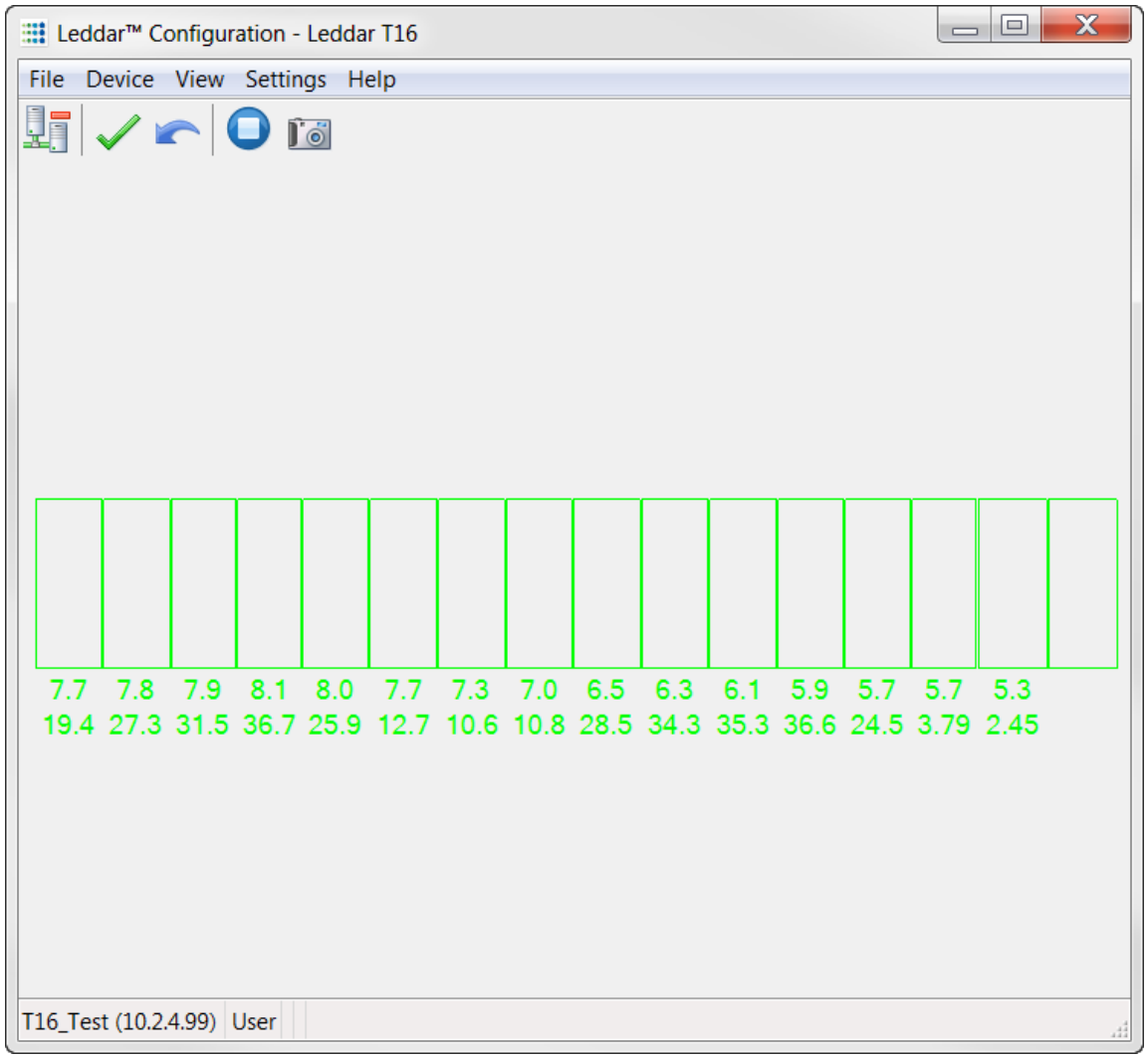


Figure 20: Leddar™ Configuration Traffic Configuration Main Window

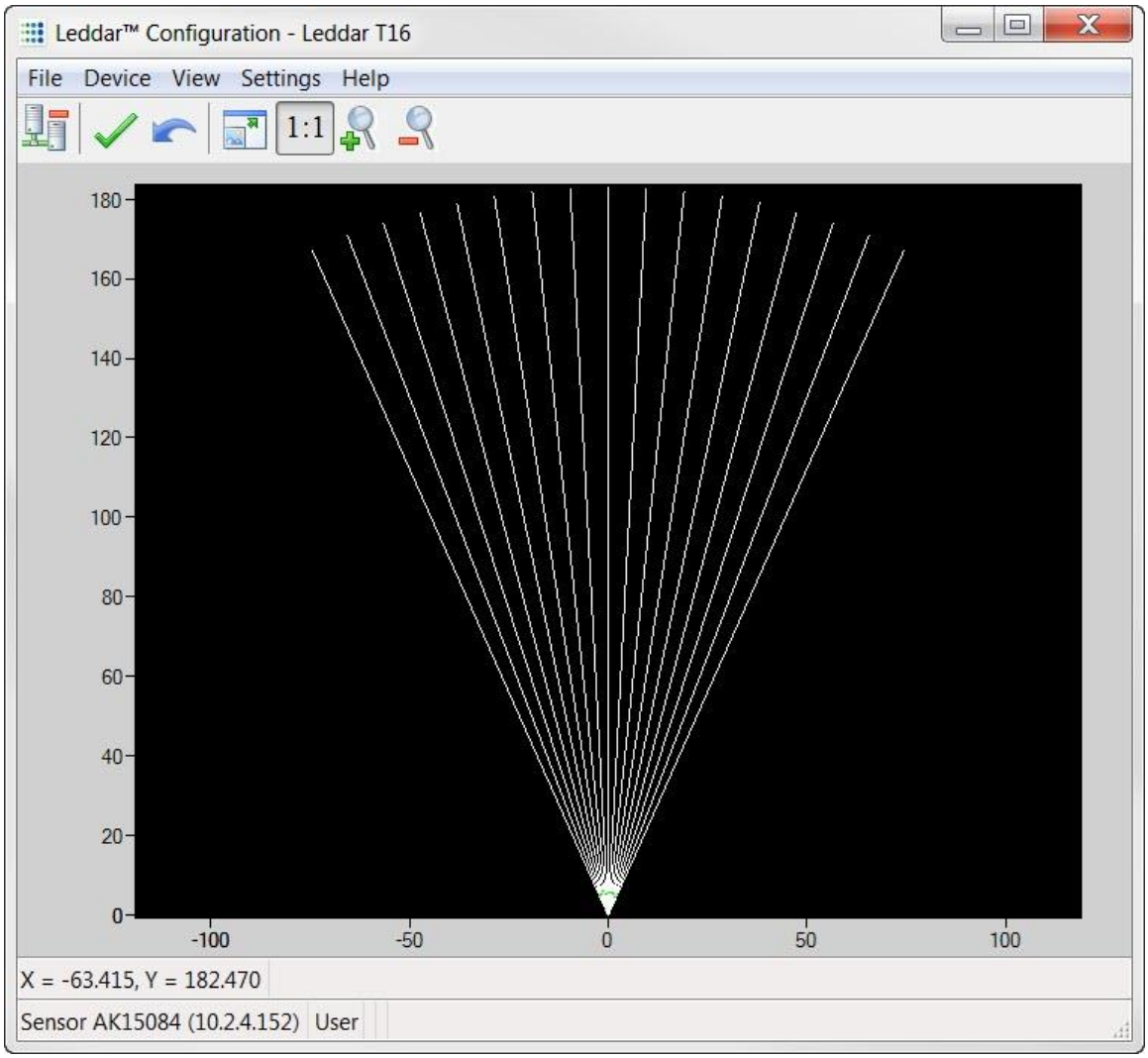


Figure 21: Leddar™ Configuration Tolling Configuration Main Window

Table 16: Main Window Menus

Menu	Description
File	Click **File** to access the following menus: **File > Record Replay** **File > Load Configuration** **File > Save Configuration As** **File > Start/Stop Recording** **File > Import Configuration** **File > Start/Stop Data Logging** **File > Quit** Refer to section **7.2 File Menu** for more details.
Device	Click **Device** to access the following menus: Traffic Configuration Menu **Device > Disconnect** **Device > Apply Changes** **Device > Undo Changes** **Device > Configuration > Name** **Device > Configuration > Acquisition Settings** **Device > Configuration > Network** **Device > Configuration > Orientation** **Device > Configuration > Video** **Device > Action > Start/Stop Live Update** **Device > Action > Take Snapshot** Tolling Configuration Menu **Device > Disconnect** **Device > Apply Changes** **Device > Undo Changes** **Device > Configuration > Name** **Device > Configuration > Acquisition Settings** **Device > Configuration > Network** Refer to section **7.3 Device Menu** for more details.
View	Click **View** to access the following menus: Traffic Configuration Menu **View > Device State** **View > Image** **View > Active Grid**

	View > Raw Detections **View > Raw Detections Graph** Tolling Configuration Menu **View > Device State** **View > Raw Detections** Refer to section **7.4 View Menu** for more details.  The d-tec Virtual Channels option is not compatible with the Leddar T16 Sensors.
Settings	Click **Settings** to access the following menus: **Settings > Record** **Settings > Data Logger** **Settings > Preferences** **Settings > Access Levels** Refer to section **7.5 Settings Menu** for more details.
Help	Click **Help** to access the following menus: **Help > User Guide** **Help > Leddar™ SDK Guide** **Help > About** Refer to section **7.6 Help Menu** for more details.

Table 17: Main Window Toolbar

Button	Description
 	The **Connect** button allows you to connect to a sensor. Once you are connected, the **Connect** button will change for the **Disconnect** button. The **Disconnect** button will then allow you to disconnect the sensor from the system.
	The **Apply** button allows you to confirm and apply the changes you just made to the system related to the sensor.
	The **Undo** button allows you to come back to the information displayed before making your changes or before specifying parameters, for example.
	The **Camera** button is used to take a high-resolution snapshot. You can also take a snapshot by going to **Device > Action > Take Snapshot** Taking a snapshot replaces the live video with a static image. To return to the live video, click  or go to **Device > Action > Stop Live Update**.
	Click the stop button or go to **Device > Action > Stop Live Update** to stop the continuous update of images and results.
	Click the video camera button or go to **Device > Action > Start Live Update** to start continuous update of images and results.
	The fit-to-window button is available with the Tolling configuration only. Click the fit-to-window button to adjust the sensor view to the window when the  button is not selected.
	The scaling button is available with the Tolling configuration only. Click the scaling button to get the original ratio of the display.
	This button is available with the Tolling configuration only. Click Zoom in to zoom in the display.
	This button is available with the Tolling configuration only. Click Zoom out to zoom out the display.

7.2. File Menu

Table 18: File Menu Options

Option	Description
Load Configuration	This option allows the user to load the sensor configuration previously saved in the system as a *.lto file (Leddar™ Configuration file). Choose the wanted sensor configuration from the **Open** dialog box. You can also get the configuration that was stored with a record file. In case of a system failure, you can load a sensor configuration and use this sensor configuration to collect signal data according to a set of parameters (scanning, distance measurements, etc.); and then, analyze the collected data or the information. In addition, if you have more than one sensor and you want to use the same configuration for all your sensors, then, you must load the previously saved configuration you want to use for all your sensors. In this case, make sure to rename all your sensors with a different name. The sensors named differently will use the same configuration. Refer to section **7.3.1.1 Device Name and How to Change it**. To load a configuration, go to **File > Load Configuration**.
Save Configuration As…	This option allows the user to save the configuration for a specific sensor to a *.lto file (Leddar™ Configuration file) from the **Save as** dialog box. This allows the user to save their settings and restore them in case of a system failure or to revert to earlier settings. In addition, if you have more than one sensor and you want to use the same configuration for all your sensors, save the configuration you want to use for all your sensors. In this case, make sure to rename all your sensors with a different name. The sensors named differently will use the same configuration. Refer to section **7.3.1.1 Device Name and How to Change it**. To save a configuration, go to **File > Save Configuration As**.
Start Recording **Stop Recording**	**Start Recording (shortcut F9)**: This option allows you to start recording detections in a *.ltl file that can later be reloaded and replayed. **Stop Recording (shortcut F9)**: This option allows to stop recording detections of the *.ltl file. Refer to section **7.2.1.2 How to Record a Scene** for more details.

Option	Description
Import Configuration	To import a *.ltl file, go to **File > Import Configuration**.
Record Replay	Once you have completed a recording, you can review it by selecting **Replay** in the File menu. The **Position** slider lets you move directly to a desired position. The **Playback Speed** slider lets you adjust the speed of the recording playback. Refer to section **7.2.1.3 How to Play a Recording** for more details.
Start Data Logging **Stop Data Logging**	**Start Data Logging**: Select this option to start the log of receiving data or the event log of the sensor. The event log displays under a text format. **Stop Data Logging**: Select this option to stop the log of receiving data or the event log of the sensor. The event log displays under a text format. Refer to section **7.2.2.2 How to Start and Stop Data Logging** for more details.
Quit	Select **Quit** to quit Leddar™ Configuration software.

7.2.1. Recordings (.ltl file)

Detection records provide a playback of detections recorded by a sensor. This visual information can be useful for verification, troubleshooting, or training purposes. Detection records allow for a full data playback stored in a *.ltl file that you can later reload and replay.

7.2.1.1. How to Edit Recording Settings

Click **Settings > Record**, the **Record Settings** window opens.

Detection records provide a playback of detections recorded by a sensor. This visual information can be useful for verification, troubleshooting, or training purposes.

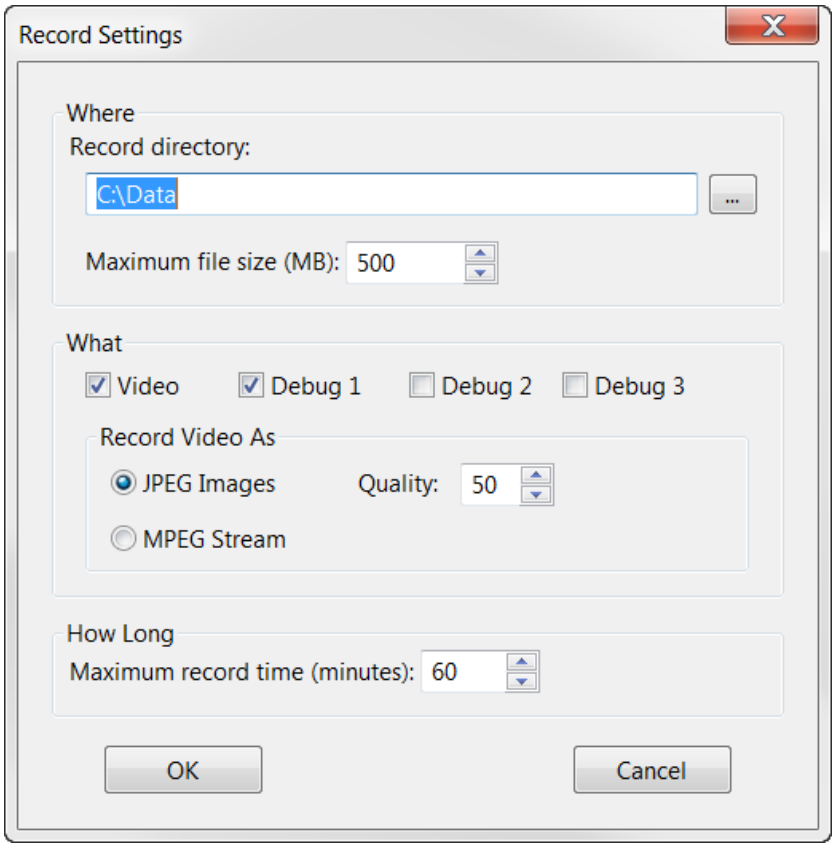


Figure 22: Record Settings Window

1. Choose a directory where you want to save the record file.

2. Indicate a **Maximum file size**.

3. Only check **Debug 1**, **Debug 2**, and **Debug 3** if requested by LeddarTech to activate troubleshooting information. If activated, data acquisition rate (Hz) decreases.

4. Indicate a **Maximum record time**. Click **OK**.

The file name of the recording will be the sensor name followed by the date and time of the recording. The user can change the name of the file by changing the device name (refer to section **7.3.1.1 Device Name and How to Change it**) or after the recording.

The video section is not available with the Tolling configuration and will be grayed out.

7.2.1.2. How to Record a Scene

To start recording the detection scene:

1. Under **Settings menu > Preferences > Recording** tab, indicate a maximum file size and a maximum record time. Refer to section **7.2.1.1 How to Edit Recording Settings** for more details.

2. In the **File** menu, select **Start Recording** (shortcut F9).

When selecting this option, a counter will start at the bottom left of the main window next to the name of the sensor.

To stop recording the detection scene: In the **File** menu, select **Stop Recording** (shortcut F9).

7.2.1.3. How to Play a Recording

To access this menu, disconnect from the sensor and click **File > Replay**.

The **Record Replay** dialog box offers the same functions as a regular video player: there is a stop button, play button, and frame-by-frame forward and backward buttons.

The Start, End, and Extract buttons allow you to select a portion of the recording and extract it for further reference or analysis.

Once you have completed a recording, this option allows the user to review the recorded *.ltl file and to extract parts of this file.

