Fiber SenSys
AN OPTEX GROUP COMPANY

Laser Defender™ Interior and Exterior Protection

Application Note

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Summary

The versatility of the Fiber SenSys intrusion detection technology allows for a wide array of implementation options. Laser Defender™ is a quality solution for interior and exterior applications using LiDAR technology. With a two-dimensional plane of coverage, Laser Defenders provide security by creating a virtual wall or ceiling of protection. The purpose of this application note is to define how to successfully plan, install, calibrate, and maintain Laser Defenders for the use of interior and exterior protection. The two products discussed in this note include the LD308SH™ (30m detection radius 180°-190°) and the LD204S™ (20m x 20m at 95° coverage).

Introduction

The successful installation and operation of Laser Defenders is achieved by a thorough understanding of the security needs of the site. Exercising careful planning before an installation greatly increases durability and reliability throughout the life of the system. Advanced planning should be followed for proper installation to ensure the sensors operate to their full potential. As with any security system, periodic maintenance is necessary for long-lasting performance.

Fiber SenSys® recommends the following procedure for the installation of Laser Defender security sensors:

- **Planning:** Survey the site to be protected, observe all accessible areas of intrusions, laser orientation (vertical and horizontal), wall, ceiling, rooftop, or pole mount, and record all information needed for the site design phase.
- **Design:** Create a strategy for protecting the site. Choose the best-fit detector, its location, number of zones, and masking of unwanted areas from detection should it be necessary.
- **Installation:** Proper installation and alignment of the Laser Defender.
- **Configuration**: Settings for Target Size, Location, Area Masking, and Zone Allocating.
- **Performance Testing:** Conduct a series of simulated intrusions per site criteria while maintaining a low nuisance and false alarm rate (NAR/FAR). Simulated intrusions may include:
    - Crawling
    - Jumping
    - Walking
    - Running
    - Rolling

Planning

The first step to a successful installation is performing a detailed site survey. The site survey includes identifying the level of security, threat assessments, area drawings, site walk-through, wire connections, and available mounting options. Analysis of the data obtained through this process aids in the proper planning of zone layout and equipment selection.

Level of Security and Threat Assessment

During this stage, it is helpful to think from an intruder's perspective. Try to imagine what weak points of the building you would exploit and why.

- Given the nature of the facility, what is the maximum level of knowledge and experience that potential intruders may possess?
- What are the most accessible entry points into the facility or property?
- What could cause a nuisance alarm?
    - Dusty environments
    - Moving objects
    - Unstable mounting
    - Steam or spray from ventilation
    - Environmental conditions

Site Mapping, Walk-through, Mounting location

Before conducting a walk-through, it is helpful to obtain a detailed drawing or blueprint showing the site's layout. This drawing should include ceiling heights, wall lengths, wire runs, and entry points. During the walk-through, take note of any details not illustrated in the drawing, such as fire extinguisher stations or other wall-mounted objects. These could affect the field-of-view of the laser detector. Data collected during the threat assessment and walk-through is used to determine zone layout and equipment quantities.

Design

Based on the previous data, selecting the appropriate detector for the application is next. The Laser Defender product line offers two sensing options.

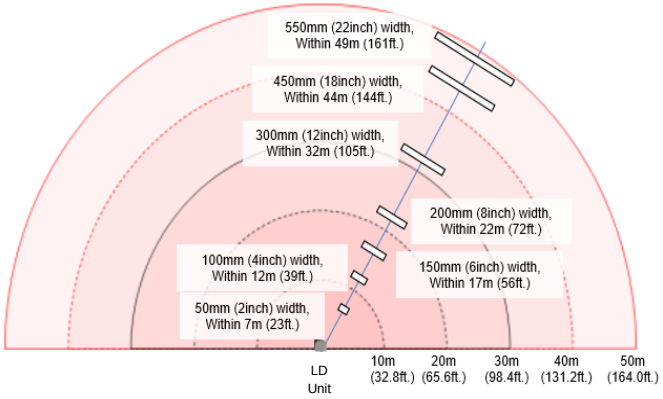
- LD308SH - 30m radius detection coverage.
    - 19.2 to 30 VDC / 24 VAC.
    - 4 analog zone outputs / 1 master alarm output / 8 virtual zones for IP connection.
    - Horizontal Mode for ceiling protection / Vertical Mode for wall protection.

- Please refer to PM-ENG-083 LD308SH installation manual for mounting types
- PL-1 Approved (indoor only).

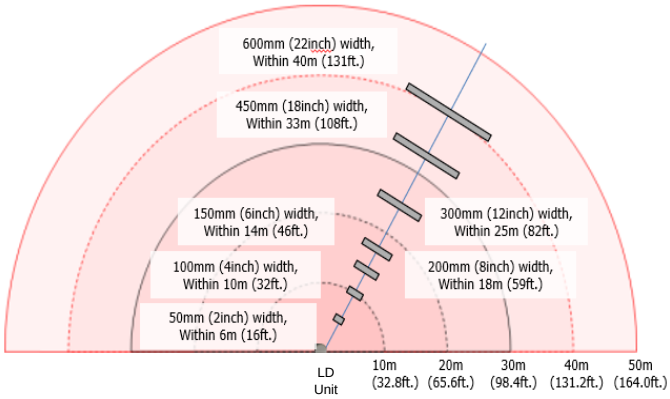
- LD204S - 20m x 20m at 95° detection coverage.
  - 12 to 24 VDC / PoE(+) compatible.
  - 3 programmable analog zones / 4 virtual zones for IP connection.
  - Multiple mounting options for ceiling and wall protection. Please refer to PM-ENG-084 LD-204S installation manual for mounting types.
  - PL-1 Approved (indoor only).

