USER'S MANUAL

chroma+scan 20X5

Version 4.11.6.7

Proprietary

Trademarks and Restrictions

This product is designated for use solely as a component and as such it does not comply with the standards relating to laser products specified in U.S. FDA CFR Title 21 Part 1040.

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1 Laser Safety

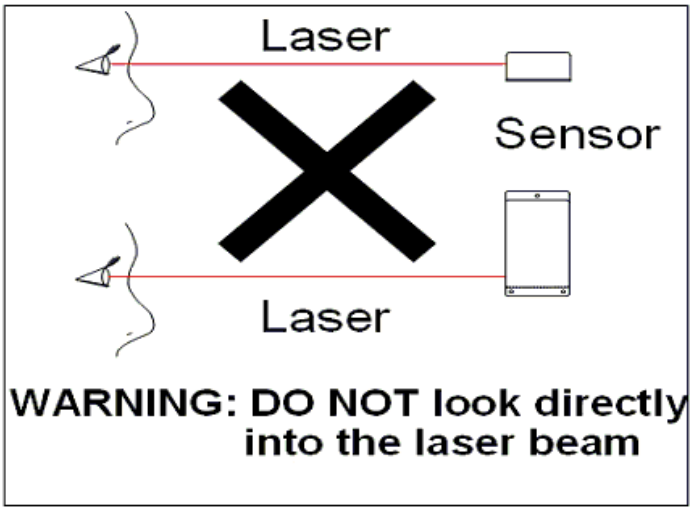
1.1 General Information

The laser light sources used in LMI Sensors are semiconductor lasers emitting visible light.

LMI Laser Sensors have a 2/II, 3R/IIIa or 3B/IIIb classification depending on model.

Class 2/II and 3R/IIIa sensors are referred to as “products” indicating that they fully comply with the standards relating to laser products specified in IEC 60825-1 and U.S. FDA CFR Title 21 Part 1040 except for deviations pursuant to Laser Notice No. 50, dated July 26, 2001.

Class 3B/IIIb sensors are sold only to qualified OEM’s as “components” for incorporation into their own equipment. The sensors do not incorporate safety items which the OEM is required to provide in their own equipment (e.g. remote interlocks, key control). As such these sensors do not fully comply with the standards relating to laser products specified in IEC 60825-1 and FDA CFR Title 21 Part 1040.



Caution! Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

1. **International Standard IEC 60825-1 (2001-08) Consolidated edition**, Safety of laser products – Part 1: Equipment classification, requirements and user's guide
2. **Technical Report TR 60825-10**, safety of laser products – Part 10. Application guidelines and explanatory notes to IEC 60825-1
3. **Laser Notice No. 50**, FDA and CDRH http://www.fda.gov/cdrh/rad-health.html

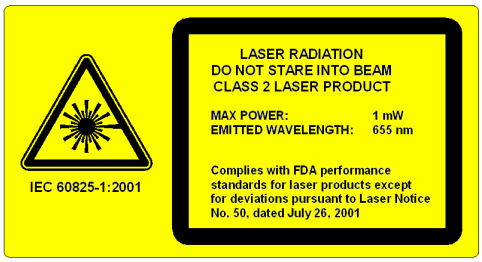
1.2 Laser Classification

1.2.1 Laser Classes

Class 2/II laser products:

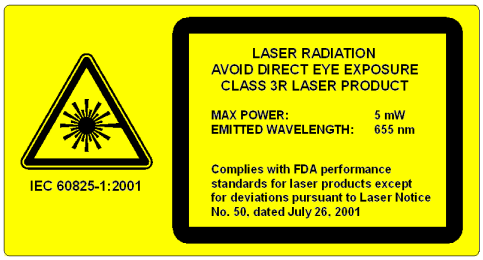
Class 2/II laser products would not cause permanent damage to the eye under reasonably foreseeable conditions of operation, provided that any exposure can be terminated by the blink reflex (assumed to take 0.25 sec). Because classification assumes the blink reflex, the wavelength of light must be in the visible range (400 nm to 700 nm). The Maximum Permissible Exposure (MPE) for visible radiation for 0.25 second is 25 Watt per square meter, which is equivalent to 1 mW entering an aperture of 7 mm diameter (the assumed size of the pupil).

Labels reprinted here are examples relevant to the laser classes. For detailed specifications observe the label on your laser sensor



Class 3R/IIIa laser products:

Class 3R/IIIa laser products emit radiation where direct intrabeam viewing is potentially hazardous, but the risk is lower than for 3B/IIIb lasers. Fewer manufacturing requirements and control measures for users apply than for 3B/IIIb lasers.