1. Click **File > Replay**. The **Record Replay** window appears:

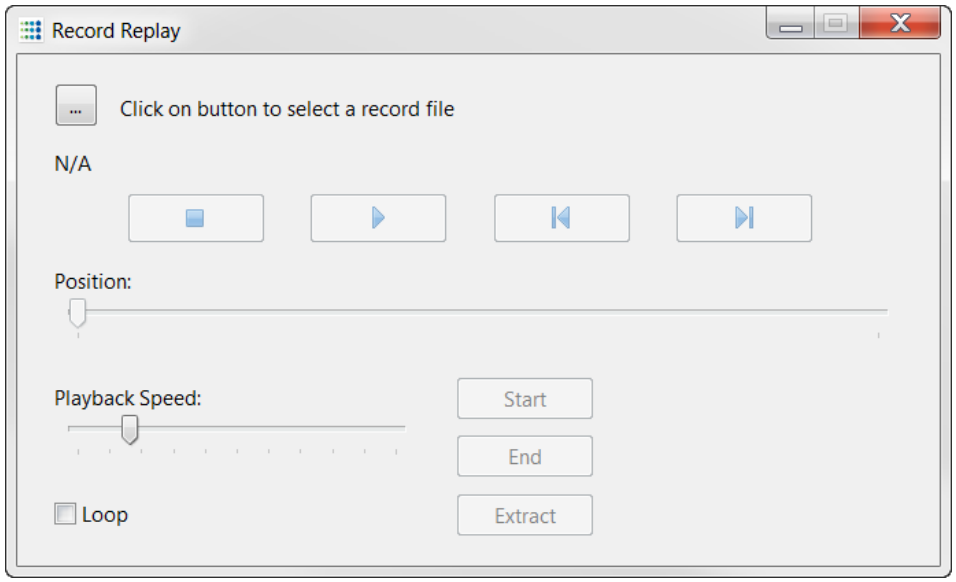


Figure 23: Record Replay Window at Opening

2. Click **Browse** to select a *.ltl file.

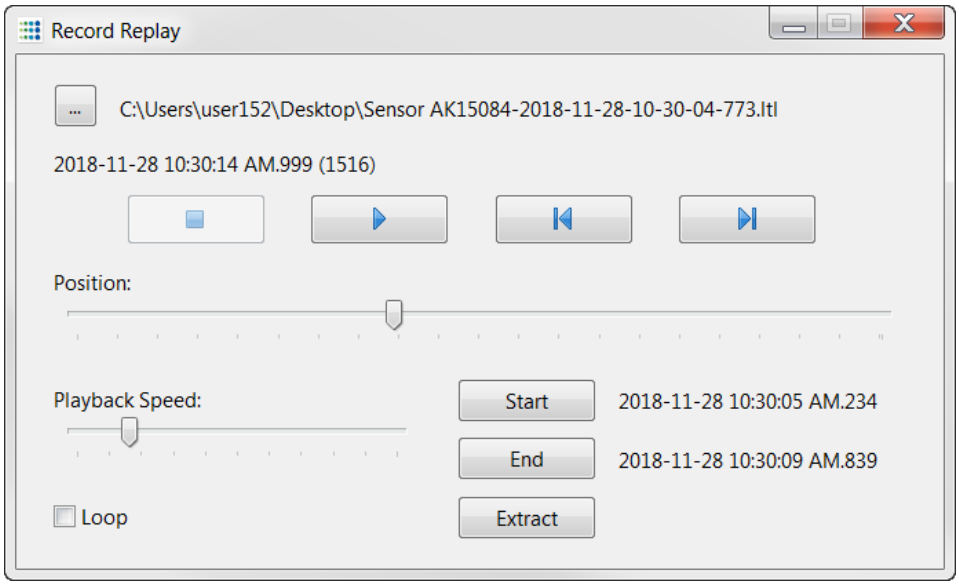
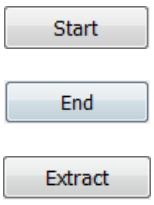


Figure 24: Record Replay Window with File Open

Table 19: Record Replay Window

Button/Feature	Description
	Click **Browse** to select the record file of the scene that you want to view again. Once selected, the name of the file will appear next to the **Browse** button.
	Click the play button to start the recording.
	Click the stop button to end the recording.
 	Click the previous or next buttons to either move to the previous frame or move to the next frame.
Position 	Move the **Position** slider to go to a desired position in the recorded file. The indication of the position is located above the stop and play buttons, for example: (1516).
Playback Speed 	Move the **Playback Speed** slider to change the speed of the playback to see the scene or the detected object more accurately. The Playback Speed slider lets you adjust the speed of the recording playback; faster is to the left.
Loop	Check this option to automatically loop back to the beginning of the recording.
	The **Start**, **End**, and **Extract** buttons allow you to select a portion of the recording and extract it for further reference or analysis. Click **Start** to tag the position to start the extraction. Click **End** to tag the position to end the extraction. Click **Extract** to extract a part of the scene and save it as a *.ltl file. Refer to section **7.2.1.4 How to Extract a Scene Segment** for more details.

7.2.1.4. How to Extract a Scene Segment

This feature allows you to extract a segment from a previously recorded scene.

1. Click [...] to select the record file to play.
2. In the Open window, select the desired record file and click **Open**.
3. Click [▶] to start the playback.

To extract a record file segment:

1. Set the Position slider to the position where you want to see the file segment start and click [Start].
2. Set the Position slider to the position where you want to see the file segment stop and click [End].

Another option:

1. Play the record and stop it at a position of interest and click [Start].
2. Restart playing the record and stop it again at a position of interest and click [End].
3. Click [Extract] to extract and save that file segment.

   If you want to specify a different speed for the playback, type the desired playback speed % or use the up and down arrows to specify the correct percentage (%).
4. Click [▶].

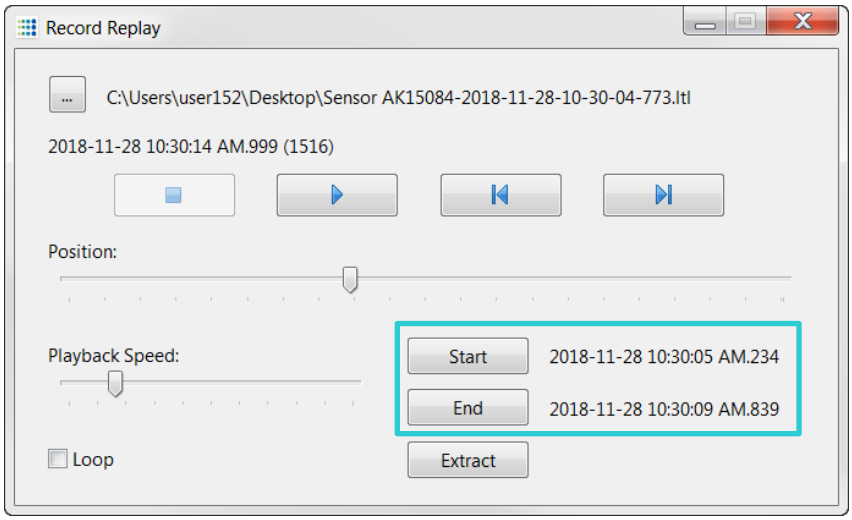


Figure 25: Extracted Segment Example

7.2.2. Data Logging (.txt file)

7.2.2.1. How to Setup Data Logging

To setup data logging file and launch data logging:

1. To configure a .txt recording, go to the **Settings > Data Logger**.

2. Click  to select where to save the log and click **OK.**

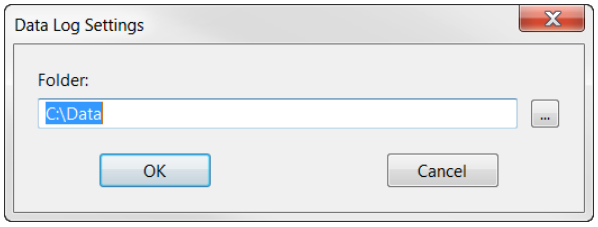


Figure 26: Data Log Settings Dialog Box

The file name of the recording will be the sensor name followed by the date and time of the recording. The user can change the name of the file by changing the sensor name (refer to section **7.3.1.1 Device Name and How to Change it**) or after the recording.

7.2.2.2. How to Start and Stop Data Logging

To access this option, click **File > Start Data Logging**.

The data logging function allows the user to output the data to a .txt file. This file can be imported in a software application, such as Microsoft Excel, for off-line analysis.

When selecting this option, a counter will start at the bottom left of the main window next to the name of the sensor.

To stop data logging, click **File > Stop Data Logging**.

7.3. Device Menu

Table 20: Device Menu Options

Option	Description
Device > Disconnect	Click  to disconnect the sensor from the software and come back to Leddar™ Configuration.
Device > Apply Changes	Select this option to confirm the changes to the settings or click  in the toolbar.
Device > Undo Changes	Select this option to undo the changes to the settings or click  in the toolbar.
Device > Configuration > Name	Select this option to view and modify the name of the sensor. Refer to section **7.3.1.1 Device Name and How to Change it** for more details.
Device > Configuration > Acquisition Settings	Select this option to access and modify the acquisition settings. Refer to section **7.3.2 Acquisition Settings** for more details.
Device > Configuration > Network	Select this option to access the network settings. Refer to section **7.3.3 Network Settings** for more details.
Device > Configuration > Orientation	This option is available with the Traffic configuration only. Select this option to move the camera to change its orientation. Refer to section **7.3.4 Orientation Control** for more details.

Option	Description
Device > Configuration > Video	This option is available with the Traffic configuration only. Select this option to set the video parameters. Refer to section **7.3.5 Video Settings** for more details.
Device > Action > Start/Stop Live Update	This option is available with the Traffic configuration only. Select this option to start or stop the live update or click  to start or  to stop the update in the toolbar. Refer to section **7.3.6 Action** for more details.
Device > Action > Take Snapshot	This option is available with the Traffic configuration only. Select this option to take a snapshot or click  in the toolbar. Refer to section **7.3.6 Action** for more details.

7.3.1. Configurations

The following sections allow the user to configure settings such as the name of the sensor, acquisition settings, network configurations, orientation control, and video adjustment.

7.3.1.1. Device Name and How to Change it

To access this menu, click **Device > Configuration > Device Name**.

This option allows the user to view and modify the name of the sensor.

When you connect to the sensor the first time, a default name will display. The user can change the name of the sensor at any time with a connected sensor.

1. In the **Device Name** dialog box, in the **Name** field, type the new name of the sensor and click **OK**.

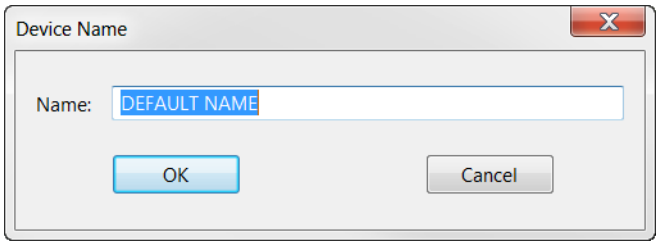


Figure 27: Device Name Dialog Box

2. A warning message in red appears.

3. Click  in the toolbar to save your changes.

7.3.2. Acquisition Settings

To access this menu, click **Device > Configuration > Acquisition Settings**.

This menu allows the user to set the acquisition parameters for detection of objects or people. To apply new acquisition settings, click  in the toolbar.

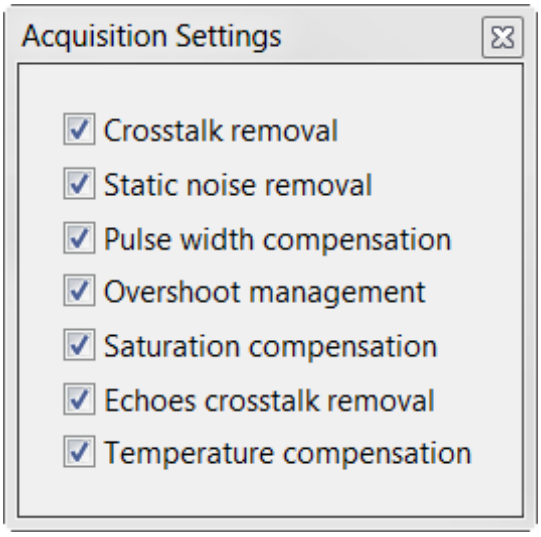


Figure 28: Acquisition Settings Dialog Box

Table 21: Acquisition Settings Window

Parameter	Description	Range
Crosstalk Removal	Inter-segment interference noise removal. Crosstalk is a phenomenon inherent to all multiple segments time-of-flight sensors. It causes a degradation of the distance measurement accuracy of an object when one or more objects with significantly higher reflectivity are detected in other segments at a similar distance.	Enable Disable
Static Noise Removal	When selected, this parameter enhances measurements by subtracting the constant electronic noise present at the beginning of signals.	Enable Disable
Pulse Width Compensation	The objects in the sensor field of detection create a signature in the full-waveform signal called pulses. The pulse detector analyzes the full-waveform signal to recognize these pulses and compute their distance. By nature, time-of-flight sensor using full-waveform analysis can detect several distinct objects with a single photodiode element. The detected pulses have specific amplitudes based on their distance from the sensor and on the reflectivity of the objects. It is well known that pulses of small amplitudes do not lead to accurate and precise distance measurements. Consequently, the algorithm removes all pulses with amplitudes under a given threshold. This threshold depends on the acquisition settings of the sensor.	Enable Disable
Overshoot Management	When selected, this parameter improves the detection of false measurements caused by specific signal shapes. For example, this may occur when strongly reflecting objects are present in the field of view.	Enable Disable
Saturation Compensation	When selected, this parameter activates the advanced distance computation algorithm for very strong (saturated) signals. This computation uses slightly more computing power to enhance the quality of the distance measurements of saturated light pulses. The algorithm classifies the detected pulses based on their shape. The sensor determines which pulses are saturated and which have a normal shape. Saturated pulse occurs when the signal backscattered by the object is so strong that the full-waveform signal is clipped. If not treated, this phenomenon creates an important degradation of the distance measurement accuracy. It is why a saturation compensation algorithm is executed when saturated pulses are detected.	Enable Disable

Parameter	Description	Range
Echoes Crosstalk Removal	When selected, this parameter can further increase accuracy by removing secondary echoes that might still be present in adjacent segments after applying the first stage of crosstalk removal.	Enable Disable
Temperature Compensation	The signal processing algorithm also embeds an advanced temperature compensation scheme which attenuates the distance measurement drift over large and sudden sensor temperature changes. The temperature compensation also ensures optimal accuracy over the full operating temperature range.	Enable Disable

7.3.3. Network Settings

To access this menu, click **Device > Configuration > Network**.

This window allows the user to view and modify the IP configuration and communication protocol configuration. The network configuration applies after a system reboot.

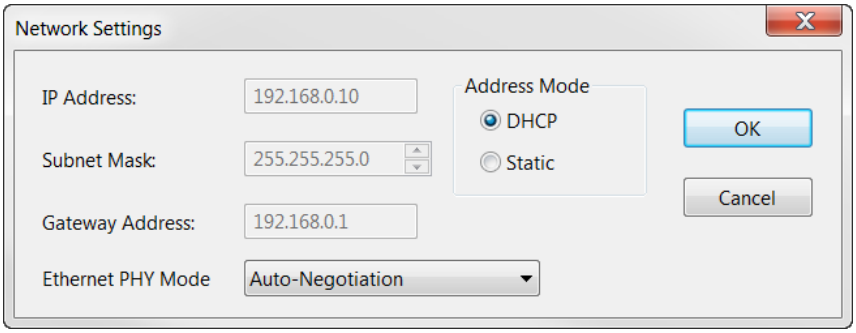


Figure 29: Network Settings Configuration Window

Table 22: Network Configuration Window

Parameter	Description
IP Address	The IP address attributed to the sensor.
Subnet Mask	This defines and identifies the local network within which DHCP addresses will be attributed to sensors.
Gateway Address	By default, this is the same as the Server Address. However, a distinct gateway address is required if you need to access another subnet, that is one or more sensors that are not on the local network.
Ethernet PHY Mode	There are five Ethernet PHY modes available: • Auto-Negotiation • 10 Mbps Half-Duplex • 10 Mbps Full-Duplex • 100 Mbps Half-Duplex • 100 Mbps Full-Duplex
Address Mode	There are two address modes available: • DHCP (Dynamic Host Configuration Protocol) • Static Refer to **Appendix A** (part A or B) for more details.

7.3.4. Orientation Control (Pan/Tilt Adjustment)

To access this menu, click **Device > Configuration > Orientation**.

This menu is available with the Traffic configuration only.

This feature allows the user to adjust the orientation of the sensor.

In the Orientation Control dialog box, use the arrows to move the sensor so that the active grid is centered on the zones to monitor.

The **Step Size** field sets the move, in degrees, for each click on an arrow button (0.1 to 1.0 degrees).

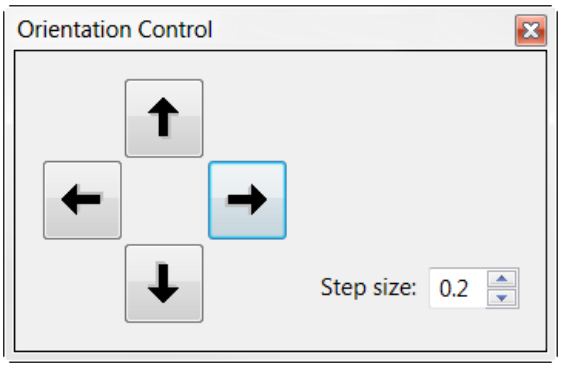


Figure 30: Orientation Control Window

The start of the first lane line must match the physical delimitation of the first lane and the reference line must be perpendicular to the road; this means that they both should line up with the reference mark and the marking or object it was aligned with.

Figure 31: Active Grid Application Example

7.3.5. Video Settings

To access this menu, click **Device > Configuration > Video**.

This menu is available with the Traffic configuration only.

Video activation and settings choices can affect the detection performance in real time.

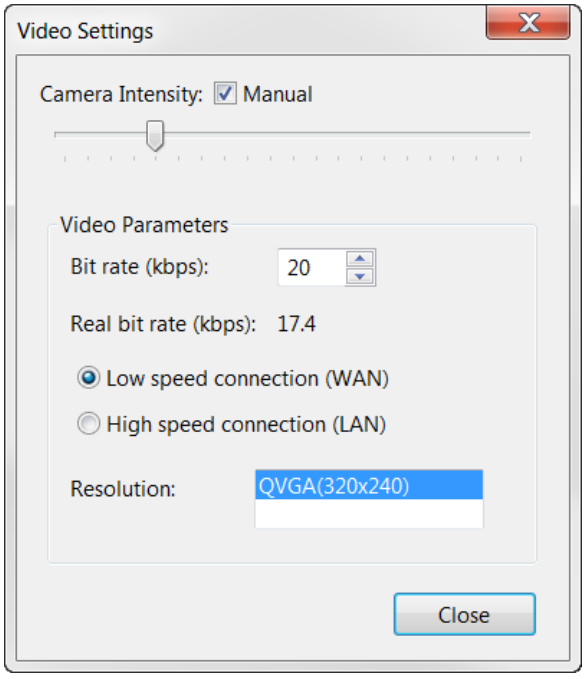


Figure 32: Video Settings Window

Table 23: Video Settings

Parameter	Description
Camera Intensity	Select the **Manual** checkbox to manually change the camera intensity with the **Position** slider. If you clear the checkbox, the intensity will adjust itself automatically.  For a darker image, move the position slider to the left and for a lighter image move the position slider to the right.
Bit rate (kbps)	1 to 4000 kilobits per second

Parameter	Description
Real bit rate (kbps)	Real bit rate in kilobits per second.
Low speed connection (WAN)	Select this option to get a low speed connection.
High speed connection (LAN)	Select this option to get a high-speed connection.
Resolution	320 x 240 QVGA (Quarter Video Graphics Array display standard)

7.3.6. Action

To access this menu, click **Device > Configuration > Action**.