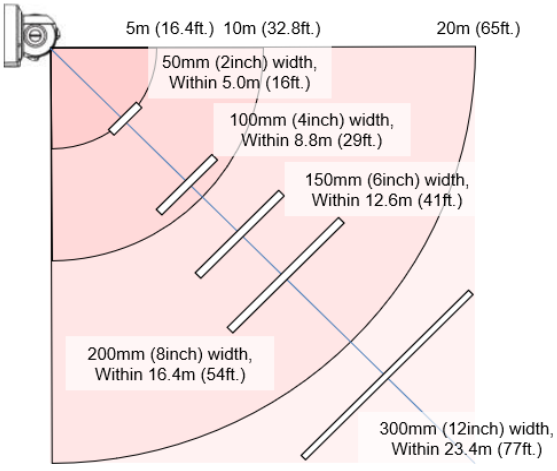
What are the size requirements for detection? The four figures below illustrate the detectable target size based on object color and reflectiveness. Note, detectable range depends on the reflectivity of the target, its shape, and speed in which the object traverses through the detection area. For military applications, install and test the system based on the black plate examples in Figure 1.

• Reflectivity of black plate: 10%



• Reflectivity of white plate: 90%





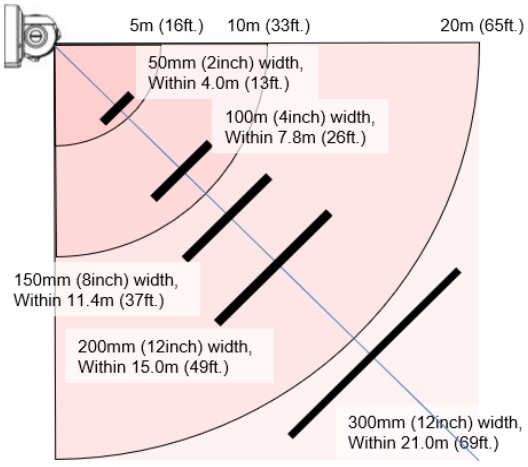


Figure 1: Minimum object detection size based on color reflectivity (white left, black right)

Using the information given in Figure 1, choosing the correct laser orientation will be the next step. Incorporating target size with an understanding on how detection is processed will greatly benefit the laser's detection capabilities.

Target size and sensitivity are the two primary settings when capturing an intrusion. Both Vertical and Horizontal Modes process these settings differently. In Vertical Mode, target size is processed as the object's height, and sensitivity measures the time met or exceeded in the detection area. This ranges from 100ms to 200ms. Special detection settings are available to increase or decrease the sensitivity time. Horizontal Mode on the other hand, processes the target size as detection width, and sensitivity as the distance the object has traveled within the detection area. This ranges from 0.48m (1.6 ft) to 1.9m (6.4 ft).

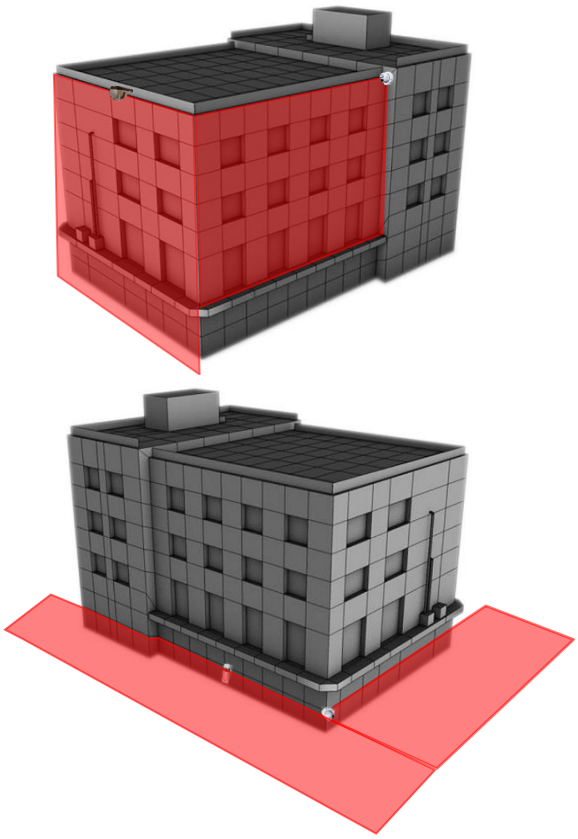


Figure 2: Laser Defender vertical and horizontal mounting orientation

Mounting heights will vary based on site requirements and mounting options. Always keep in mind the target size and where intrusions may occur within the detection area when choosing the detector placement. In vertical applications for LD308SH, it is good practice to keep the mounting height between 3.9m (13 ft) to 15.2m (50 ft). In horizontal applications where detection of an upright person is needed, 71cm (28in) is the recommended height to effectively detect the person's torso. Mounting the detector lower would require a reduction in target size to detect the intruder's lower legs. This increases the possibility of nuisance alarms caused by small animals or vegetation growth. There are no mounting height restrictions for ceiling intrusion applications.

When mounting outdoors, environmental challenges from rain, fog, and snow may be present. If the weather conditions are too severe, a judgement call is made by the detector to measure the reflection levels, reflection locations, and the number of reflected objects. The Environmental Disqualification (DQ) circuit is engaged in such circumstances. The DQ output tells the monitoring station the detection visibility is limited, and any alarms that occur during the DQ state are unreliable and may be caused by weather conditions. Alternative solutions are required to secure the area.

Installation

Between the planning stage and the installation date, there could be some downtime. During this time, boxes and other peripheral devices could be installed or placed within the sensor's field-of-view. These changes to the site can create problems for the sensor's placement and how the sensor detects. Objects visible in the sensing area cause dead spots, also known as 'shadowing.' Cases like these should be avoided, and when possible, any movable objects should be removed from the detector's view.