Class 3B/IIIb laser components:

Class 3B/IIIb components are unsafe for eye exposure. Usually only ocular protection would be required. Diffuse reflections are safe if viewed for less than 10 seconds.

1.2.2 User Precautions & OEM Responsibilities

The specific user precautions as specified in IEC 60825-1 and FDA CFR Title 21 Part 1040 are:

Requirements	Class 2/II	Class 3R/3a	Class 3B/3b
Remote interlock	Not required	Not required	**Required****
Key control	Not required	Not required	**Required**** Cannot remove key when in use
Power-On delays	Not required	Not required	**Required****
Beam attenuator	Not required	Not required	**Required****
Emission indicator	Not required	Not required	**Required****
Warning signs	Not required	Not required	**Required****
Beam path	Not required	Terminate beam at useful length	Terminate beam at useful length
Specular reflection	Not required	Prevent unintentional reflections	Prevent unintentional reflections
Eye protection	Not required	Not required	Required under special conditions
Laser safety officer	Not required	Not required	Required
Training	Not required	Required for operator and maintenance personnel	Required for operator and maintenance personnel

LMI Class 3B/IIIb laser components do not incorporate the safety items indicated by asterisks ****** in the table above. These items must be added and completed by the OEM in the system design.

1.2.3 Class 3B/IIIb OEM Responsibilities

LMI Technologies has filed reports with the FDA to assist the OEM in achieving certification of their laser products. The OEM can reference these reports by an accession number that will be provided upon request.

Detailed descriptions of the safety items that must be added to the OEM design are listed below:

Remote Interlock

A remote interlock connection must be present in Class IIIB laser systems. This permits remote switches to be attached in serial with the keylock switch on the controls. The deactivation of any remote switches must prevent power from being supplied to any lasers.

Key Control

A key operated master control to the lasers that prevents any power from being supplied to the lasers while in the OFF position. The key can be removable in the OFF position but the switch must not allow the key to be removed from the lock while in the ON position.

Power-On Delays

A delay circuit is required that illuminates warning indicators for a short period of time prior to supplying power to the lasers.

Beam Attenuators

A permanently attached method of preventing human access to the laser radiation other than switches, power connectors or key control must be employed. On some LMI laser sensors, the beam attenuator is supplied with the sensor as an integrated mechanical shutter.

Emission Indicator

It is required that the controls that operate the sensors incorporate a visible or audible indicator when power is applied and the lasers are operating. If distance (>2 m between sensor and controls) or mounting of sensors intervenes with observation of these indicators, a second power-on indicator should be mounted at some readily observable position. When mounting the warning indicators, it is important not to mount them in a location that would require human exposure to the laser emissions.

Warning Signs

Laser warning signs must be located in the vicinity of the sensor such that they will be readily observed. Examples of laser warning signs are:

FDA Example

IEC Example

1.3 Requirements for Laser Systems Sold or Used In the USA

The OEM's laser system which incorporates laser components or laser products manufactured by LMI Technologies requires certification by the FDA.

It is the responsibility of the OEM to achieve and maintain this certification.

OEM's are advised to obtain the information booklet *Regulations for the Administration and Enforcement of the Radiation Control for Health and Safety Act of 1968*: HHS Publication FDA 88-8035.

This publication, containing the full details of laser safety requirements, can be obtained directly from the FDA, or downloaded from their website at http://www.fda.gov/cdrh.

1.4 Laser Safety Specification

Laser Classification:	3B/IIIb laser component
Peak Power:	130mW
Emitted Wavelength:	660nm

2 Proper Handling and Precautions

2.1 System Installation

2.1.1 Component Grounding

All sensors should be grounded to the earth/chassis through their housing. For sensors with through-hole mounts, this can be accomplished by using star washers on the mounting bolts. The star washers must cut through the powder coating to provide electrical conductivity from the mounting hardware to the sensor housing. For sensors with tapped hole mounts, conductive hardware must to be used between the sensor and the frame. This must be checked with a multi-meter by ensuring electrical continuity between the frame and the connector housing on the sensor. It is imperative that the scan frame or chassis that the sensor is mounted to is connected to earth ground.

Master networking products should have the housing connected to earth ground. This can be accomplished using star washers on the mounting holes or through the earth ground connection located on the rear of the Master 1200 and 2400. FireSync Networking products should be installed inside electrical cabinets that are suitably grounded to earth ground.

2.1.2 Shielded Cable

LMI Technologies recommends the use of shielded cables in all environments to ensure isolation from electrical noise. The shield should be electrically connected to both the sensor housing (via the connector housing) and to the electrical box containing either the Master (network systems) or the power supply (standalone sensors).

LMI Technologies supplies both shielded FireSync cordsets and shielded FireSync cable for building cordset.