This menu is available with the Traffic configuration only.

This menu allows you to start or stop a live update (**Device > Action > Start/Stop Live Update**) or take a snapshot (**Device > Action > Take Snapshot**).

You can also use shortcuts by clicking the following buttons in the toolbar.

Table 24: Action Buttons Description

Button	Description
	Click the stop button or go to **Device > Action > Stop Live Update** to stop the continuous update of images and results.
	Click the video camera button or go to **Device > Action > Start Live Update** to start continuous update of images and results.  Video activation and settings choices can affect the detection performance in real time.
	The **Camera** button is used to take a high-resolution snapshot. You can also take a snapshot by going to **Device > Action > Take Snapshot** Taking a snapshot replaces the live video with a static image. To return to the live video, click the video camera button or go to **Device > Action > Stop Live Update**.

7.4. View Menu

Table 25: View Menu Options

Menu	Description
View > Device State	Select this option to view sensor information. Refer to section **7.4.1 Device State** for more details.
View > Image	This option is available with the Traffic configuration only. Select this option to get a live view from the camera sensor. Refer to section **7.4.2 Image Activation** for more details.
View > Active Grid	This option is available with the Traffic configuration only. Select this option to get the sensor detection zone overlay on the live view from the camera sensor. Refer to section **7.4.3 Grid Activation** for more details.
View > Raw Detections	Select this option to view the displayed raw data and define the desired detection parameters. Refer to section **7.4.4 Raw Detections** for more details.
View > Raw Detections Graph	This option is available with the Traffic configuration only. Select this option to view the detection scene in 2D. Refer to section **7.4.5 Raw Detections Graph** for more details.

7.4.1. Device State

To access this menu, click **View > Device State**.

This window allows the user to view information about the sensor.

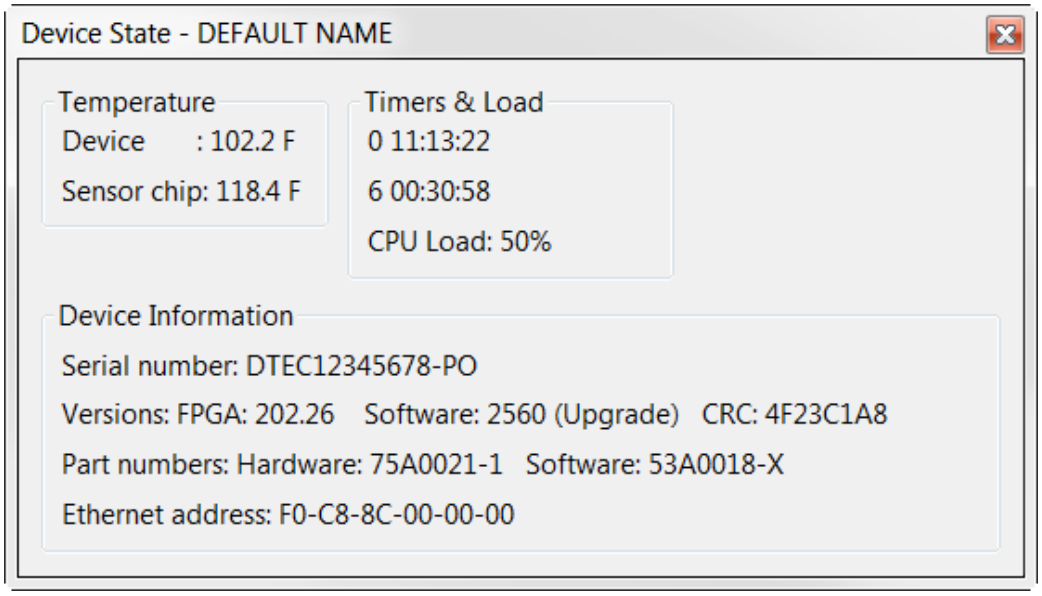


Figure 33: Device State Dialog Box

Table 26: Device State Information

Parameter	Description
Temperature	This section indicates the temperature of the sensor and of its chip.
Timers & Load	This feature gives information in number of days, hours, minutes, and seconds about two types of activities of a sensor. The first line indicates how long it has been since the last sensor reset; the second line indicates how long it has been since the last power cut or outage. The **CPU load** indicates how much of the sensor processor capacity is in use.
Serial Number	The serial number of the sensor as attributed by LeddarTech.
Versions	**FPGA**: the firmware version. **Software**: the software version of the sensor. **CRC**: Software Cyclic Redundancy Check for integrity validation.

Parameter	Description
Part Numbers	This provides the **Hardware** and **Software** part numbers of a sensor, as attributed by LeddarTech.
Ethernet Address	Also called the Ethernet MAC address, this is a unique identifier of the sensor on the network.

7.4.2. Image Activation

To access this menu, click **View > Image**.

This menu is available with the Traffic configuration only.

This option allows the user to activate or deactivate the camera of the sensor and get a live view.

When the image is activated, you can take a snapshot of the live image by clicking  and the image will freeze.

7.4.3. Grid Activation

To access this menu, click **View > Active Grid**.

This menu is available with the Traffic configuration only.

This option allows the user to activate or deactivate the grid that appears on the main window.

To change the color of the grid, go to **Preferences** and select Leddar™ T16. Refer to section **7.5.3 Preferences** for more details.

7.4.4. Raw Detections

To access this menu, click **View > Raw Detections**.

This window allows the user to view detection values. It also provides filters to isolate segments and detection parameters.

An object crossing the beam of the sensor is detected and measured. This detection is qualified by its segment position, distance, and amplitude. The quantity of light reflected to the sensor by the object generates the amplitude. The bigger the reflection is, the higher the amplitude will be.

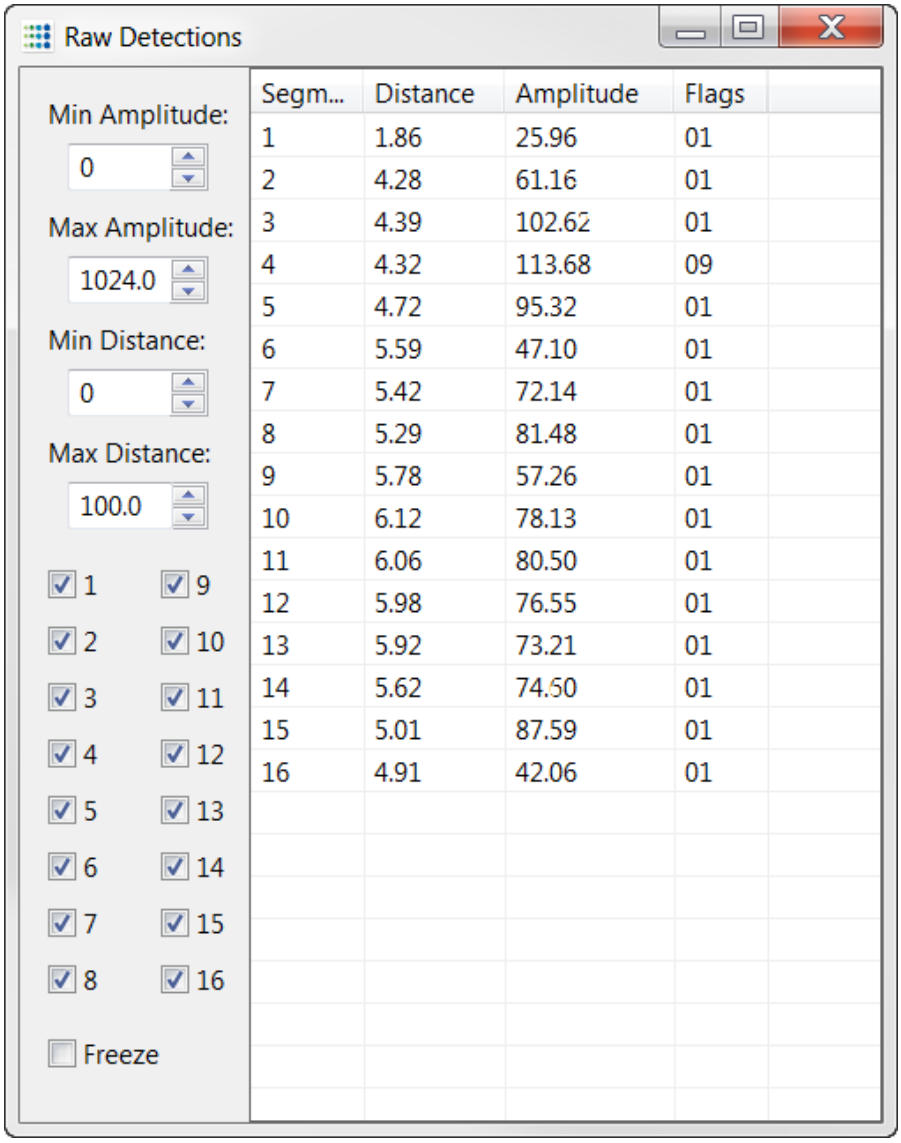


Figure 34: Raw Detections Window

Table 27: Raw Detections Parameters

Parameters	Description	Range
Min Amplitude **Max Amplitude**	The value entered in the **Min Amplitude** box shows only detections of amplitude higher or equal to that value. The value entered in the **Max Amplitude** box will show only detections of amplitude lower or equal to that value. The maximum amplitude is set at 1024.0 by default. Setting a value in both fields will result in a range of amplitude to display.	0.0 to 1024.0
Min Distance **Max Distance**	The minimum and maximum distance from where to detect an object. Maximum distance is set at 100.0 by default.	0 to 200
Segment	Select the segments that you want to display in the detection results. 	1 to 16
Freeze	Check the Freeze box to freeze the raw data and view the information.	Enable Disable
Distance (m)	Position of the detected object.	Varies
Amplitude	Quantity of light reflected by the object and measured by the sensor.	0 to 128
Flags	The **Flags** parameter provides the status information that indicates the measurement type (8-bit status encoded as a bit field). See Table 28.	1 to 255

Table 28: Flag Value Description

Bit position	Bit = 0	Bit = 1
0	Invalid measurement	Valid measurement
1	Reserved	Reserved
2	Reserved	Reserved
3	Reserved	Saturated
4	Reserved	Reserved
5	Reserved	Reserved
6	Reserved	Reserved
7	Reserved	Reserved

7.4.5. Raw Detections Graph

To access this menu, click **View > Raw Detections Graph**.

The Raw Detection Graph window is available with the Traffic configuration only.

The raw detections graph window allows the user to view the segments.

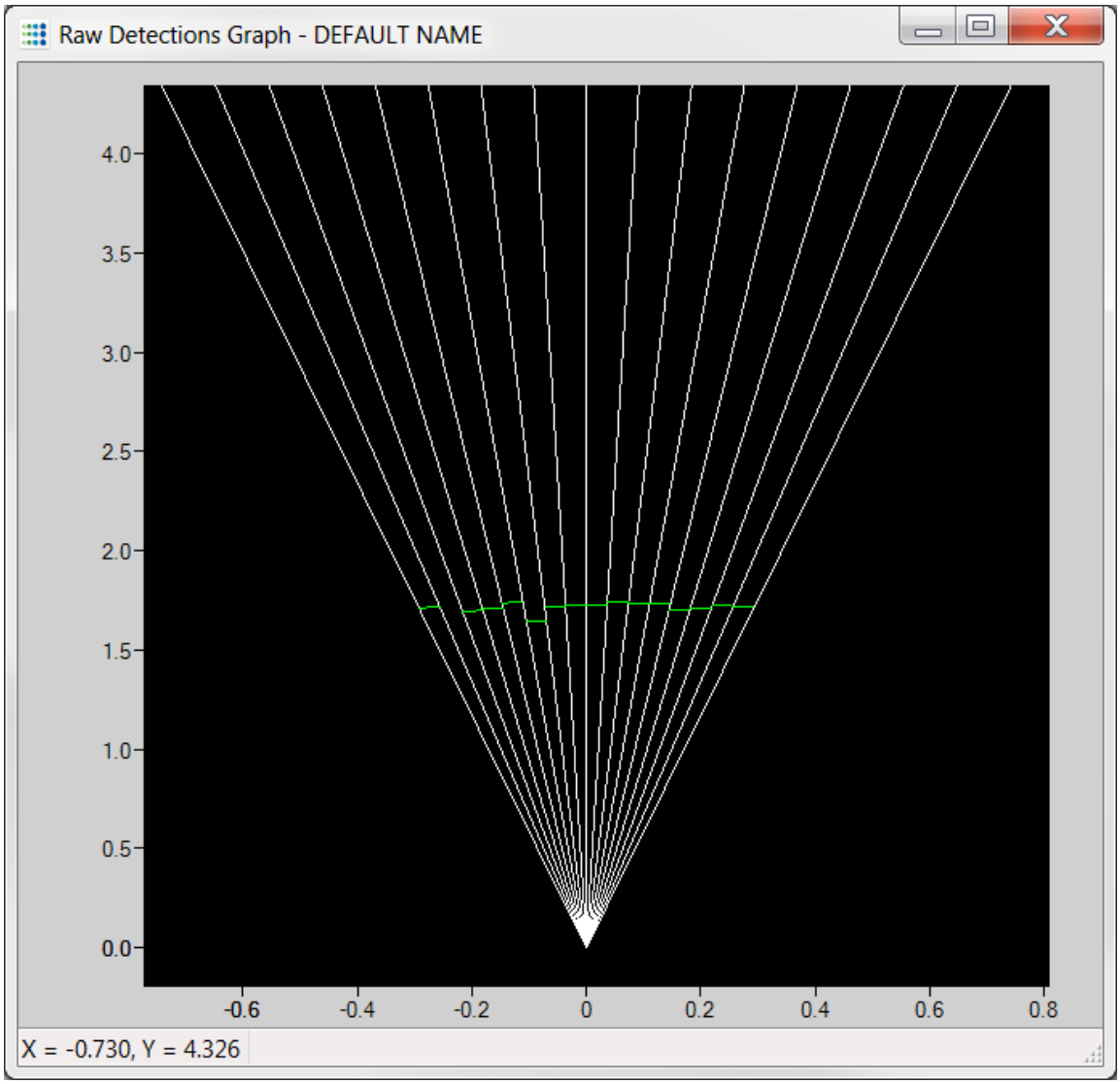


Figure 35: Raw Detection Graph Example

The measurements are represented in a symbolic graph containing the 16 segments (white lines) originating from the sensor. Detections are drawn as arcs in their corresponding segments. Only valid measurements are displayed. A more detailed description of the measurements can be obtained in the Raw Detections dialog box (refer to section **7.4.4 Raw Detections**).

The X and Y numbers displayed at the bottom are the mouse cursor position coordinates.

The display in the main window can be panned, viewed and zoomed in different ways. Panning and zooming is done according to the mouse cursor position.

You can move up, down, and sideways by clicking and dragging the display.

The window opens with default scale settings.

7.4.5.1. Setting Scale Areas and Detection Points

The horizontal and vertical scales can be changed manually by entering new values in the fields accessible by clicking the areas shown in Figure 36, Figure 37, Figure 38, and Figure 39 below.

Click next to the desired number to change the vertical and horizontal scales independently.

To apply the changes, click anywhere in the main window.

See Figure 40 and Figure 41 below to view detection points information examples.

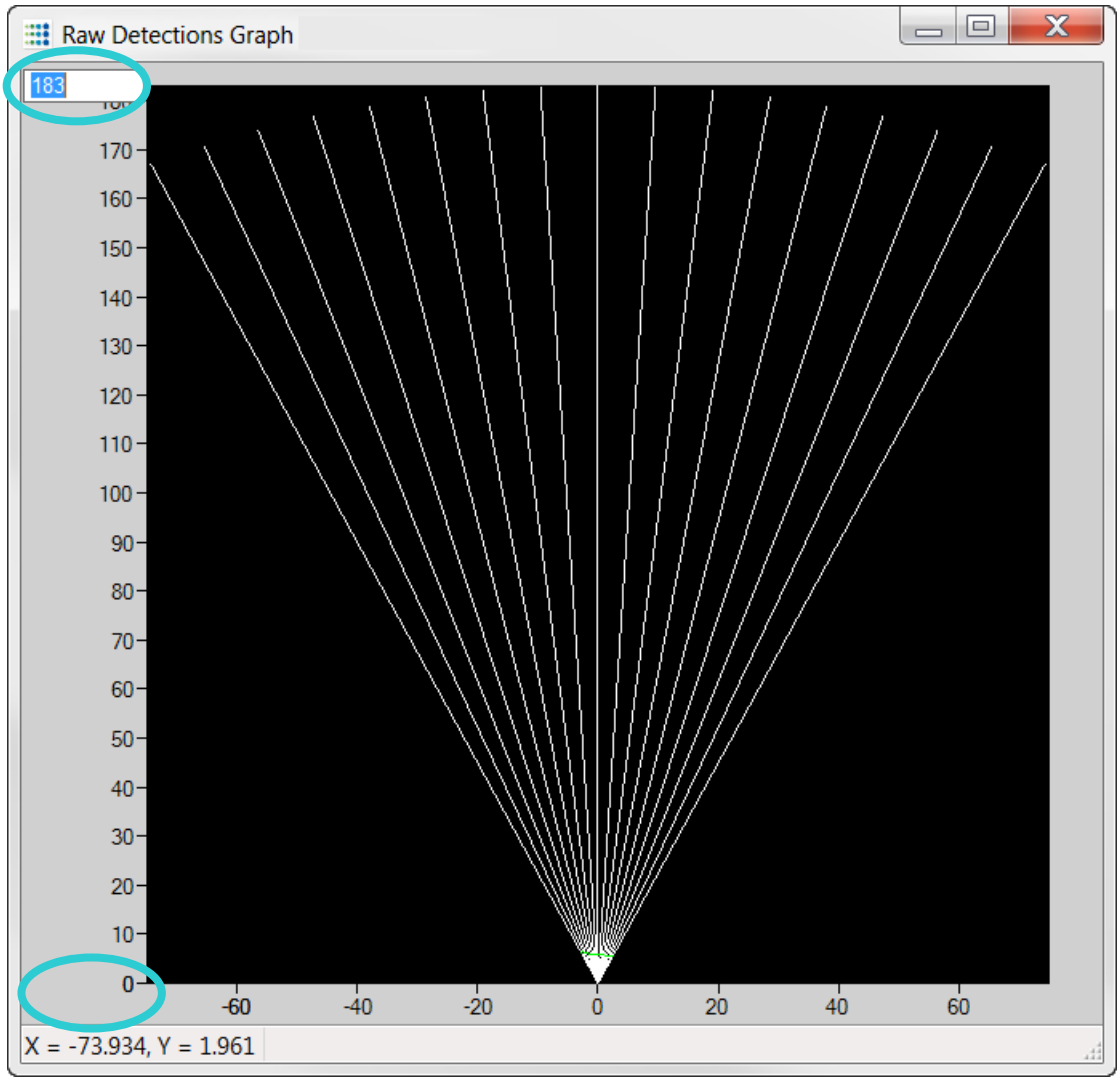


Figure 36: Vertical Scale Setting Areas (Traffic Configuration)