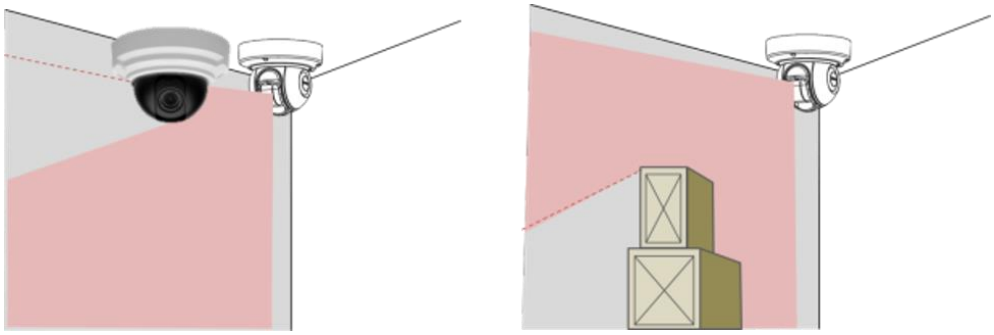


Figure 3: Dead zones from shadowing objects

Rooftops, on the other hand, are not so easy to relocate shadowing objects. HVAC units are typically preexisting, and the system designer needs to work around these obstructions. Even with rooftop dimensions within the Laser Defender's detection capability, additional detectors may be needed to combat any shadowing caused by HVAC units. See Figure 4 below for an example.

In colder climates, running HVAC units produce steam that emits from the vents. If the laser is aiming at or near these areas, there is a risk of nuisance alarms. Such nuisance alarms can be avoided by applying an Offset or Masking the area around the HVAC units. Offsetting creates an area of non-detection (0 to 39 inches) along the entire perimeter of the detection area. Masking is discussed later in the app note.

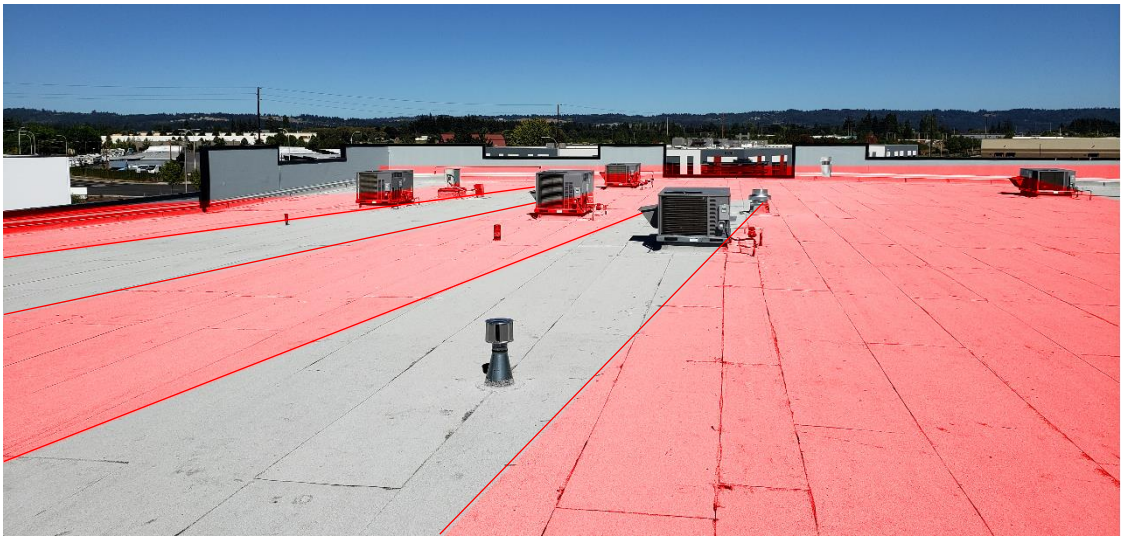


Figure 4: Shadowing from HVAC units

Before tuning can begin, laser alignment ensures proper detection in the desired area. Alignment is best accomplished by using the Laser Area Checker (LAC-1). Using LED and audible indication, the LAC-1 sounds and flashes LEDs when in line with the laser's detection pattern, as seen in the figure below. This shows where the laser terminates and helps when adjusting the detector to its proper sensing position.