2.1.3 Power Supply

The user must provide a suitable +48VDC power supply for the system capable of handling an infinite capacitive load. These power supplies must be isolated such that DC ground is NOT tied to AC ground. The power supply should be of a suitable capacity for the size of the system.

LMI Technologies recommends the Phoenix Contact QUINT series of power supplies.

2.1.4 Uninterruptible Power Supply (UPS)

To maximize the life of the sensor, LMI Technologies recommends the use of an on-line double-conversion UPS whenever the quality of the electrical supply to the system is poor. This includes but is not limited to when the electrical supply:

- contains high frequency noise (due to other electronics, electic motors or other factors)
- is prone to “brown-out” conditions or large voltage fluctuations
- is prone to electrical surges or spikes due other components or electrical storms.

LMI Technologies recommends the Tripp Lite SU2200RTXL2UA UPS.

2.1.5 Installation Environment

To prevent damage to LMI 3D sensors and ensure reliable operation, avoid installing the sensor in locations:

- that are humid, dusty, or poorly ventilated
- with a high temperature such as a place exposed to direct sunlight
- where there are flammable or corrosive gases
- where the unit may be directly subjected to vibration or impact
- water, oil, or chemicals may splash onto the unit
- where static electricity is easily generated

2.2 Temperature and Humidity

LMI 3D Sensors are rated for operation between 0- 50°C, and 25-85% Relative Humidy (non-condensing).

2.3 Maintenance

LMI 3D sensors are high-precision optical instruments. To ensure the highest accuracy is achieved in all measurements, the windows on the front of the sensor should be kept clean and clear of debris.

Use dry, clean air to remove dust or other dirt particles. If dirt remains, clean the windows carefully with a soft, lint-free cloth using an ammonia based cleaner. Ensure that no residue is left on the windows after cleaning.

2.4 Laser Lifetime

LMI Technologies uses semiconductor lasers in their 3D measurement sensors. To maximize the lifespan of the sensor it is recommended to turn off the laser by stopping the sensor whenever it is not in use.

2.5 Avoid Flash Writes (Standalone Sensors only)

Operation parameters for standalone sensors are stored with flash memory inside the sensor. Flash has an expected lifetime of 100,000 writes. Avoid frequent or unnecessary write commands to the sensor to maximize the lifetime of the sensor.

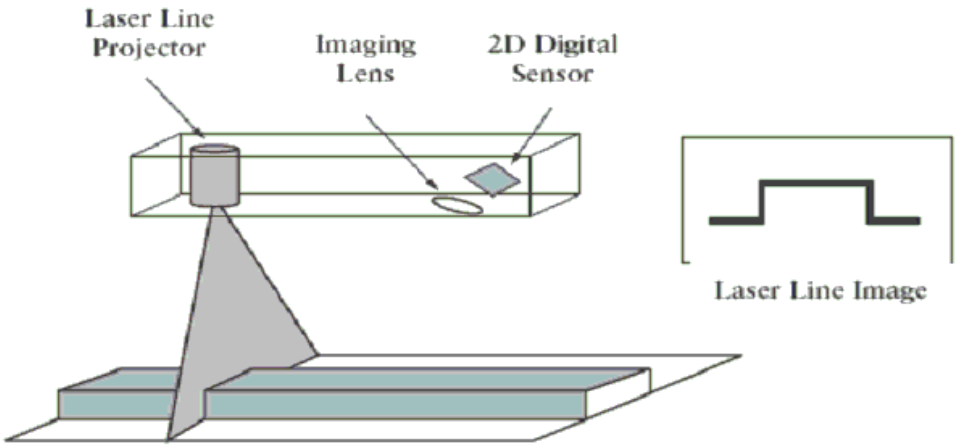
3 Sensor Overview

3.1 Introduction

The chroma+scan 20X5 sensors are based on LMI's field-proven FireSync platform, which provides a synchronized, scalable, distributed vision processing architecture for building reliable, high performance systems. High reliability and simple, rapid installation are achieved with a single cable for power, data, and synchronization. Communication is via Gigabit Ethernet.

3.2 Measurement Principles

The chroma+scan 20X5 sensors function on the principle of structured light triangulation. A semiconductor laser with special optics projects fan of light onto the target. A digital



camera mounted at an angle to the laser plane acquires images of the light pattern created on the target. These images contain the basic information needed to compute distances to the target.