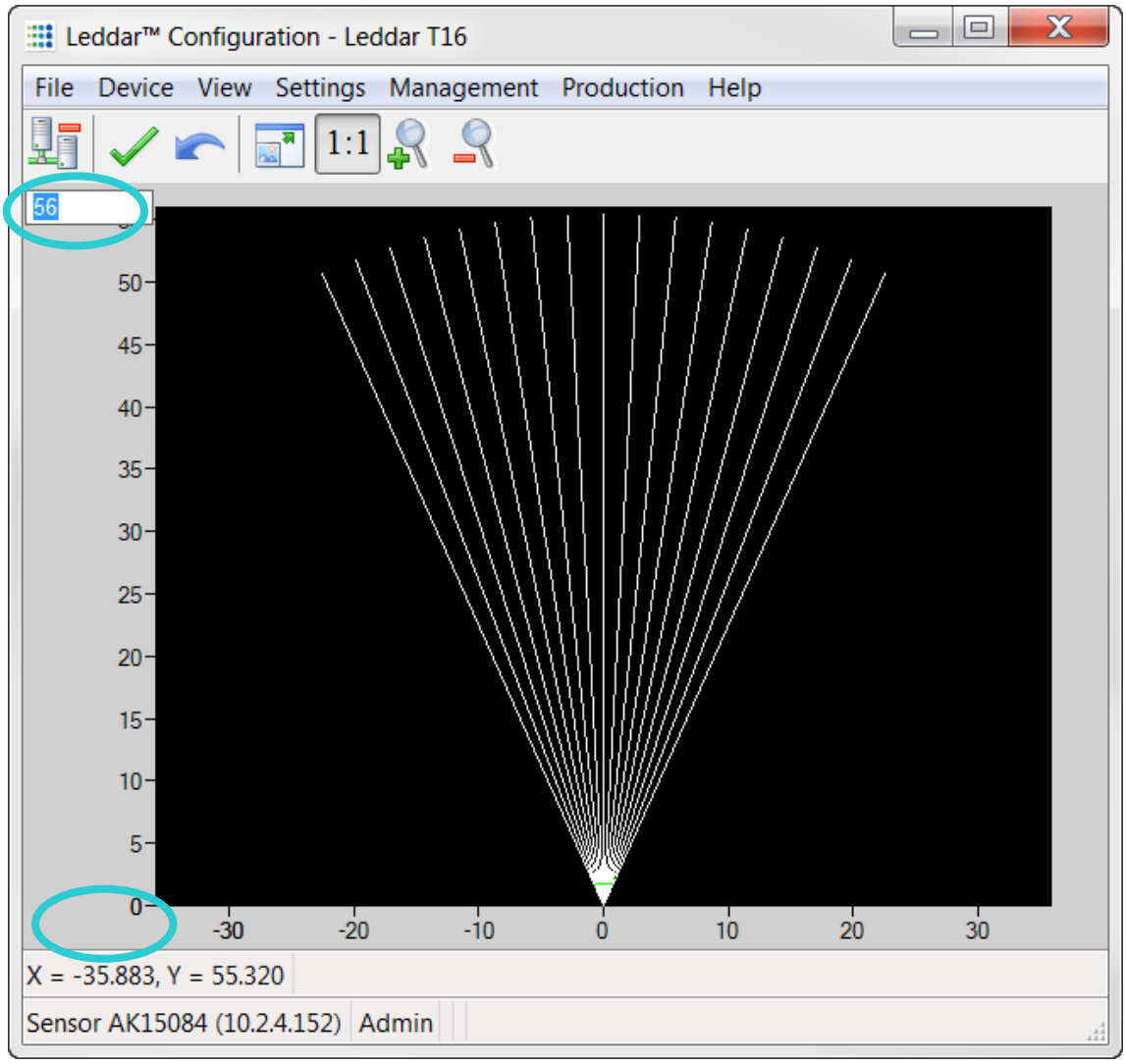


Figure 37: Vertical Scale Setting Areas (Tolling Configuration)

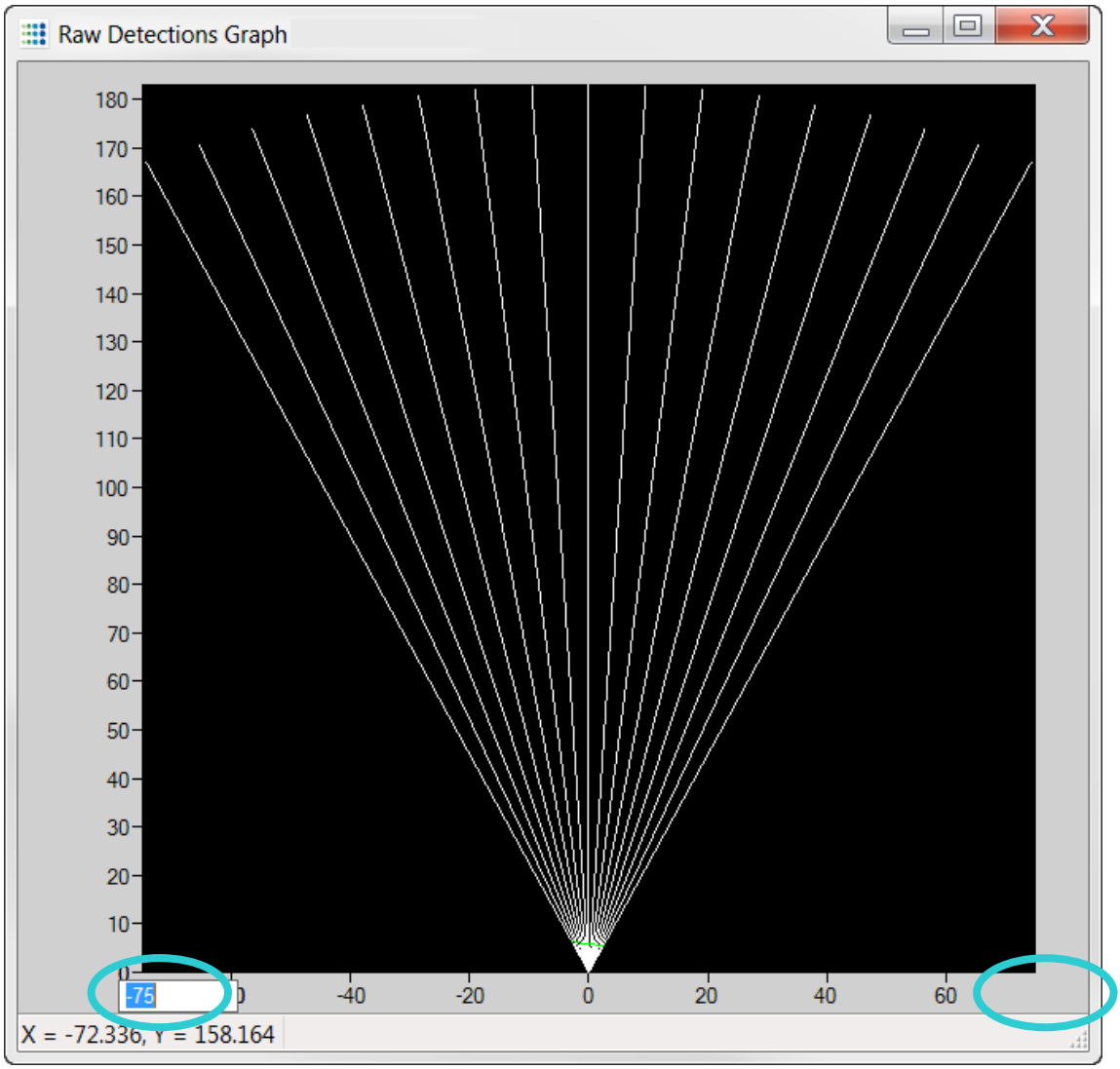


Figure 38: Horizontal Scale Setting Areas (Traffic Configuration)

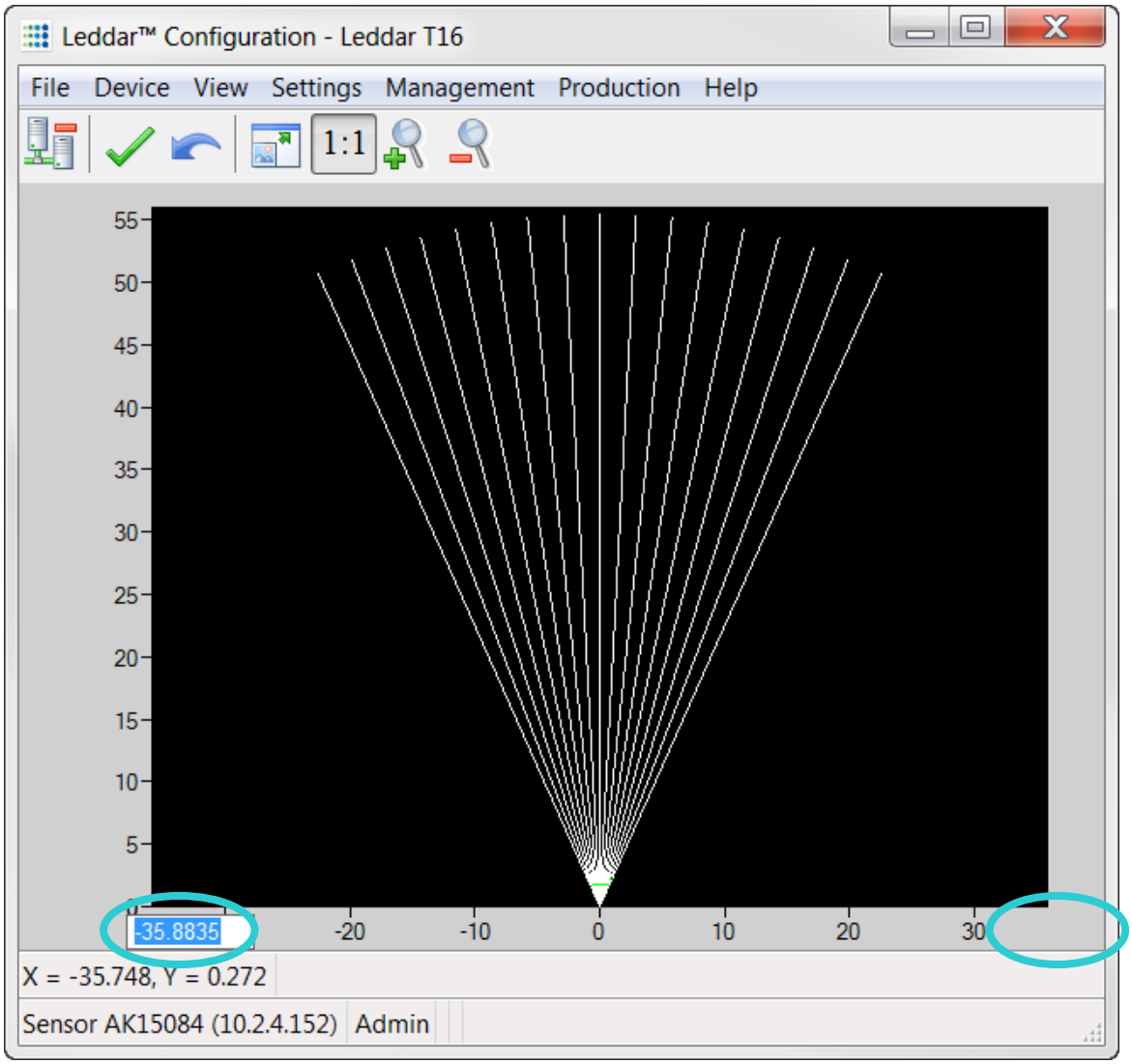


Figure 39: Horizontal Scale Setting Areas (Tolling Configuration)

You can hover the mouse on a segment to get the following information:

- Segment
- Distance (in meter)
- Amplitude

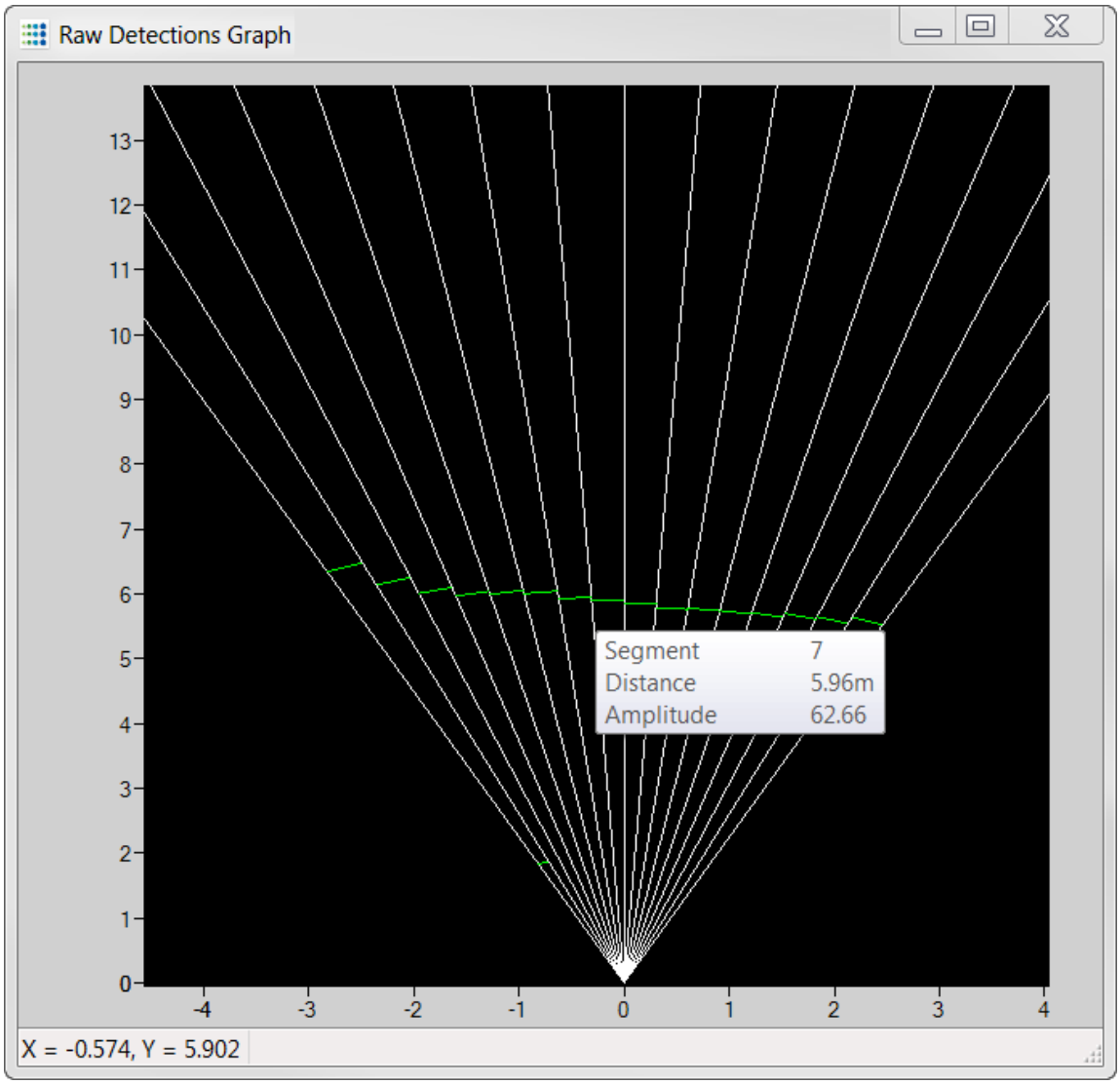


Figure 40: Detection Point Coordinates (Traffic Configuration)

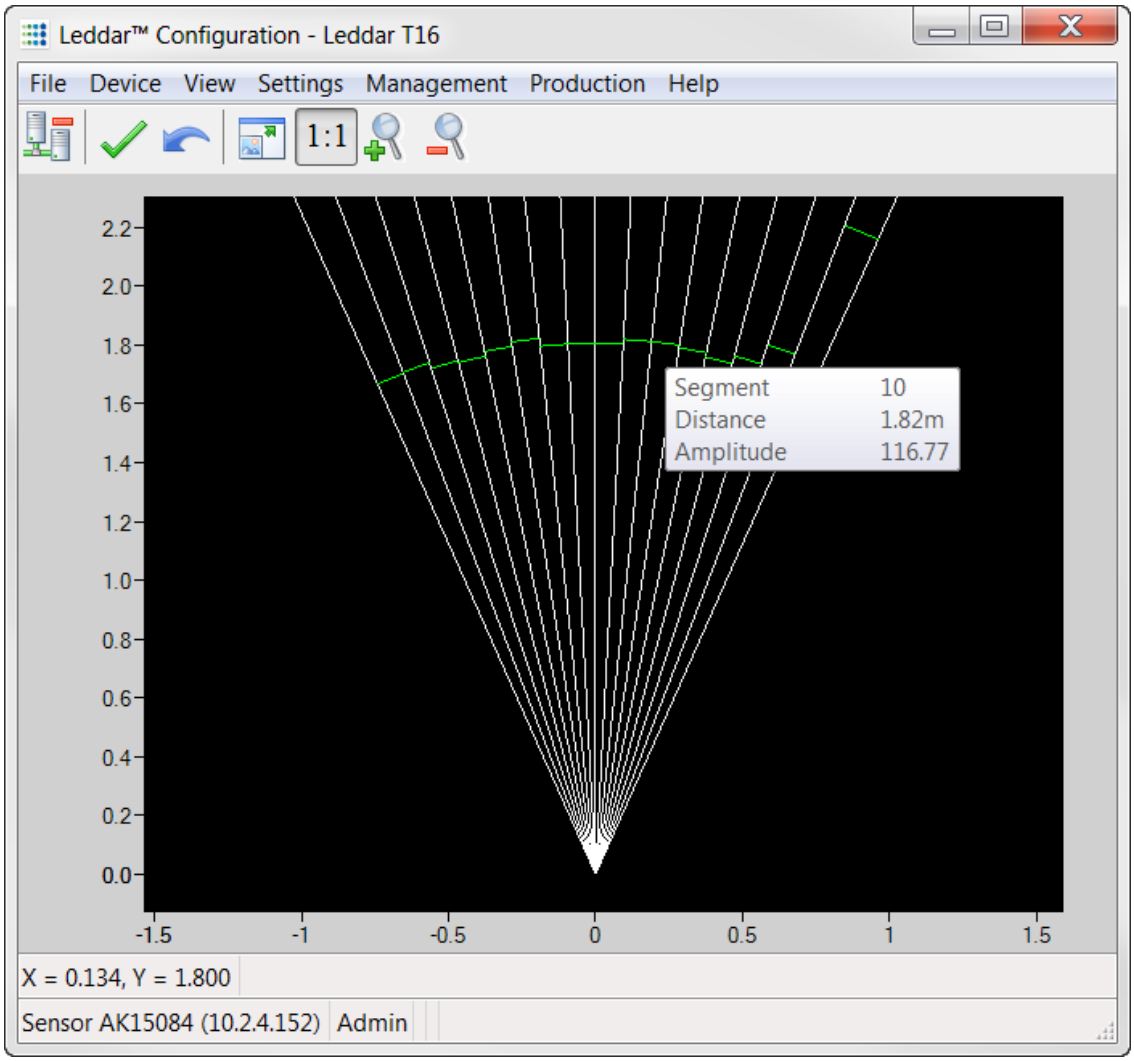


Figure 41: Detection Point Coordinates (Tolling Configuration)

7.4.5.2. Detection Scene Short Keys

Short keys allows you to pan or zoom the display of the detection scene.