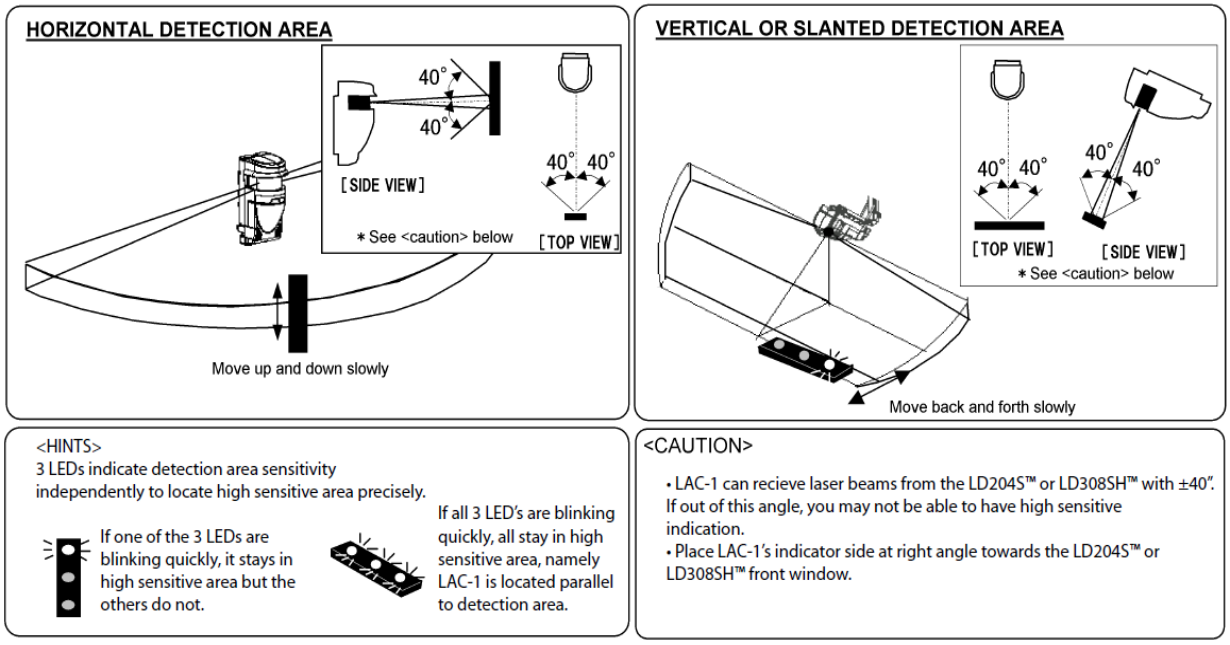


Figure 5: Laser alignment using the LAC-1

Running Intrusion

Time is an important factor when detecting a fast runner. High sensitivity and angling of the laser allow the detector more time to process fast intrusions.

Installing the laser facing straight down 270°, the LD308SH can detect a 1.6m (5.5ft) or larger intruder running at a speed of 9.84fps (6.71mph). Any faster potentially results in a missed alarm. Using the same intruder height and high sensitivity, angling the laser 30° increases the running speed to 28.47fps (19.41mph). Note: Mounting height and detectable target size should be considered when choosing the mounting location. Refer to Figure 1 of this app note to reference detectable target size.

Detection speed using the LD204S:
270° = 13fps (8.9mph)
Angled 30° = 36.37fps (24.8mph)

LD308SH

LD204S

Figure 6: Vertical mount hangar door protection

Configuration

To calibrate the sensor, first install the Laser Defender Manager Software (LDMS) on a laptop or workstation. This software is provided as a free download with each hardware purchase and can also be found at www.fibersensys.com/product/product-software. Connect the PC to the Laser Defender via Ethernet port. Change the Network Settings of the PC to fit the same subnet as the laser's default IP address.
(*Example*: IP address 192.168.0.100 and subnet mask 255.255.255.0 to communicate with the main port)

LD308SH:
IP address - 192.168.0.126
Subnet Mask - 255.255.255.0
Default Gateway - 192.168.0.1

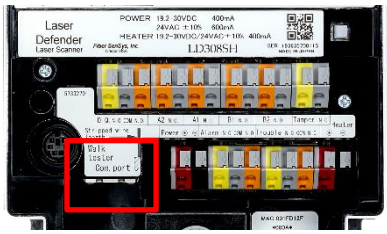


Figure 7: LD308SH Ethernet port location

LD204S:
Main Port - 192.168.0.126
Subnet Mask - 255.255.255.0
Default Gateway - 192.168.0.1

Maintenance Port - 192.168.1.126
Subnet Mask - 255.255.255.0

Figure 8: LD204S Main Ethernet port (L) and maintenance port (R) location

The LD204S offers two Ethernet ports, main and maintenance. The main port inside the base is for constant connection to the LAN. This port supports PoE(+) and provides network alarm reporting. The maintenance port is used for the initial setup and post-install maintenance. This port is located near the laser window for easy access and avoids altering the laser alignment.

After launching the Manager software, log in using the credentials below.
User ID: LASERDEFENDER
Password: FSI
Click on Edit Group/Detector Information to select the detector currently connected to the PC. For this application note, we are using the LD204S as an example. In LDMS, confirm the PC's IP address fits the same subnet as the detector's default IP address. Click Connect (F1) to establish a connection to the Laser Defender.

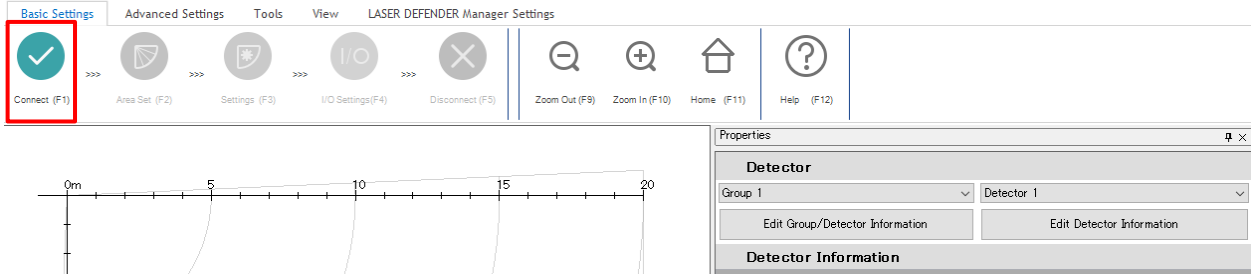


Figure 9: Connecting to the Laser Defender

If connection times out and aborts the connecting process, follow the troubleshooting steps below.