4 Sensor Specifications

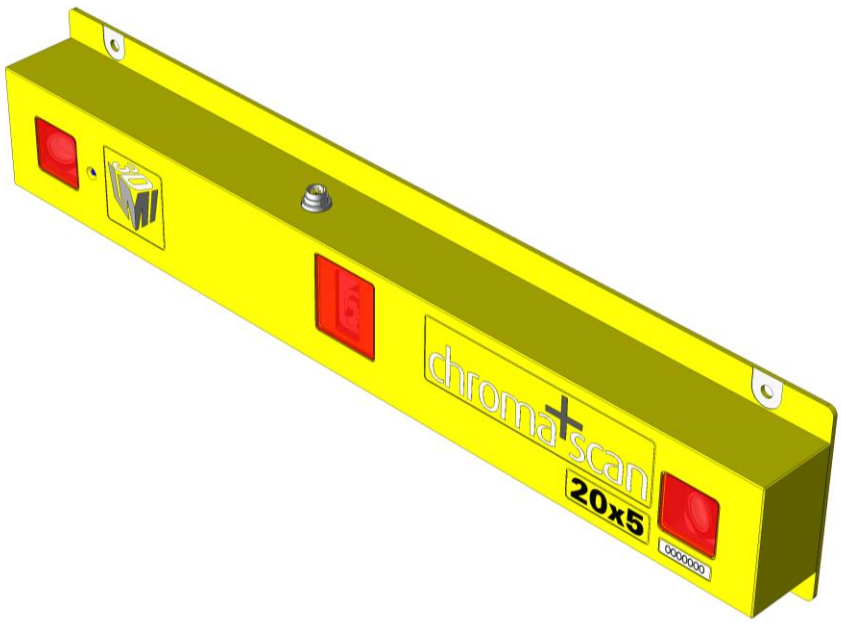
This section presents sensor specific chroma+scan 20X5 information. It describes the different models, and gives dimensions of the scan zone and sensor.

4.1 Models

The chroma+scan 20X5 sensors are available in the following models:

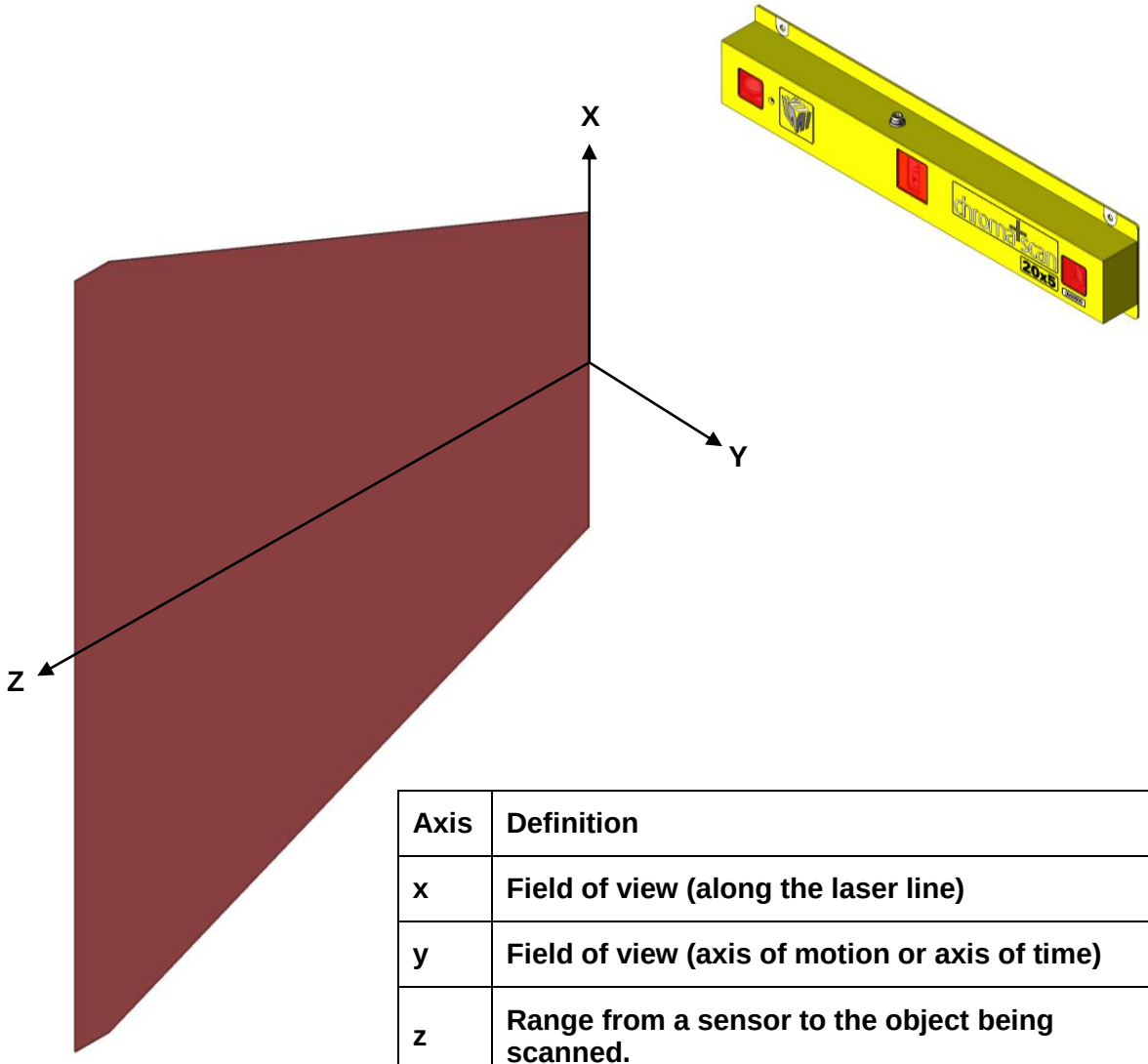
Models	Maximum Scan Rate	Laser Power
chroma+scan 2015	250 Hz	100mW
chroma+scan 2025	500 Hz	100mW
chroma+scan 2045	1000 Hz	100mW