Mouse wheel: to zoom in or zoom out vertically and horizontally (Traffic and Tolling configurations).

Mouse click: to move the detection scene vertically and horizontally (Traffic and Tolling configurations).

Shift + mouse wheel: to resize the detection scene horizontally (Traffic and Tolling configurations).

Ctrl + mouse wheel: to resize the detection scene/enlarge the segments (Traffic configuration only).

7.5. Settings Menu

The Settings menu includes the Record, Data Logger, Preferences and Access Levels.

7.5.1. Record Settings

To access this menu, click **Settings > Record**.

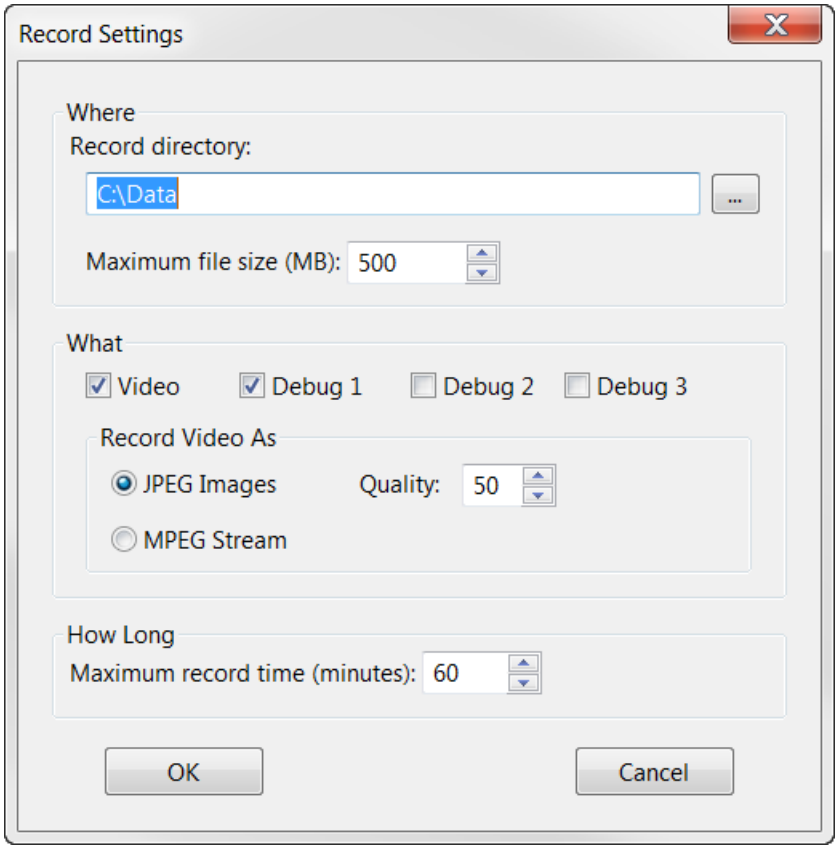


Figure 42: Recording Settings Window

Table 29: Recording Settings

Feature	Description
Record Directory	The record directory is the folder to which all record files will be saved. These files are in a proprietary format, with extension *.ltl, and can only be opened and viewed with the Leddar™ Configuration software.
Maximum File Size	Record files can be quite large. Set the maximum file size as needed. The recording stops for the current file once it reaches the

Feature	Description
	maximum file size and automatically switches the recording to another file. This is to keep record files of manageable sizes.
Video	This option is available with the Traffic configuration only. This feature is needed to record the live images with the data. When not selected, only the data will be recorded. Video activation and the debug mode set for recording can affect the detection performance in real time.
Debug	These check boxes are reserved for the use of LeddarTech technicians.
Record Video As	This option is available with the Traffic configuration only. Two types of video recordings can be used: JPEG Images records a series of JPEG images and MPEG Stream records an MPEG video format. The MPEG stream format is recommended when using a local area network (LAN) connection. The quality is as good as the JPEG images but generates a smaller file size. The JPEG image format is recommended when recording remotely through a wide area network (WAN) connection. Reducing the JPEG image quality can help reduce file size by compressing the JPEG images that are contained in the record. A level of 75% to 80% usually provides acceptable image quality and a reasonable file size.
Maximum Record Time	The value entered as the Maximum record time determines the length of the time for recording. At the end of that period, recording will stop even if the file size has not reached its maximum.

Refer to section **7.2.1.1 How to Edit Recording Settings** for more details.

7.5.2. Data Logger

To access this menu, click **Settings > Data Logger**.

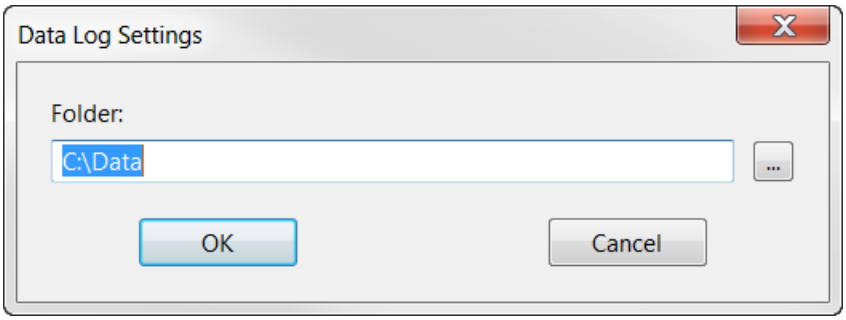


Figure 43: Data Logger Dialog Box

Refer to section **7.2.2.2 How to Setup Data Logging** for more details.

7.5.3. Preferences

To access this menu, click **Settings > Preferences**.

This menu allows the user to change various settings related to window display.

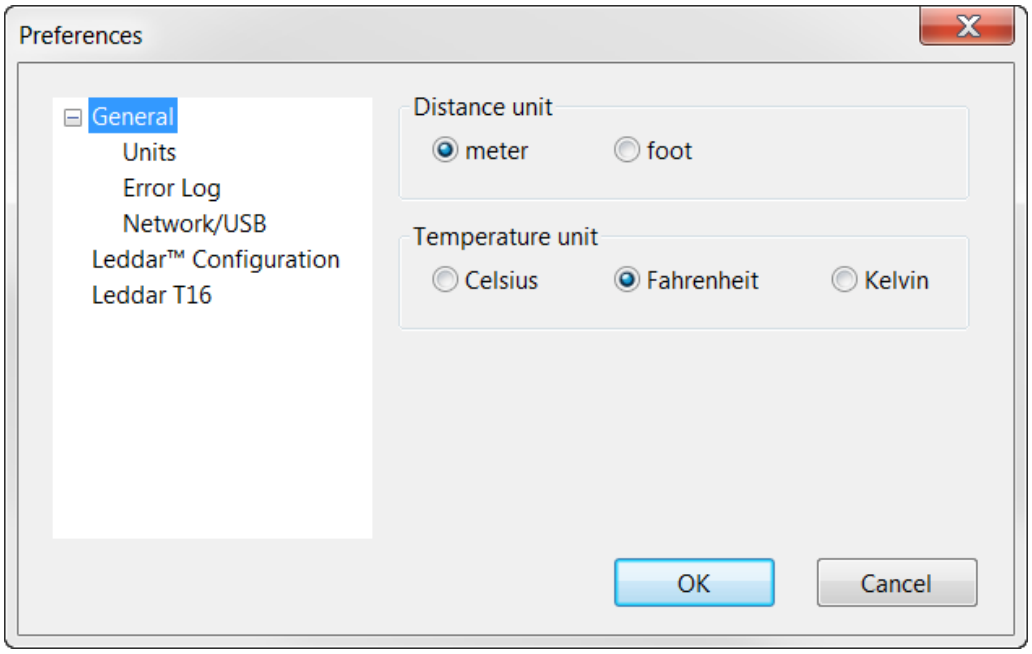


Figure 44: Preferences Options Window

With the Tolling option, *Leddar T16* does not appear in the General menu.

Table 30: Preferences Window Options and Settings

Option	Description	Range
Units	The units that are applied to distances displayed in the Leddar™ Configuration software.	Meter Foot
Temperature Unit	The units for displaying temperatures of sensors.	Celsius Fahrenheit Kelvin
Error Log	Select **Show error log** to display error messages that are logged during the current session. Error messages are displayed in the Error Log box.	Enable Disable
Network	Select the network timeout, in seconds, to decide how long you want to wait for an operation before your request for that operation is canceled (timed out) on a network.	2 to 30 seconds
Leddar™ Configuration	The main window size can be manually set, and the preferences selected before connecting to a sensor. When **Fixed aspect ratio** is selected, you can enlarge the Leddar™ Configuration main window while keeping the display height and width ratio. When both features are selected, you can resize the Leddar™ Configuration main window while keeping the display height and width ratio.	N/A
Leddar™ T16	This option is available with the Traffic configuration only. Select this option to change the color and opacity of the grid. When the **Fit image to window (no zoom)** feature is selected it resizes the image, so it fits the main window size. When cleared, it provides a zooming feature: Clear the check box, click the display, and then use the mouse wheel to zoom in and out.	Opacity: 0 to 255

7.5.4. Access Level

To access this menu, click **Settings > Access Level**.

You can also change license by double-clicking on User located at the bottom of the main window.

The Leddar™ Configuration software has two access levels: The User operation mode (by default at startup) for normal use and the Technician operation mode which is password protected for approved personnel use only.

In the **Enter Master Password** dialog box, type the password provided by LeddarTech.

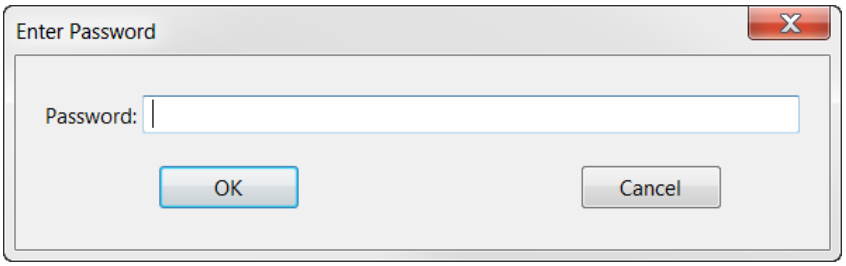


Figure 45: Enter Password Dialog Box

For more information on licenses, contact LeddarTech Support at support@leddartech.com.

7.6. Help Menu

The Help menu includes User Guide, Leddar™ SDK Help, and About options.

7.6.1. User Guide

To access this menu, click **Help > User Guide**.

The User Guide option allows the user to select and consult a PDF version of a user guide directly from Leddar™ Configuration.

Select a user guide in the list to open a PDF version of the selected user guide.

7.6.2. Leddar™ SDK Help

To access this menu, click **Help > Leddar™ SDK Help**.

The Leddar™ SDK is an interface to allow programmers to integrate sensors in their products.
C language interface available for Windows platforms.

For more information, open the SDK help.

7.6.3. About

To access this menu, click **Help > About**.

The **About** option allows the user to know which software version is currently used and the software part number. These can be used when contacting LeddarTech support.

8. Communication Protocol

The Leddar T16 Sensor uses LeddarTech's proprietary communication protocol (TCP/IP socket-based protocol called Ipv4).

Refer to the *Communication Protocol User Guide* provided by LeddarTech for more information about the communication protocol of the sensor.

9. Troubleshooting

Problem	Action to Take
No power	Verify that your sensor is connected. Verify that your sensor is connected to an appropriated PoE+ port.
The optical window is damaged	Contact LeddarTech Support.
The Ethernet connection is not available	Verify that your computer is configured with a static IP address. Verify that the cable is well secured in the Ethernet port. If the cabling connection seems secure, verify that the Ethernet link between the control computer and the sensor is valid using the ping command.
The sensor is not detected in Leddar™ Configuration	Verify that the power supply of the sensor. Verify that the sensor is detected by your network board. Use the appropriate Ethernet connection mode and addressing in function of your network architecture.
The sensor is not detected by your network board	Verify if the LEDs of your Ethernet port are blinking.
The LEDs Ethernet port is not blinking	Verify the setting of your Network board. The IP setting shall be set as in Appendix A. Verify if the Ethernet cable is well connected.

In the case of failure of the Leddar T16, please contact LeddarTech Support at support@leddartech.com.

10. Maintenance

Following this maintenance guideline will ensure optimal performance of the product.

Manipulation	Avoid touching the optical surface as fingerprints can permanently damage optical coatings.
Cleaning of the optics	1. Remove dust using blow dry compressed air. 2. Clean using lens tissue or isopropanol.

To safely perform maintenance operations of the Leddar T16 Sensor, please contact LeddarTech Support at support@leddartech.com.

11. Warranty

PLEASE READ CAREFULLY
V2.0 2018-06-01

LeddarTech® Limited Warranty

1. Application. This limited warranty (this "Warranty") from LeddarTech Inc. ("LeddarTech") applies to all LeddarTech products referenced on the LeddarTech website at leddaretch.com (each, a "Product"). This Warranty does not apply to any prototype units of the Product.

2. Limited Product Warranty. Subject to the terms and conditions of this Warranty, LeddarTech warrants to any purchaser of a Product ("Customer") that the Product will be free from defects in material and workmanship, when used in accordance with the specifications sheet and User Guide provided by LeddarTech for such Product. LeddarTech shall not be liable under this Warranty if the alleged problem in the Product was caused by misuse, negligence, improper installation or testing of the Product, unauthorized attempts to disassemble the Product for repair or any other reason, or by accident, fire, or other hazard or the combination of the Product with any third party product (a "Combination Product"). No representative of LeddarTech or its authorized resellers are authorized to make any change or modification to this Warranty or express any other warranties with respect to the Products.

3. Warranty Period. The Warranty is valid for a period of 12 months (the "Warranty Period") from the shipment date to customer of any Product sold by LeddarTech and/or its authorized resellers.

4. Warranty Procedures. Any claim under this Warranty must be submitted in writing by Customer to LeddarTech promptly after discovery of occurrence of a suspected defect in materials or workmanship, and in any case prior to the expiry of the Warranty Period, describing with reasonable specificity such defect. Timely notification will permit Customer to obtain a Return Authorization Number (RMA) from LeddarTech's Customer Service Department which will indicate return procedures and terms and conditions of such returns. A proof of purchase of the Product, such as an invoice or a receipt certifying the validity of the Warranty, must be presented in order to obtain Warranty coverage.

The Product or part shall be returned to LeddarTech, accompanied by the Return Authorization Number with prepaid shipping charges. Customer must insure the shipment or accept the risk of loss or damage during the shipment. Customer shall also pay any tariff or duty applicable to the return of the defective part or Product.

LeddarTech shall be entitled to require delivery by Customer of whatever proof it requests to evaluate the validity of the claim. Customer agrees that any claim under this Warranty will be subject to LeddarTech's determination of validity and if LeddarTech determines the claim is valid, any such claim is expressly limited, at the option of LeddarTech, to either: (i) reimbursing the purchase price of the Product found to be defective, (ii) repairing at no cost any defective Product or parts thereof, or (ii) replacing the defective Product. This Warranty is the sole remedy of Customer for any defect in the Product. LeddarTech will be responsible for returning any repaired or replacement Product to Customer.

If after evaluation by LeddarTech the defect is not covered by this Warranty, LeddarTech may provide a quote to Customer for the cost of repair of the Product. Any such Product or part shall be shipped back to Customer at Customer's cost.

The original Warranty Period shall not be extended by any replacement, but the remaining Warranty Period shall continue in effect and be applicable under the terms and conditions of this Warranty to the replaced Product.

5. Disclaimer. THE WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, LIABILITIES OR OBLIGATIONS OF LEDDARTECH, EXPRESSED AND IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT AND ANY IMPLIED WARRANTIES ARISING FROM COURSE OF DEALING, USAGE OF TRADE, OR COURSE OF PERFORMANCE.

6. Limitation of Liability. LEDDARTECH, ITS PARENT COMPANIES, SUBSIDIARIES AND AFFILIATES, THEIR OFFICERS, DIRECTORS, EMPLOYEES AND AGENTS, SUCCESSORS AND ASSIGNS ("LEDDARTECH PARTIES") SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, EXEMPLARY, PUNITIVE OR CONSEQUENTIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOSS OF PROFITS, LOSS OF USE, DOWNTIME, LOSS OF DATA, FAILURE TO DETECT ANY FLAW IN ANY SUBJECT MATTER OF ANY TEST, LOSS OF GOODWILL, DELAY IN PERFORMANCE, BUSINESS INTERRUPTION, PRODUCT LIABILITY OR ANY CAUSE OF ACTION IN CONNECTION WITH THE USE OR HANDLING OF THE PRODUCTS BY CUSTOMER OR ANY PERSON AUTHORIZED BY CUSTOMER. Some jurisdictions do not allow exclusion or limitation of consequential or incidental or special damages, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights, all of which vary from jurisdiction to jurisdiction.

7. Indemnification. Customer shall defend, indemnify and hold harmless the LeddarTech Parties ("Indemnified parties") from any third party claims, demands, lawsuits, damages, liabilities, including attorney's fees and court costs, judgments and settlements of every kind ("Claims") arising out of, connected with, or resulting from any acts, duties, obligations or omissions of Customer or that may be made for injuries (including death) to persons or damage to property, including theft, and resulting in whole or in part in connection with the use, installation, removal, replacement, manipulation and/or repair of the Products and any Combination Product.