- Confirm power.
- Confirm IP addresses are on the same subnet. (LD204S maintenance port uses a different subnet.)
- Check the physical connection.
- Verify no IP conflicts from other sensors. (Isolate sensor and try again.)
- Contact Fiber SenSys technical support at support@fibersensys.com – 503-726-4455

Settings

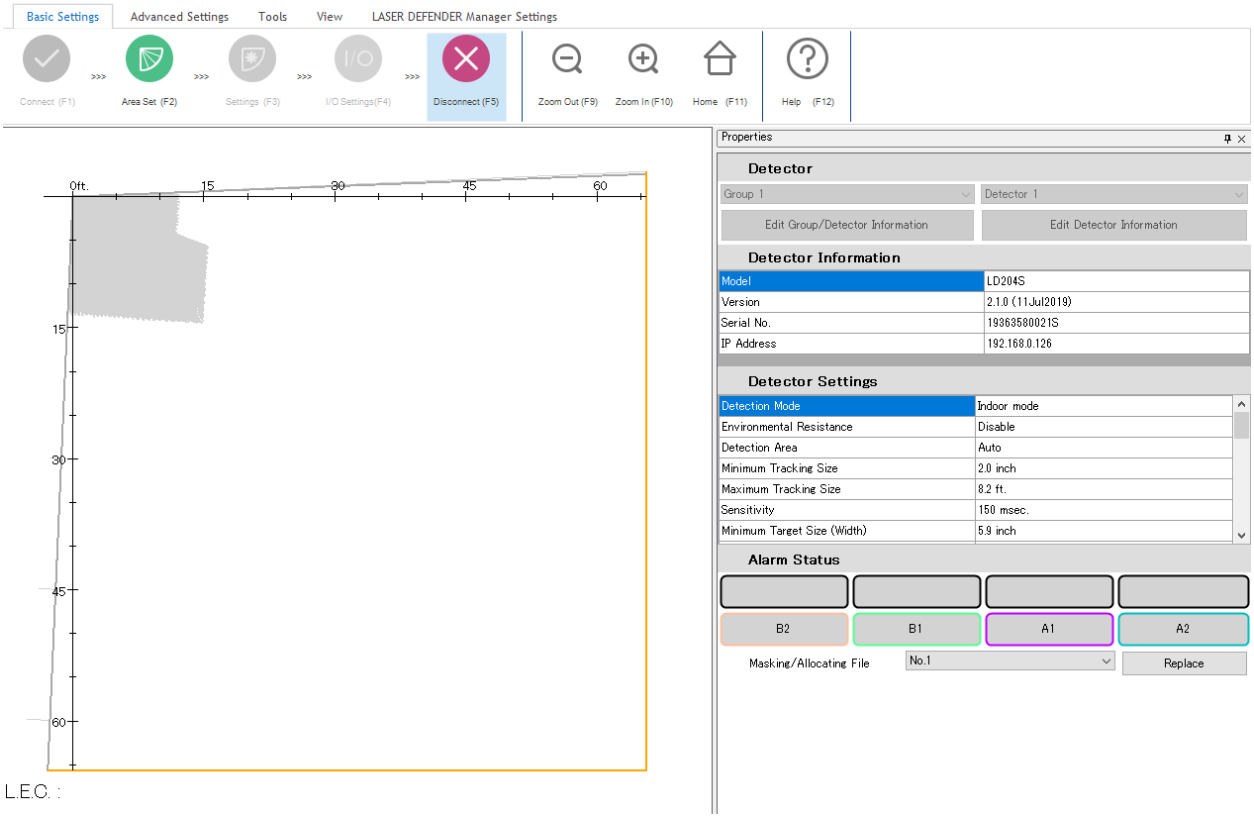


Figure 10: Acquiring sensing information through Area Set

Once a connection to the Laser Defender has been made, the screen shows the detector's information and the sensing area displayed in the graph. Before any changes to the detector can be applied, an Area Set (F2) must be performed. The action of Area Set takes the perimeter edge of the sensor's field-of-view and learns the entire sensing area as the primary focus of detection. The sensing area shows a gray outline around the perimeter.

Note >> Any physical adjustments, such as mounting height or angle, require another Area Set to learn the laser's new position.

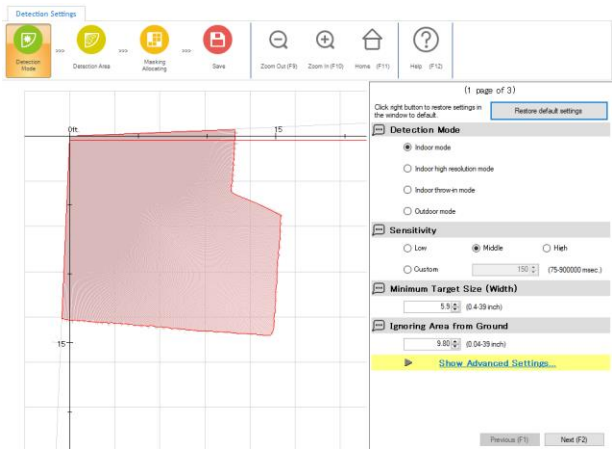


Figure 12: LD204S Detection Mode settings

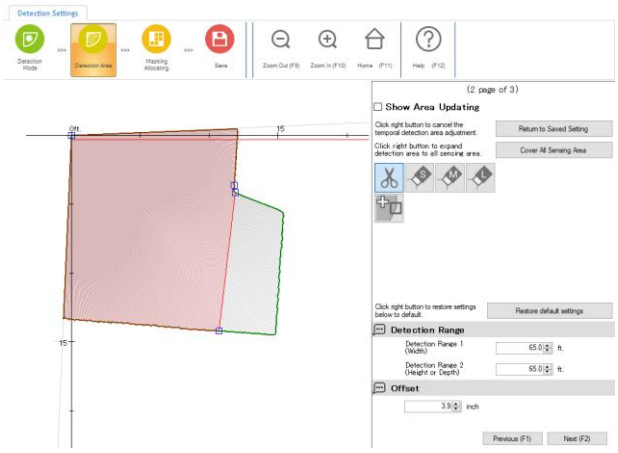


Figure 11: Removing unwanted areas using the scissor tool

Proceed to Settings (F3) and make the necessary detection changes to fit the application. Indoor Mode should be all that is necessary for most hangar door applications. For more information about the other modes, please refer to PM-ENG-084 LD204S or PM-ENG-083 LD308SH installation manuals. The next section provides adjustments to the detection area itself. Users can cut out unwanted areas or minimize the overall detection coverage. Offsetting the detection area places an area of non-detection around the entire perimeter of the sensing area. This helps avoid nuisance alarms caused by reflective surfaces.