4.1.1 chroma+scan 2015, 2025, 2045



4.2 Coordinate Definitions

Throughout this document and software interface, displacements are represented in x-, y- and/or z-coordinates. The coordinates are defined as follows:



Axis	Definition
x	Field of view (along the laser line)
y	Field of view (axis of motion or axis of time)
z	Range from a sensor to the object being scanned.

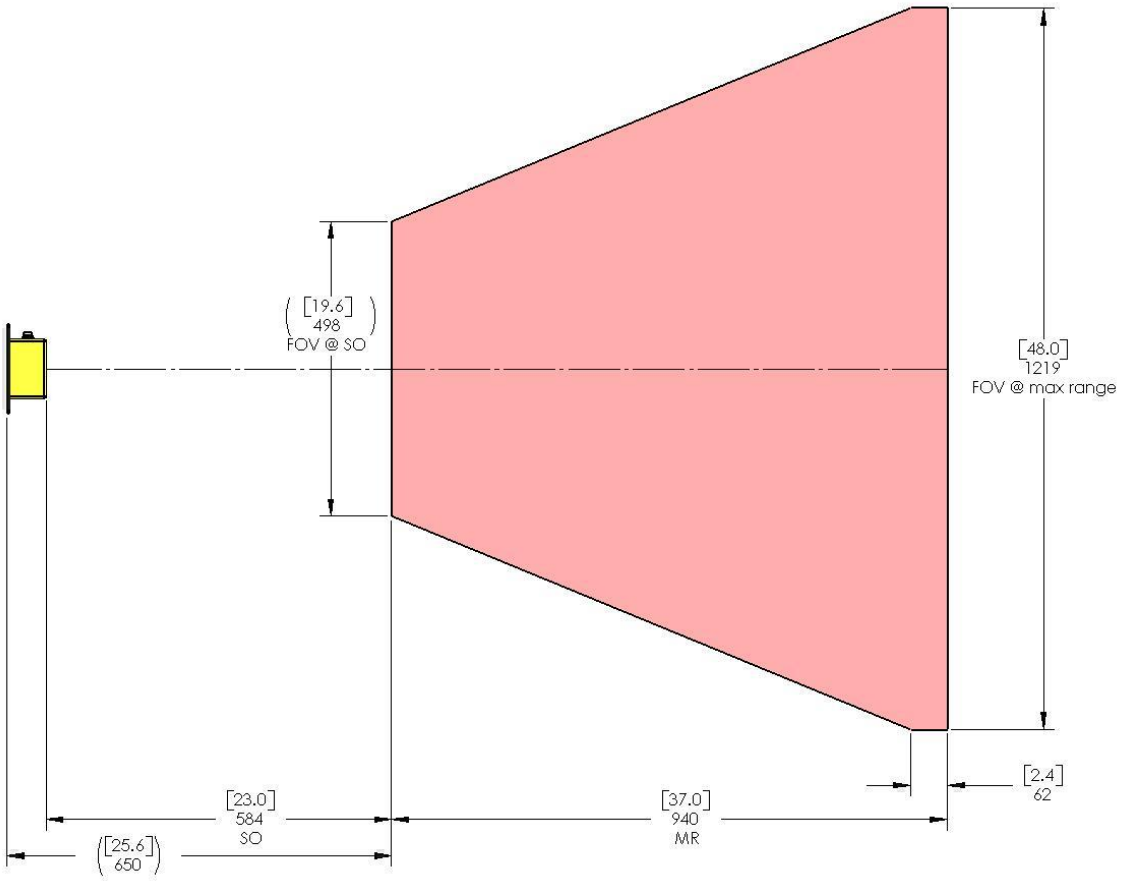
4.3 Performance

Range Accuracy	±1.3 mm	±0.050 in
Profile Resolution	3.0 mm	0.120 in