8. Software. All software embodied in or used in connection with the Products is provided to Customer subject to the terms and conditions of the End-User License Agreement to which Customer must agree to be bound as part of the installation of the said software. Warranties, if any, for the software are contained in such separate End-User License Agreement.

9. Entire Agreement. This document contains the entire agreement of the parties regarding the subject matter of the Warranty and supersedes all previous communications, representations, understandings and agreements, either oral or written, between Customer and LeddarTech.

10. Governing Law: This Warranty shall be governed by and is to be interpreted in accordance with the laws of Quebec and the laws of Canada applicable therein without reference to its conflict of law provisions and excluding the United Nations Convention on Contracts for the International Sale of Goods. The parties agree that the Courts having jurisdiction in the judicial district of Quebec (Province of Québec) shall have exclusive jurisdiction to hear any litigation resulting from the interpretation, application or execution of this Warranty.

LeddarTech's Customer Service Department can be reached during regular business hours (Monday to Friday, 8:30 a.m. to 4:30 p.m. Eastern Time) by calling (418) 653-9000 or 1 855 865-9900. Visit www.leddartech.com

12. Technical Support

For technical inquiries, please contact LeddarTech technical support by registering online at https://support.leddartech.com to:

- Follow up on your requests
- Find quick answers to questions
- Get valuable updates

Or by contacting us at:

- + 1 418 653 9000
- + 1 855 865 9900
- support@leddartech.com

8:30 a.m. - 5:00 p.m. Eastern Standard Time

To facilitate the support, please have in hand all relevant information such as part numbers, serial numbers, pictures (if possible).

LeddarTech Inc.
4535, boul. Wilfrid-Hamel, #240
Quebec QC G1P 2J7
Canada

www.leddartech.com

13. Index

N

O

P

R

S

T

U

V

W

Appendix A. Static IP and DHCP Configuration Under Windows 7 and Up

Part A – Configuring the network for static IP mode.

You will lose internet connection if you are not connected via other means.

1. In **Control Panel > Network and Internet > Network and Sharing Center**, select **Change adapter settings**.

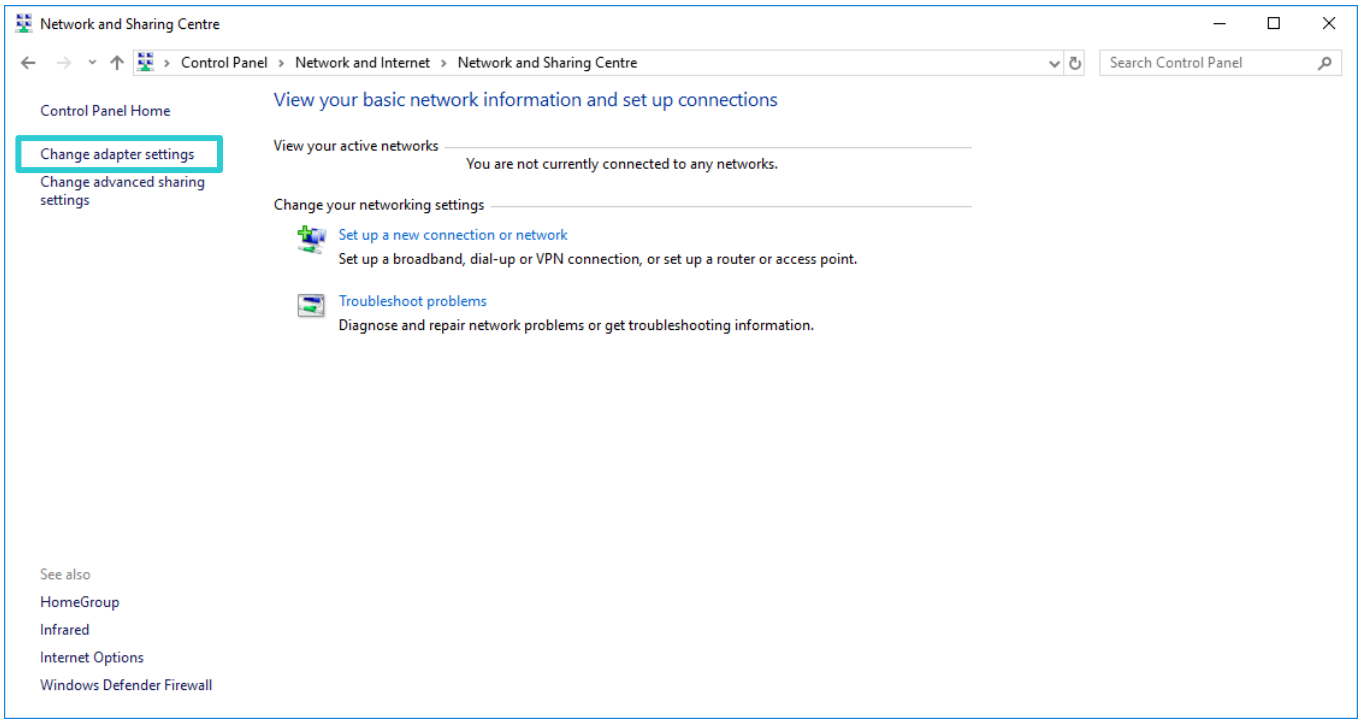


Figure 46: Change Adapter Settings

2. In the **Network Connections** window. Double-click on **Ethernet**.

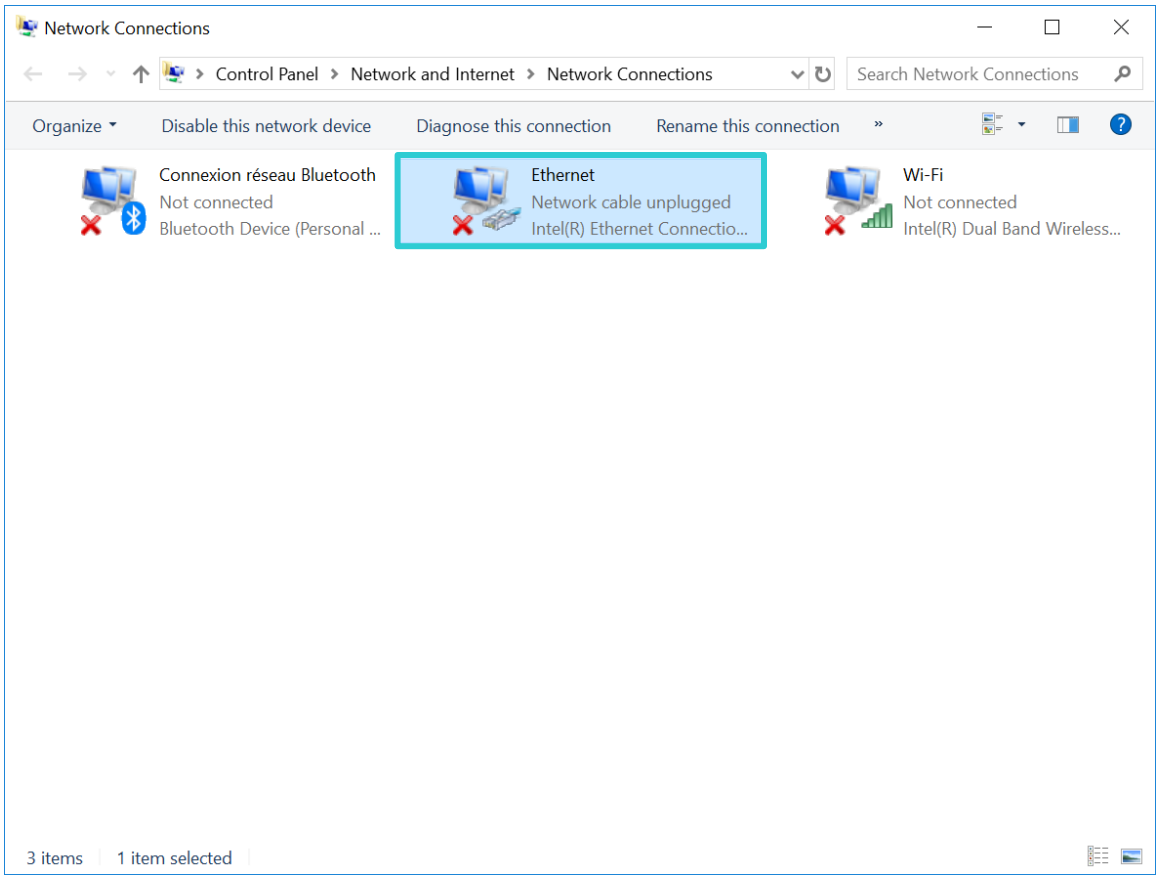


Figure 47: Ethernet Network Option

3. In the **Ethernet Properties** window, select **Internet Protocol Version 4 (TCP/IPv4)**, then click on **Properties**.

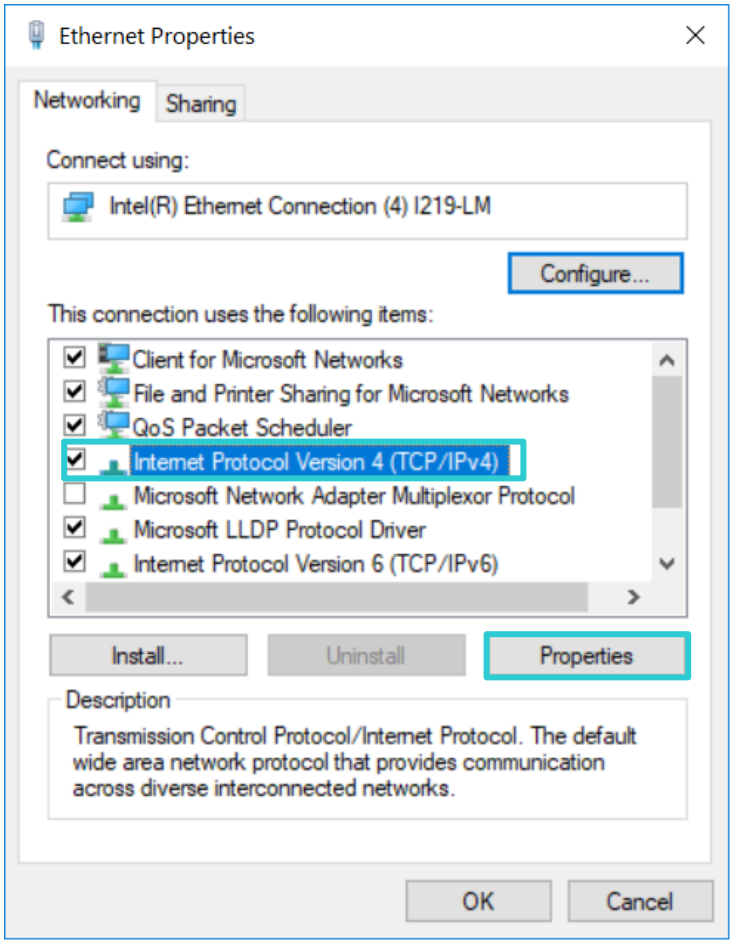


Figure 48: Ethernet Properties

4. Select **Use the following IP address** and insert an IP address different than the sensor, for example: 192.168.000.100 in the IP address field.

5. Insert the same subnet mask as the sensor (**255.255.255.0** by default) in Subnet Mask field.

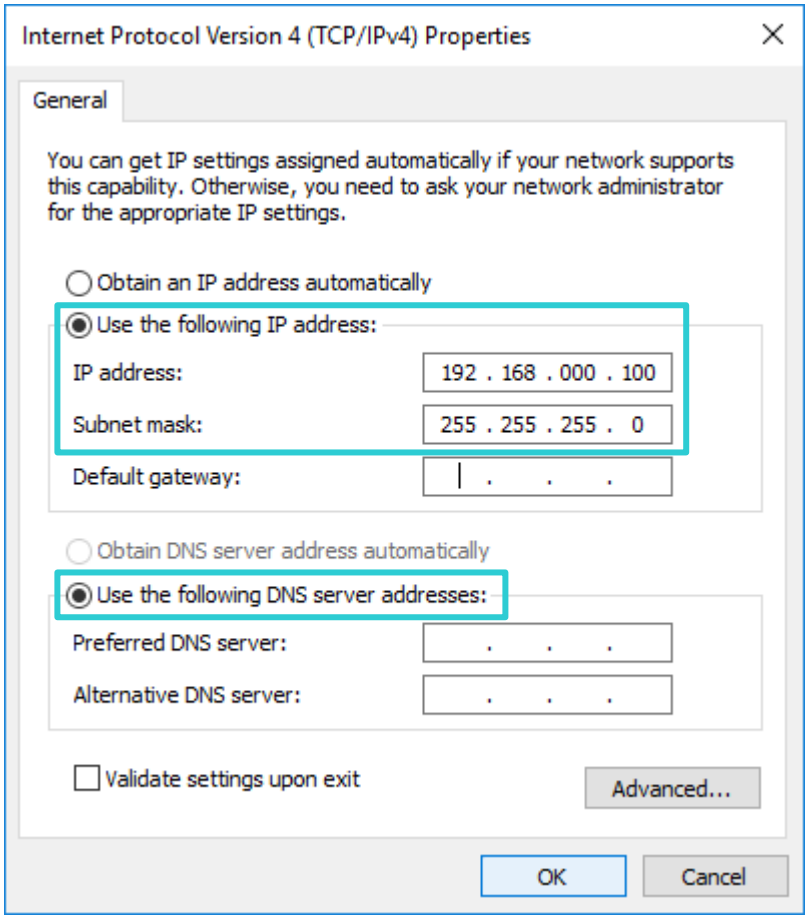


Figure 49: IP Address and Subnet Mask

Refer to section **6 Installing Leddar™ Configuration** once the configuration is done.

Part B – Configuring the network for DHCP mode

1. Connect the Ethernet cable (POE+ connection) into the Ethernet port of the sensor and the other end of the Ethernet cable to your computer or switch. See Figure 50.

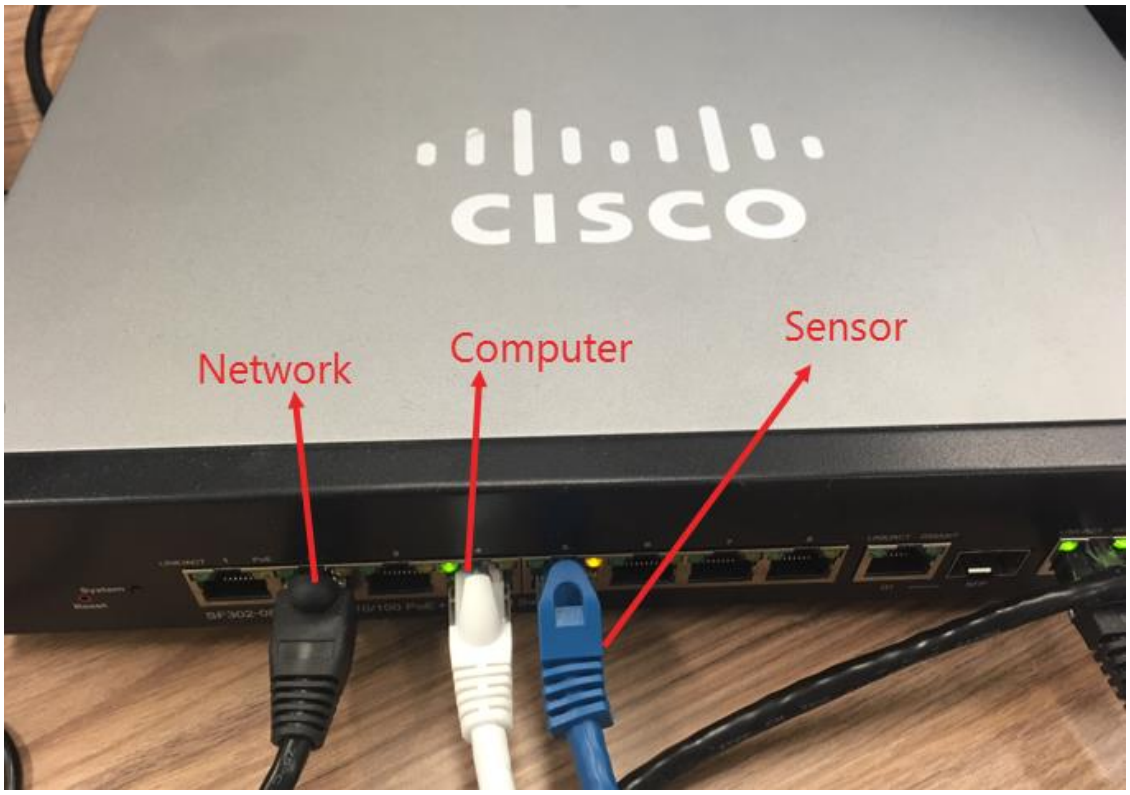


Figure 50: Sensor Connection to POE+ Switch

2. In the network connections, make sure that the TCP/IPV4 is set to automatic.

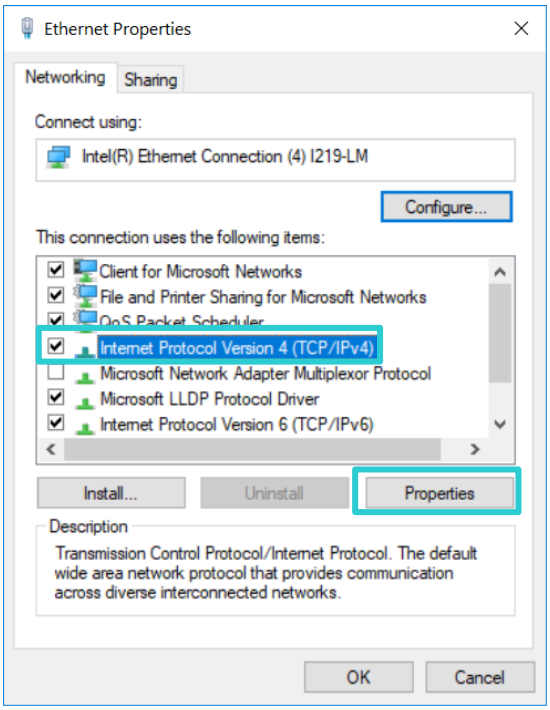


Figure 51: Ethernet Properties

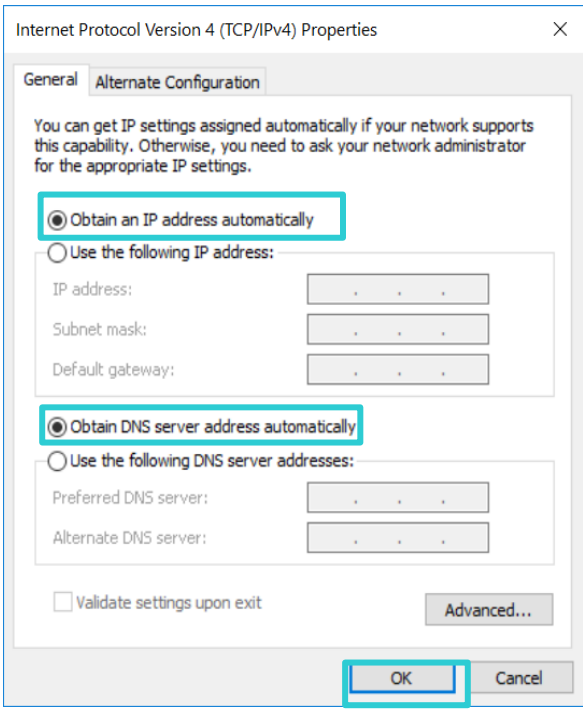


Figure 52: IP Address and Subnet Mask

Refer to section **6 Installing Leddar™ Configuration** once the configuration is done.