The LD308SH offers a special mode specifically designed for ceiling and wall applications. This mode is Indoor Ceiling/Wall Protection Mode. Vertical is selected automatically in this mode; however, it is used in a horizontal installation for ceiling protection and vertical installation for wall protection. In this mode, the detectable distance for a 5cm (2in) object is 4.8m (16.4ft), while a 30cm (12in) object is detected at 30m (100ft) from the detector. Target size is not adjustable in this mode.

Figure 13: LD308SH in horizontal mode protecting skylights from intrusions using Indoor Ceiling/Wall protection mode

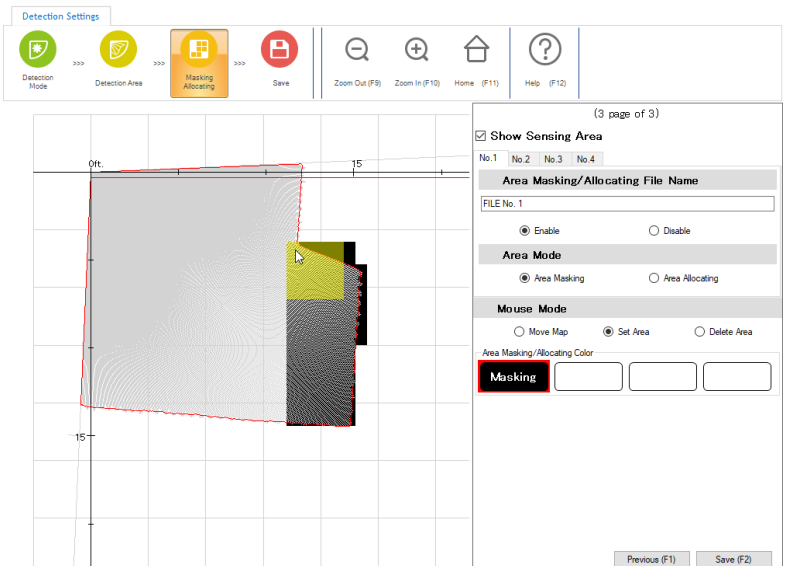


Figure 14: Masking unwanted areas

The third and final settings section covers area Masking and Allocating. Masking a section of the detection area becomes a non-detectable segment while the rest of the detection area remains detectable.

Enabling area allocating creates independent detection segments in the sensing area. Up to eight patterns can be allocated in the LD308SH; however, four patterns is set as default. This is commonly used with CCTV or independent zoning.

The scan area for the LD204S is divided into 10,000 segments, 19.8cm (7.8in) squares.
The LD308SH is divided into 20,000 segments, 30cm (12in) squares.
To save all detector settings either click the save button located at the bottom right corner of the screen or by clicking the red save button in the task bar.

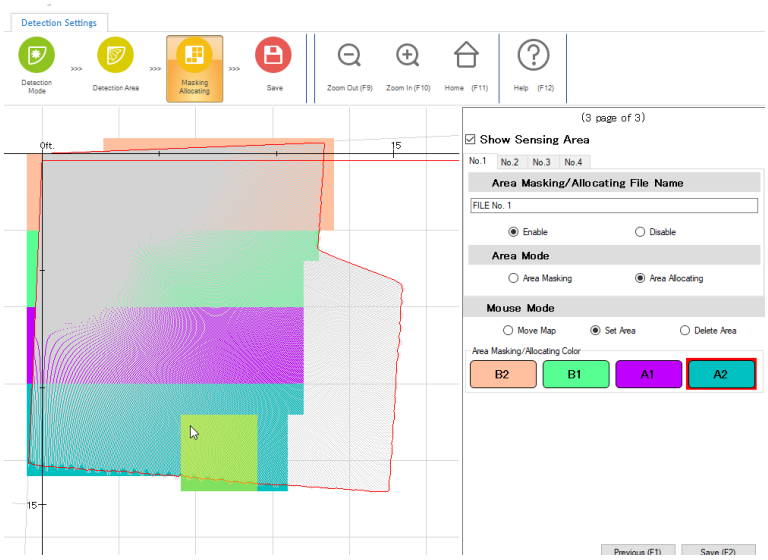


Figure 15: Zone selection using area allocating

Terminal Settings

Select I/O Settings (F4) for relay output configuration. Shown below in Figure 12 is the Terminal settings page for the LD204S. Here the user can change alarm outputs from N/C to N/O. Users can also customize specific detection areas to a selected output. Additionally, trouble outputs can be selected for the desired output.

Terminal settings for the LD308SH change only the individual area output from N/O to N/C. All additional trouble outputs have their own dedicated output.