Scan Resolution @ 4.5m/s (900 fpm) • chroma+scan 2015 • chroma+scan 2025 • chroma+scan 2045	 18.3 mm 9.2 mm 4.6 mm	 0.720 in 0.360 in 0.180 in
Scan Rate • chroma+scan 2015 • chroma+scan 2025 • chroma+scan 2045	 250 Hz 500 Hz 1000 Hz	

4.4 Specifications

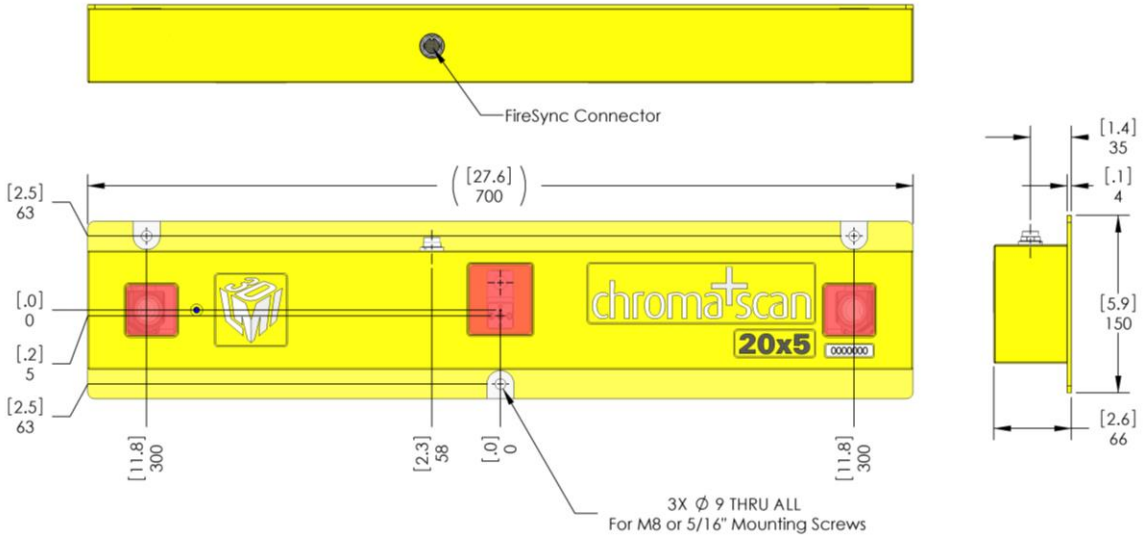
Operating Temperature	0 - 50°C	32 - 122°F
Input Power	+48VDC	
Housing	IP67, Powder Coated, Aluminum	

4.5 Scan Zone



Clearance Distance (CD)	584 mm	23.0 in
Measurement Range (MR)	940 mm	37.0 in
Field of View (FOV) @ CD	498 mm	19.6 in
Field of View (FOV) @ CD + MR	1219 mm	48.0 in