Appendix B. Making Connectors for the Ethernet Cable

A Cat 5e RJ45 Ethernet cable must link the sensor to a network or a computer. You must install a connector at both ends of the Ethernet cable. To do so, use the supplied RJ45 connector kits. See Figure 53 and Figure 61.

Figure 53: RJ45 Industrial Modular Connector Kit for the Sensor Side of the Ethernet Cable

Required tools and materials

Tools	Material
1. RJ45 crimp tool 2. 18 mm, open-end wrench 3. Cutter	If customer supplied: shielded Cat 5e cable (Belden 7929A recommended)

To make the Ethernet cable connectors:

1. Strip the cable jacket to approximately 1 in. (25 mm) and feed the cable through the plug housing (IP67 industrial modular connector).

LeddarTech is not responsible of water infiltration if the IP67 industrial modular connector is not used.

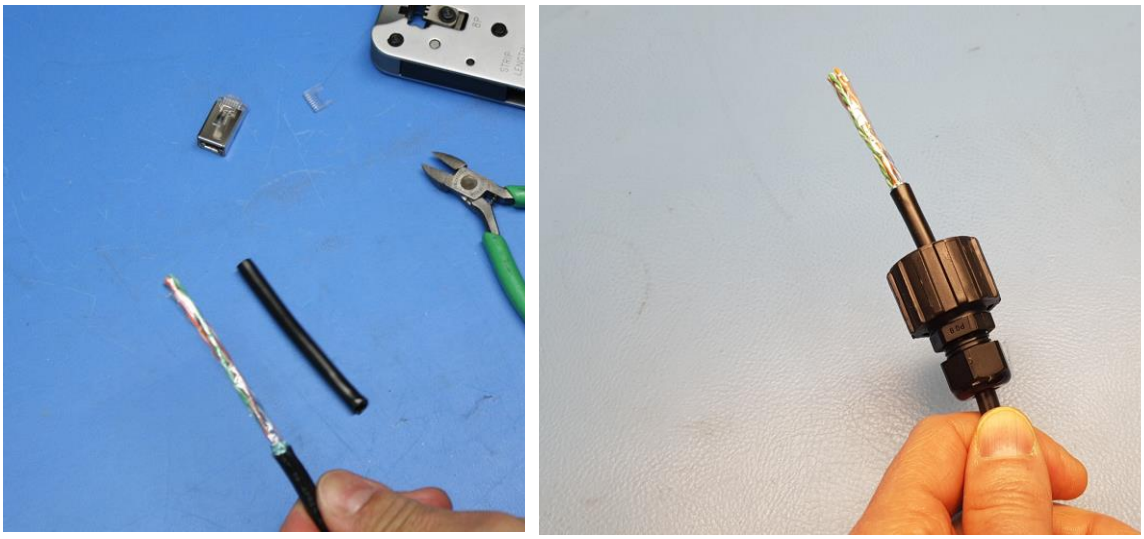


Figure 54: Ethernet Cable with the Jacket Stripped and Plug Housing

2. Untwist wire pairs and separate them.

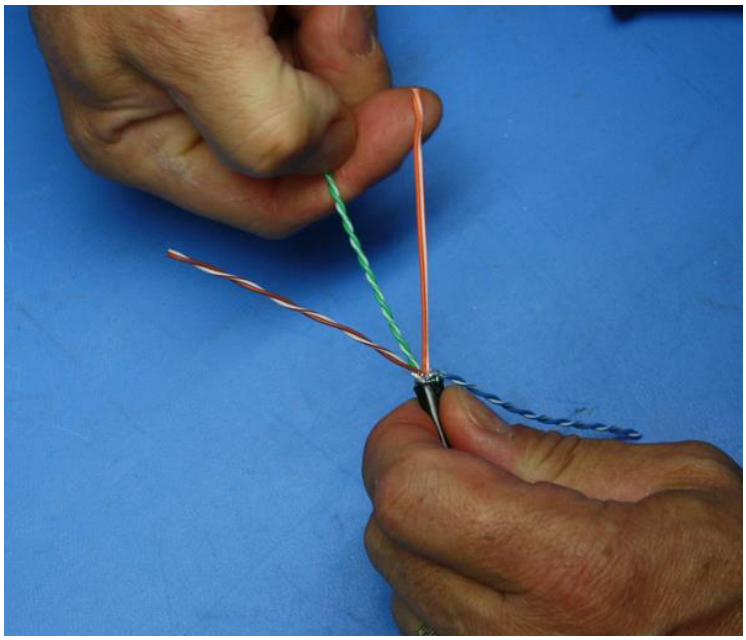
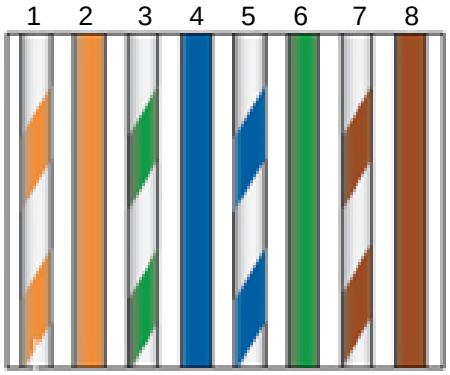


Figure 55: Twisted Pairs

3. Align the wires according to the T568B standard (see Figure 56).

Do not remove the insulation of individual wires.

1: White-orange
2: Orange
3: White-green
4: Blue
5: White-blue
6: Green
7: White-brown
8: Brown



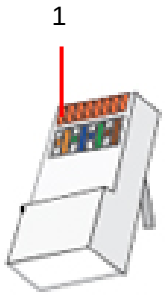


Figure 56: Cat 5e T568B Wiring Diagram

4. Cut the wires and insert them in the load bar.

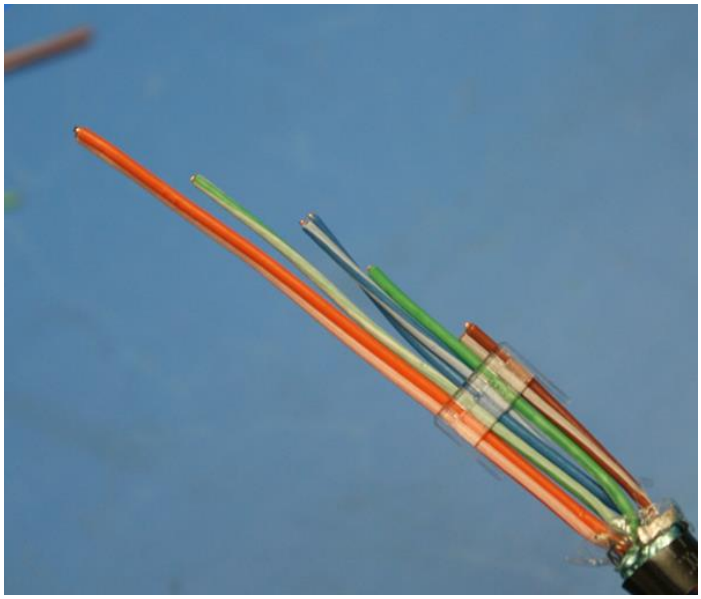


Figure 57: Wires in the Load Bar

5. Slide the load bar until it sits against the cable jacket and cut the wires to approximately 1/4 in. (5 mm).

6. Trim the remaining wire tips and retract the cable to leave about 1/32 in. (1 mm) of wire.

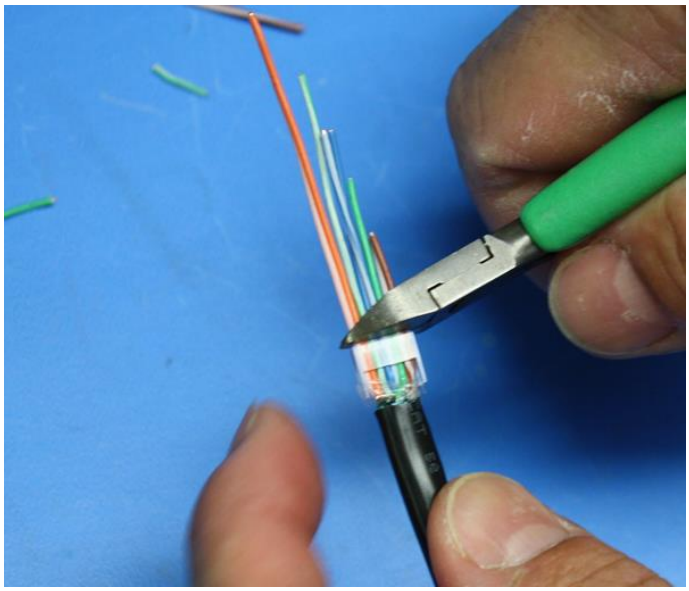


Figure 58: Trimming the Wires

7. Insert the load bar inside the RJ45 plug all the way until the wire tips are seated against the inside wall of the plug housing.

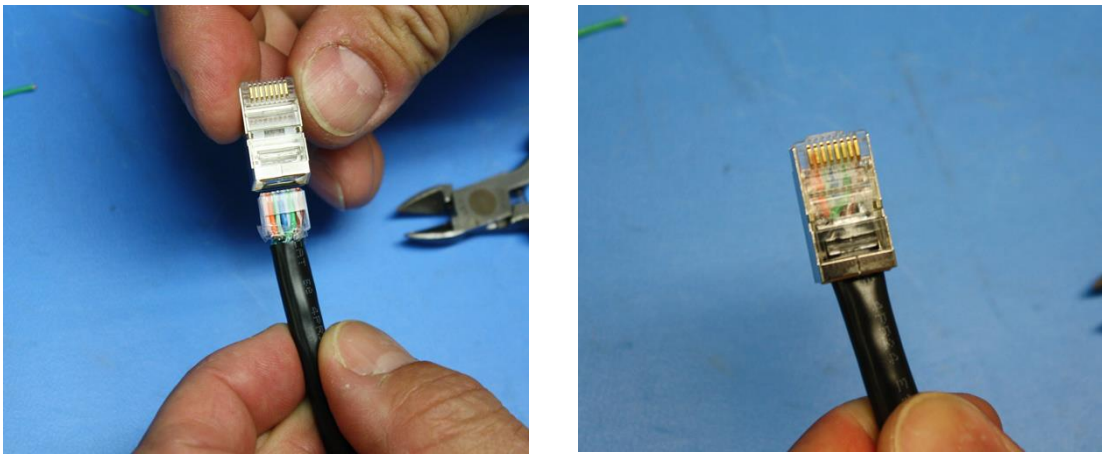


Figure 59: Inserting the Load Bar and Wires in the RJ45 Plug

8. Crimp the connector with the crimp tool.

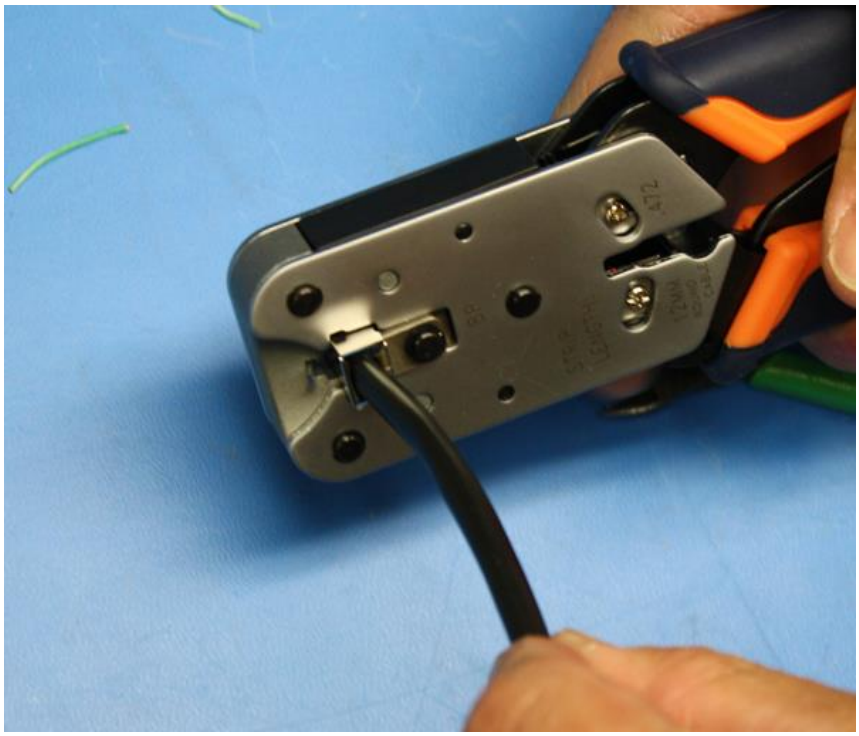


Figure 60: Crimping the RJ45 Plug

9. Depress the connector tab and pull the cable until the connector is fully seated inside the plug housing.

10. Hold the plug in position and rotate the cable fitting clockwise until tightened to a torque of 20 lbs-in. (2 Nm).

11. Install the sensor as described in Section **5 Installing the Leddar T16 Sensor**.

12. Connect the Ethernet cable to the sensor as follows:

    a) Align the tab of the RJ45 connector with the upper slot of the RJ45 jack on the sensor.
    b) Align the three pins of the plug housing ring with the three notches of the receptacle on the sensor.
    c) Press and rotate the plug housing until the pins “click” into the notches.

13. Using another RJ45 connector and the strain relief for the computer or network side make the cable connector as explained in steps 1 through 8.

In step one, instead of using the plug housing, use the yellow strain relief (see Figure 61).

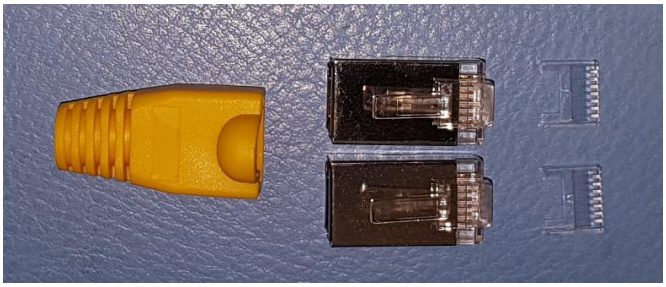
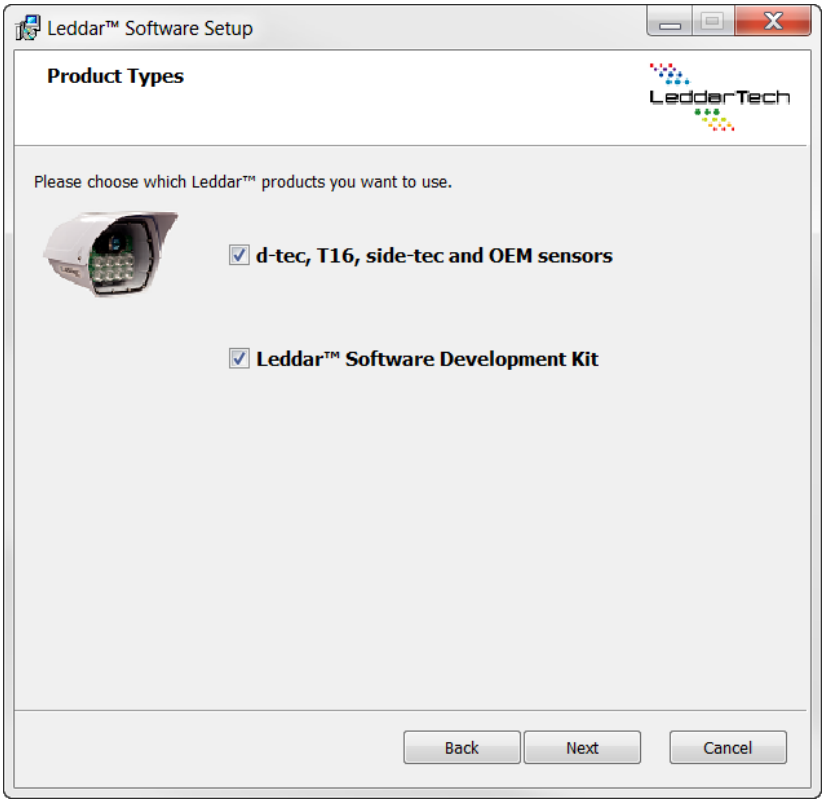


Figure 61: RJ45 Strain Relief Connector Kit for the Other End of the Ethernet Cable

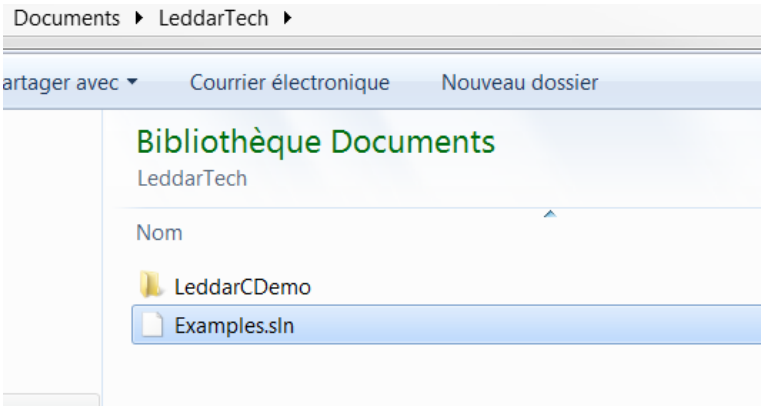
14. Repeat steps 1 through 13 for other sensors.