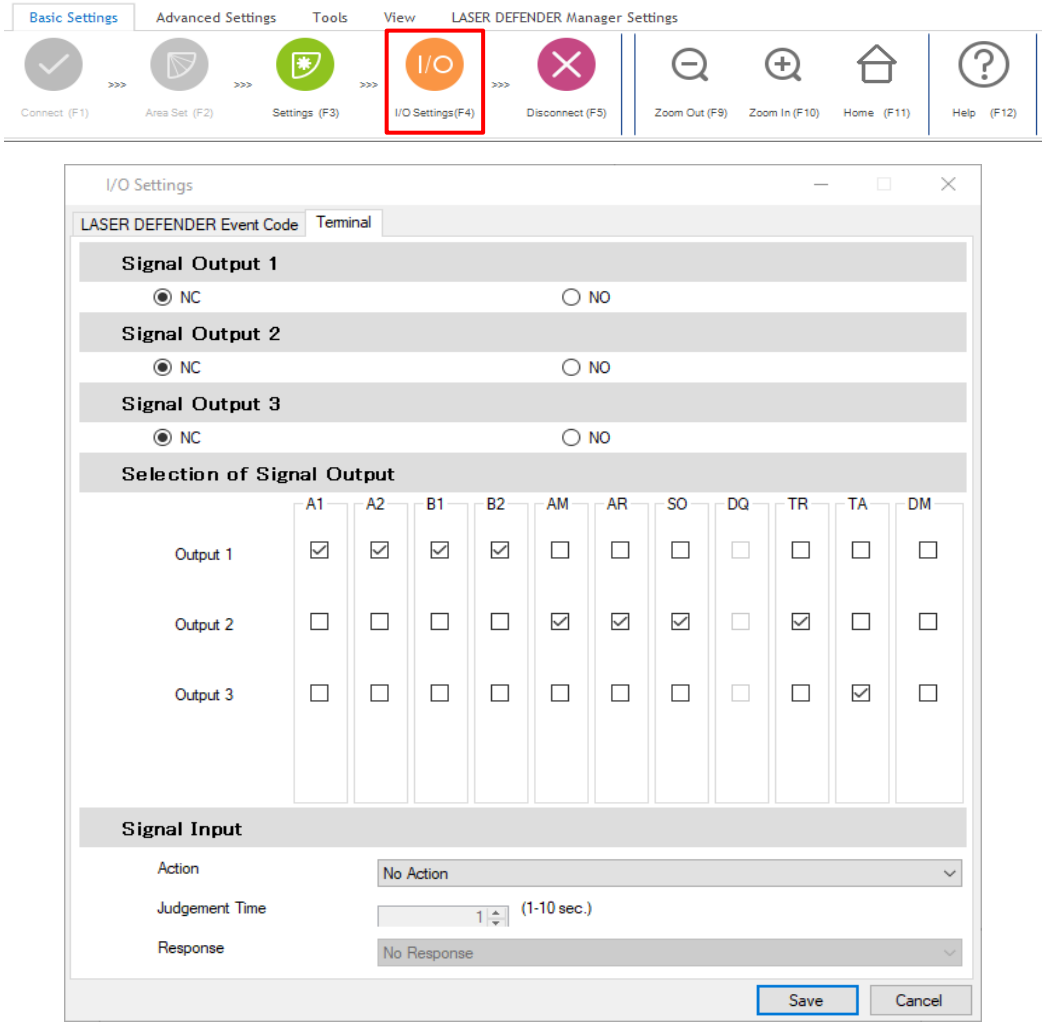


Figure 16: I/O terminal selector for LD204S

Figure 17: I/O terminal selector for LD308SH

Network Settings

In the Advanced Settings tab, selecting Network (F6) allows the user to change the detector's Network Settings.

Enter the preferred IP settings. Be sure the main and maintenance ports remain on separate subnets. After saving the Network Settings, the detector resets, and the user is disconnected from the detector. To reconnect to the Laser Defender, the IP address on the user's PC may need to be updated to fit the detector's new IP address scheme, and the new Laser Defender IP address entered in the Group/Detector information area.