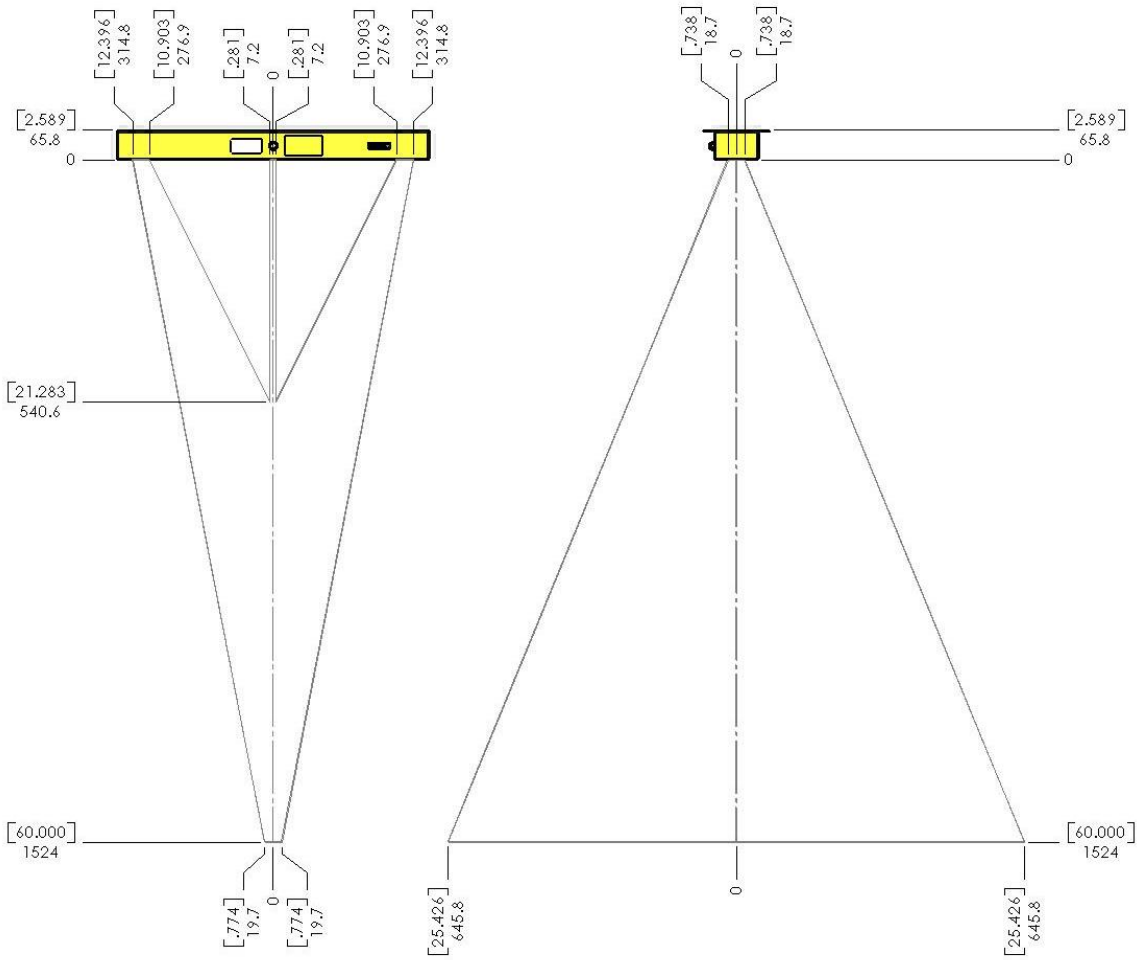
4.6 Dimensions



The sensor can be mounted with either M8 or 5/16" hardware. Provision to adjust the position and orientation of the sensor to align its laser plane with the laser planes of the other sensors in the ring is recommended. Although this alignment is not required for reliable profile data (adjacent sensors typically scan during different time slices), aligned laser planes provide a better appearance to the end user of the system. The laser fan is emitted through the clear center window. The cameras are located behind the two end red tinted windows. When mounting the sensor, ensure that there are no obstructions between the camera windows and the Scan Zone.

4.7 FOV Envelope

The following drawings detail regions in front of the sensor that should be kept free of obstructions. These regions envelope the laser fan projection and the two cameras view of the scan zone. Note that intermittent blocking of one or the other camera views will not cause loss of data as the other camera will fill in the blocked scan zone.



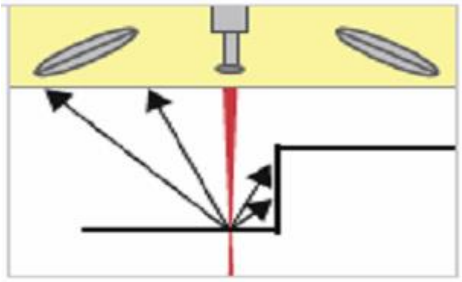
4.8 Cleaning

The windows on a sensor must be kept clean and free of debris at all time. If the windows become dirty, clean them with an *ammonia-based* cleaner only.

4.9 Features

The chroma+scan 20X5 is the new-generation, high-speed, high-density 3D profile scanning system for primary log optimization. Binocular scanning provides complete 3D profiles unobstructed by protruding knots and log features. Normalized intensity data provides raw data to allow the end-user to process the data for a variety of applications.

4.9.1 Binocular 3D Scanning



The chroma+scan 20X5 sensors incorporate a dual camera design which places two cameras symmetrically about the laser plane. The two cameras provide binocular 3D profile scans that eliminate occlusions due to protruding features. This avoids data dropouts that would occur with conventional single amera sensors.

This also allows "dead zone" creation to eliminate problem light sources that generate spurious data without loss of profile data. The problem source will appear in only one camera view. Single camera sensors can not provide this feature without loss of data in parts of the sensor's measurement range.

4.9.2 High Scan Rates

The chroma+scan 20X5 sensor family provides scan rates up to 500Hz. At the same time, the sensors maintain excellent dark wood performance and ambient light immunity.