Appendix C. Procedure to Use LeddarCDemo (SDK Code Example) with the Leddar T16 Sensor

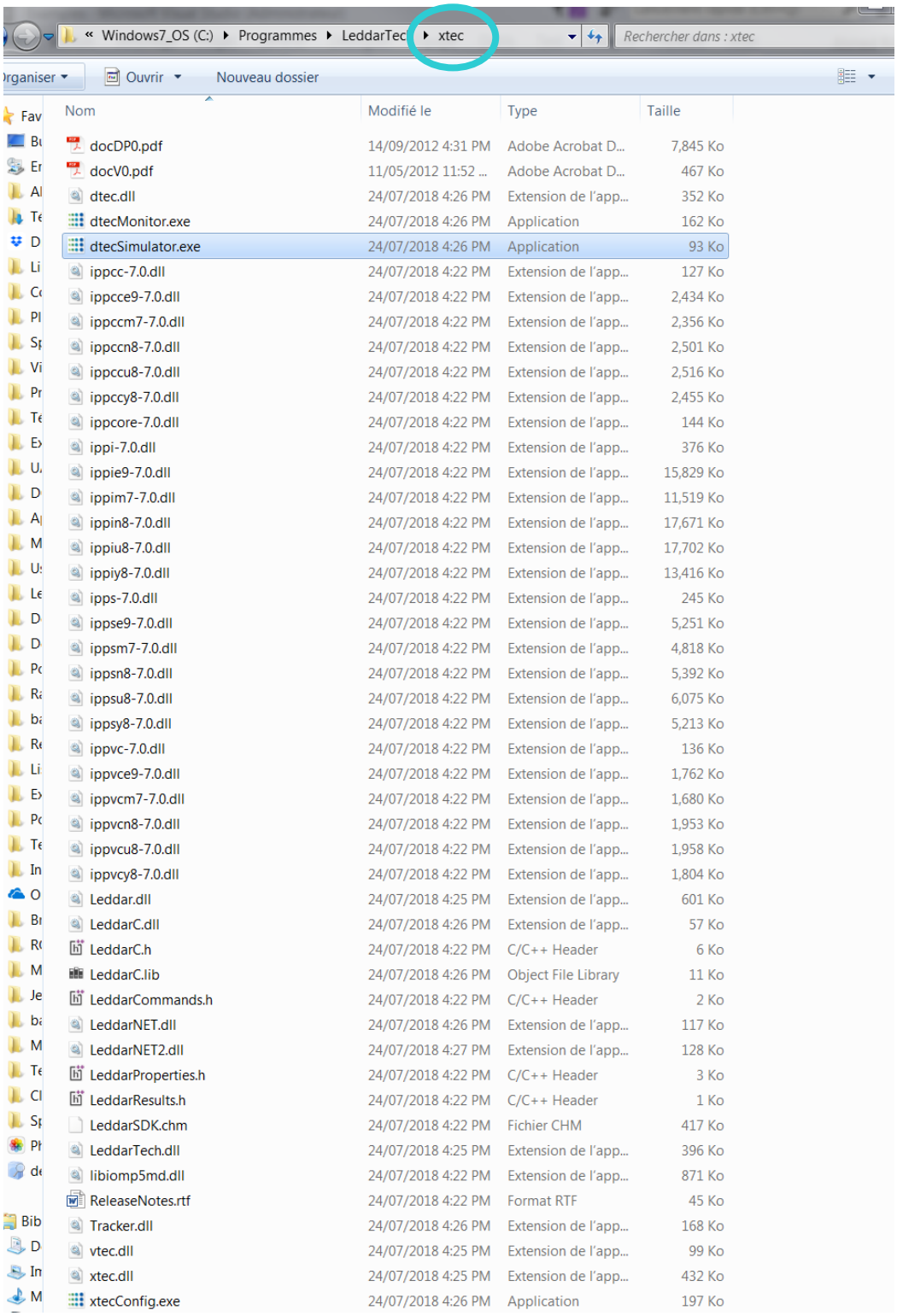
1. When installing the Leddar™ Configuration software, you must select both products below.



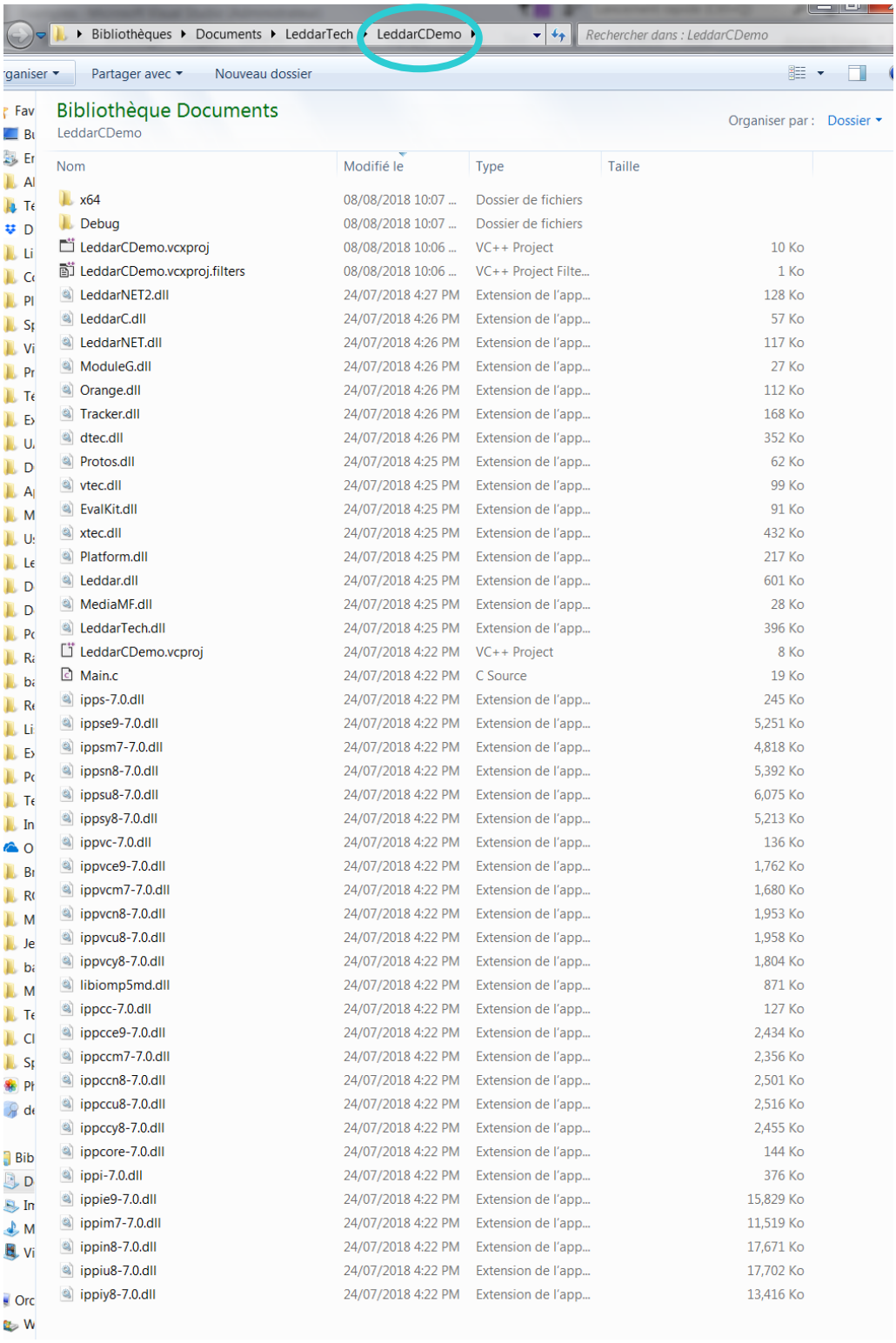
2. You should have the code **Examples** in your Documents folder in your computer C:\....Documents\LeddarTech as you can see below.



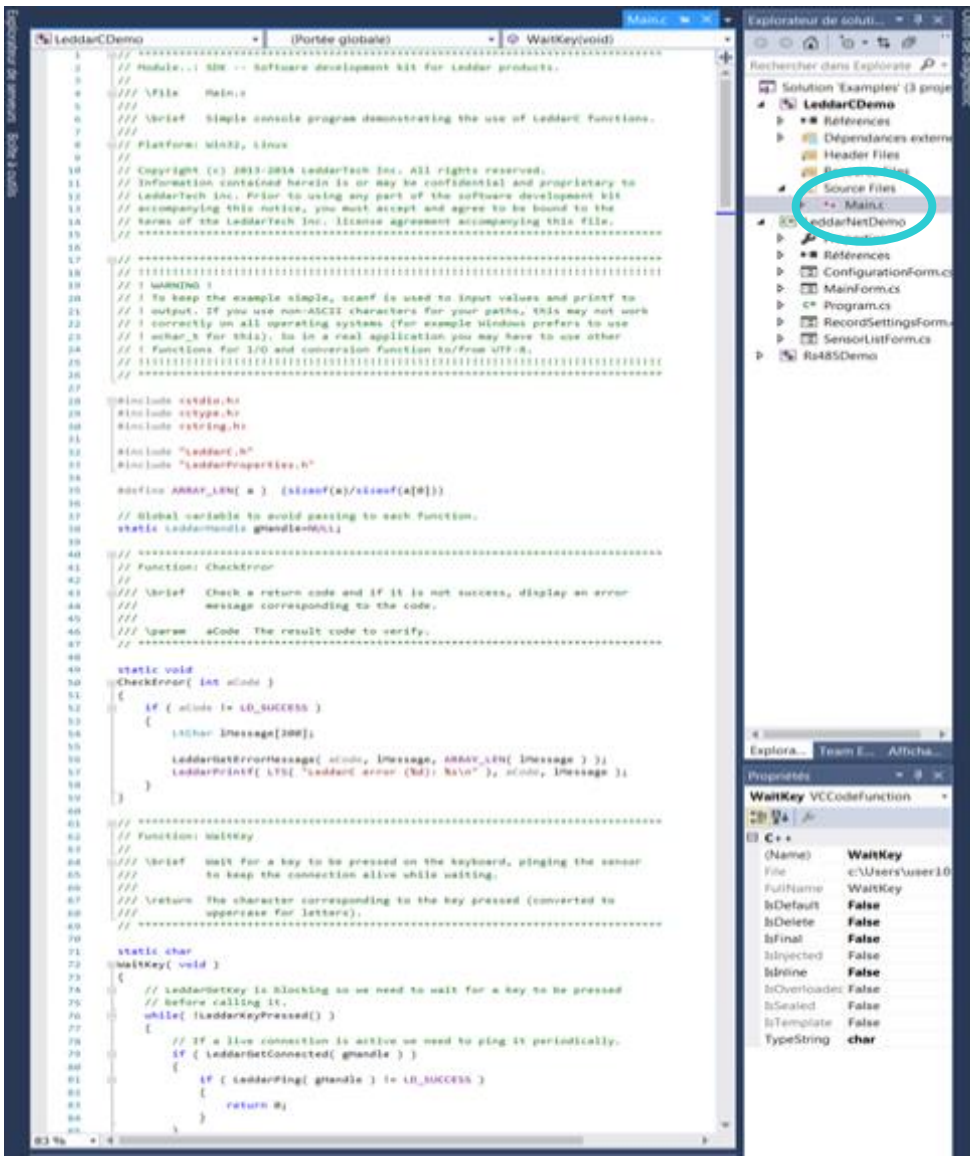
3. Copy paste all the DLL files from the C:\Program Files\LeddarTech\xtec to LeddaCDemo folder. Copy all the DLL files from here:



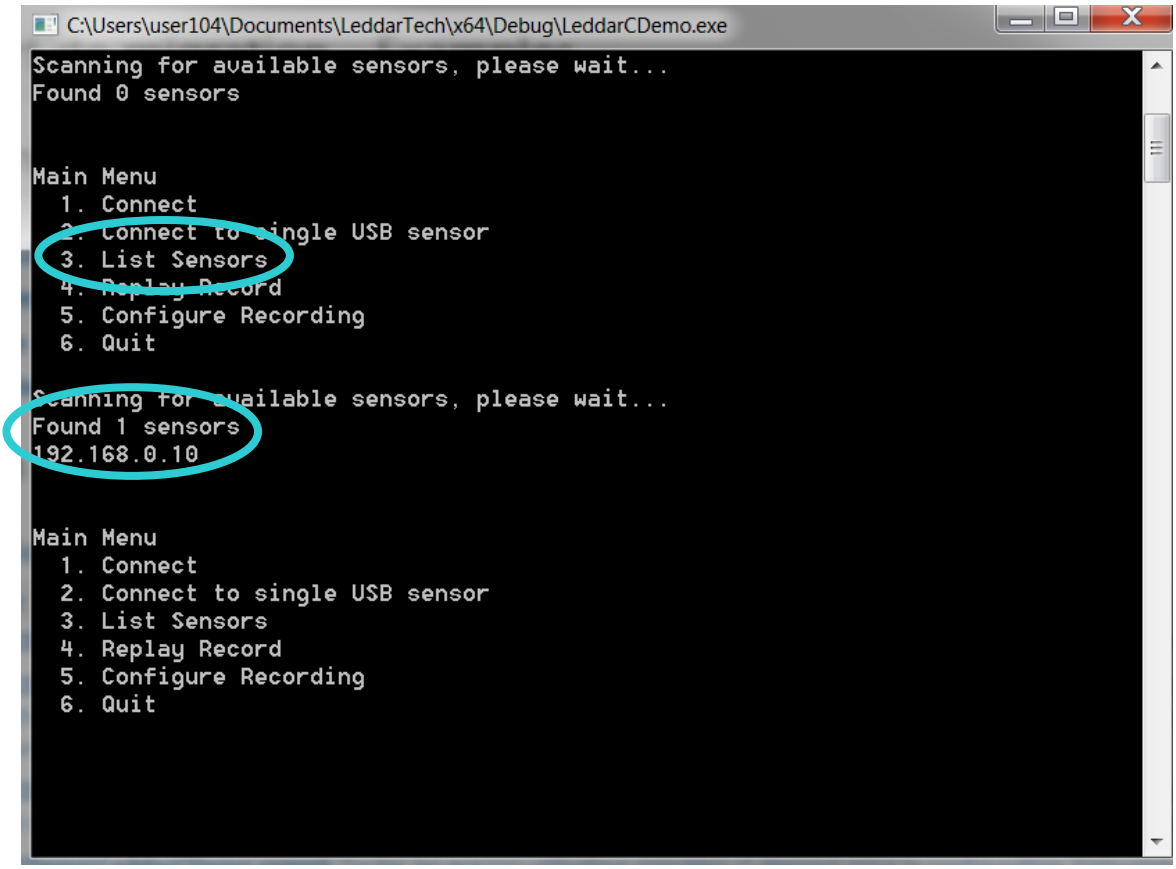
4. Paste the DLL files to the LeddarCDemo folder here:



5. Open the LeddarCDemo.vcxproj with Visual Studio and compile the Main.c

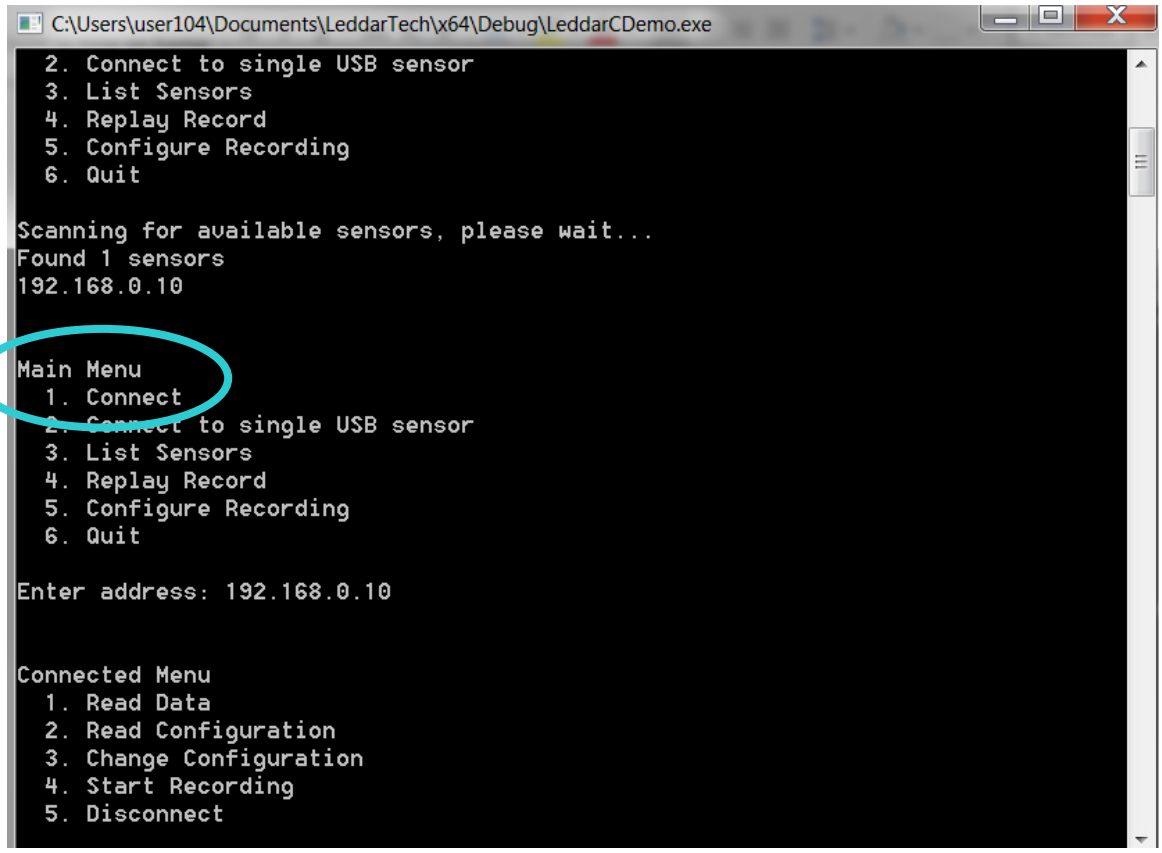


6. The DOS window below appears:



Click **3. List Sensors** to find the sensor with the address 192.168.0.10.

Click option **1. Connect**, then option **1. Read Data**.



Note: The code example below reads only 8 segments.

```
C:\Users\user104\Documents\LeddarTech\x64\Debug\LeddarCDemo.exe
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.19  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18  5.24  5.34  5.45  5.59  5.77  5.97  6.23
4.68  4.72  4.73  5.18
```

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