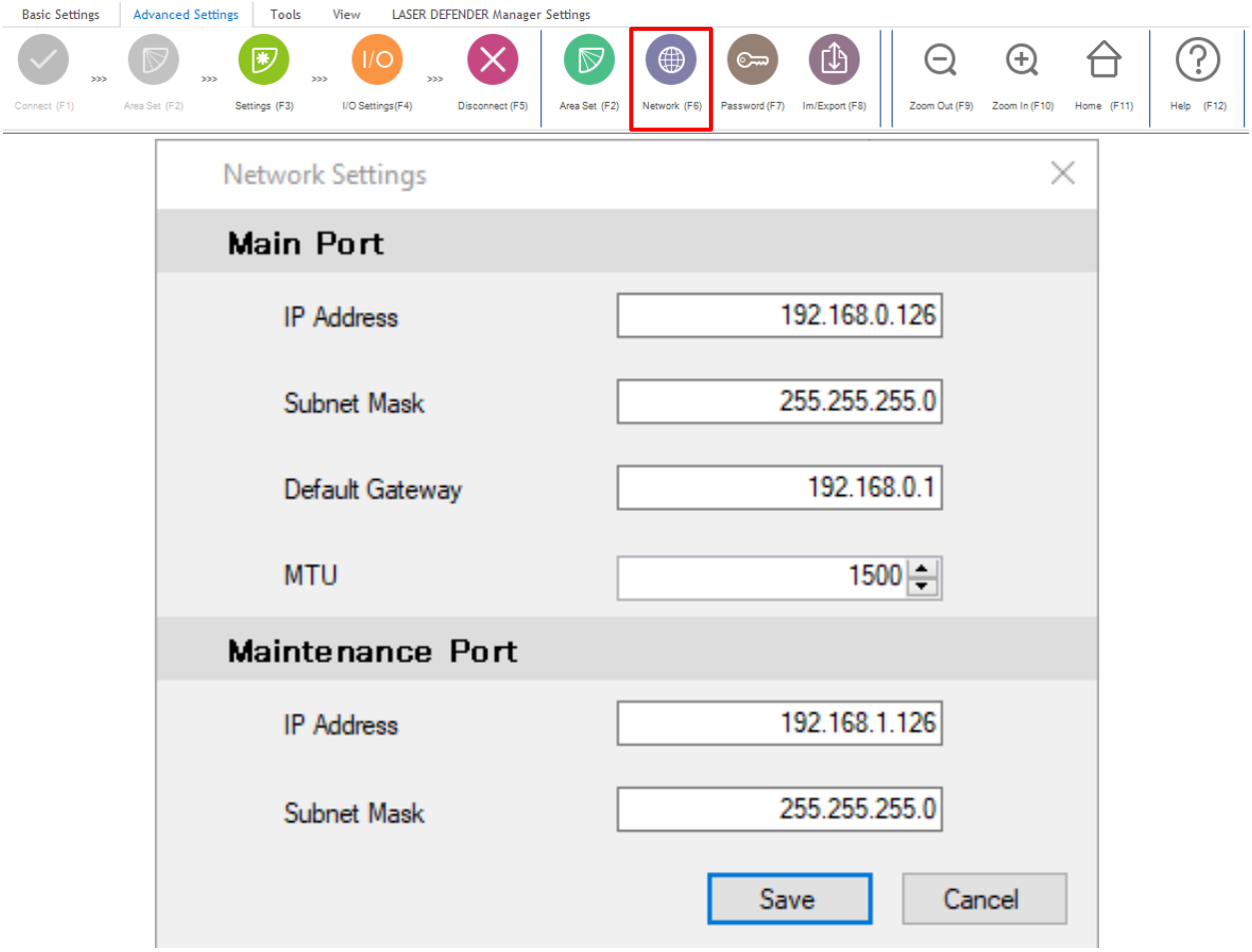


Figure 18: Changing network settings

Probability of Detection

To ensure reliable detection, a series of simulated intrusion attempts must be conducted. These intrusion attempts are application-specific based on the laser's orientation. An example layout would be having the Laser Defender ceiling mounted and in the vertical mode. The objective is to trigger an alarm when an intruder enters any part of the facility's openings. As a system tester, simulate how the intruder attempts to bypass the detector.

These intrusion attempts may include:

- Crawling
- Jumping
- Walking
- Running
- Rolling

Simulate each attempt multiple times to confirm the laser is detecting reliably. Adjust settings as is necessary and continue to simulate the intrusions.

An event Record feature is available to monitor the sensor's performance after the initial installation. Recorded files are stored in the workstation that is running Laser Defender Manager Software and must remain running to record these files. This is also a good tool to identify recurring nuisance alarms to pinpoint the alarm location.

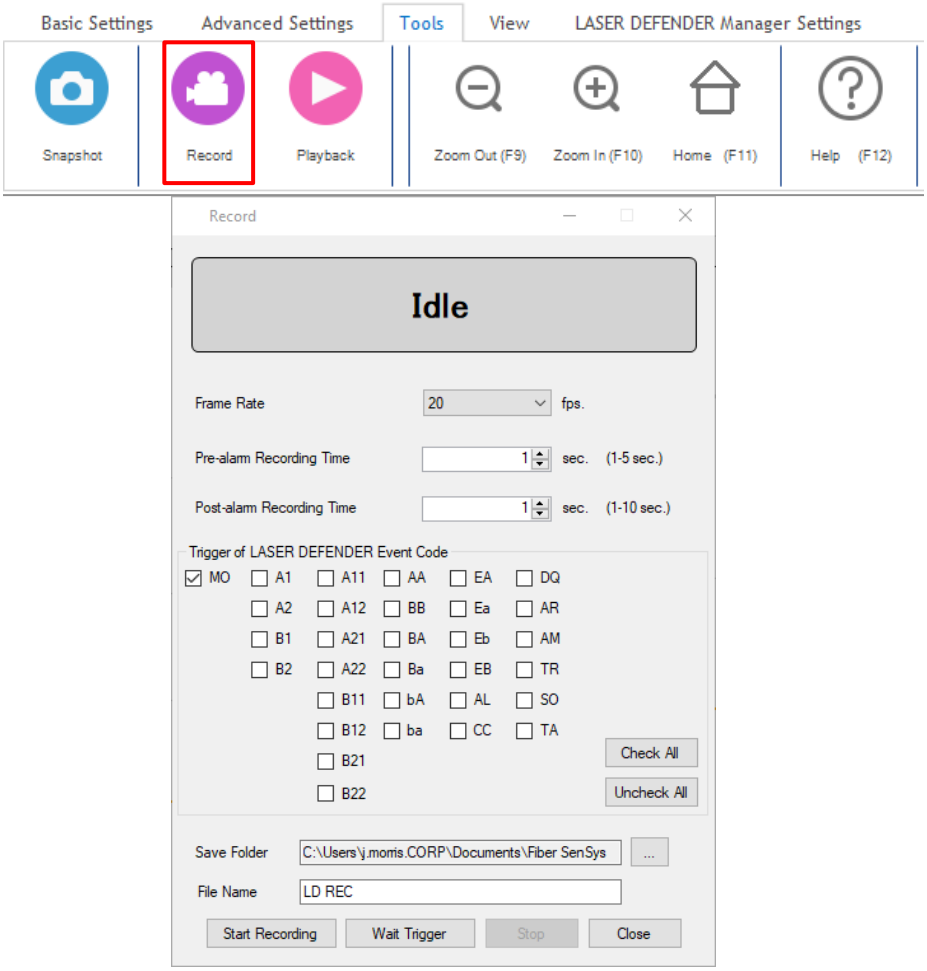


Figure 19: Laser Defender event recorder

Maintenance

Periodic testing is a good way of extending the life of your system and ensuring correct functionality. Dusty environments, including cobwebs, put Laser Defenders at risk of unwanted trouble signals from debris obscuring the laser window. Maintaining a clean laser window prevents these signals from occurring. Failure to maintain a clean laser window will eventually result in nuisance or missed alarms. The detection area needs maintenance as well by keeping the detection area clear from boxes and other material that may obstruct the sensor's field-of-view. Wet floors create reflective surfaces, and if offset is minimized or not used, this will result in nuisance alarms.

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