The sensors achieve dark wood sensitivity equivalent to level 18 on the Kodak gray scale chart. They are insensitive top laser saturation on light wood and are immune to high levels of ambient illumination.

5 System

A chroma+scan 20X5 system consists of following components:

1. Network components:
    a. Master 400/800/1200/2400
    b. Station computer (Host computer) running Windows XP 32-bit or Windows 7 32-bit / 64-bit
    c. Client computer
    d. Network switch
    e. 48V power supply
    f. FireSync network cordsets
    g. Other cabling: Ethernet, power & encoder
2. Safety Interlock
3. Scan Frame
4. System Calibration Target
5. chroma+scan 20X5 sensor(s)

5.1 Network Components

FireSync Network devices are hardware components used to distribute power, data, safety interlock, and synchronization information to all devices in a FireSync sensor network. The Information and requirements for Masters, Station computers, Client computers, Network Switches, Power, Cabling, Network configurations, can be found in the appropriate FireSync Network Manual.

5.2 Safety Interlock

The Safety Interlock signal allows the user to turn on and off all light sources in the sensors without disrupting power to the system. The laser safety control signal must be provided at the Master for the sensors to properly function.

To enable the laser safety control signal, apply the required voltage across the laser safety +/- connections. Please refer to the network manual for more specific details.

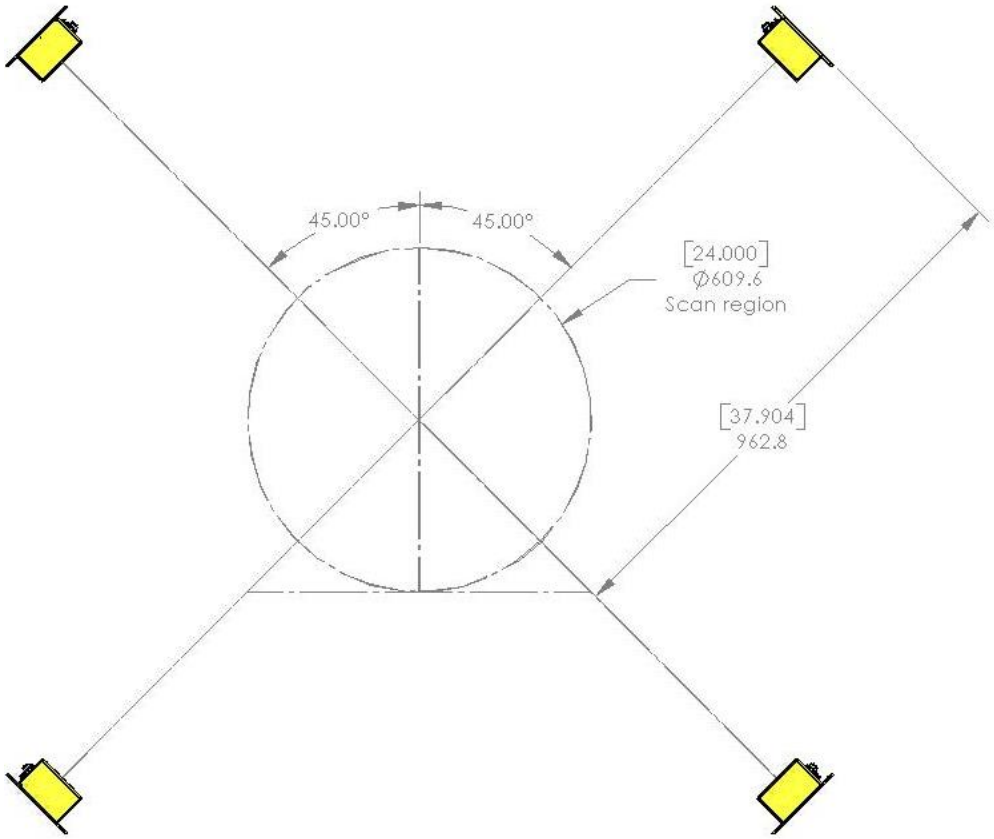
5.3 Scan Frame

A typical scanner arrangement is a ring of four, chroma+scan 20X5, sensors in an "X" configuration. However, different configurations and multiple rings can be employed as needed to suit the application.

Currently, Detection Mode only supports a single ring of sensors.

The scan frame mechanically supports the sensors, and should provide a means of adjusting the location and orientation of each sensor so that their laser planes can be aligned. This is not required to eliminate interference between adjacent sensors (typically the system is set up with adjacent sensors scanning during different slices of the scan period). Provision to support a system calibration target in the scan zone is also required. Shrouding to trap laser light from the sensors, and block external light sources from the scan zone and view of the sensors should be included.

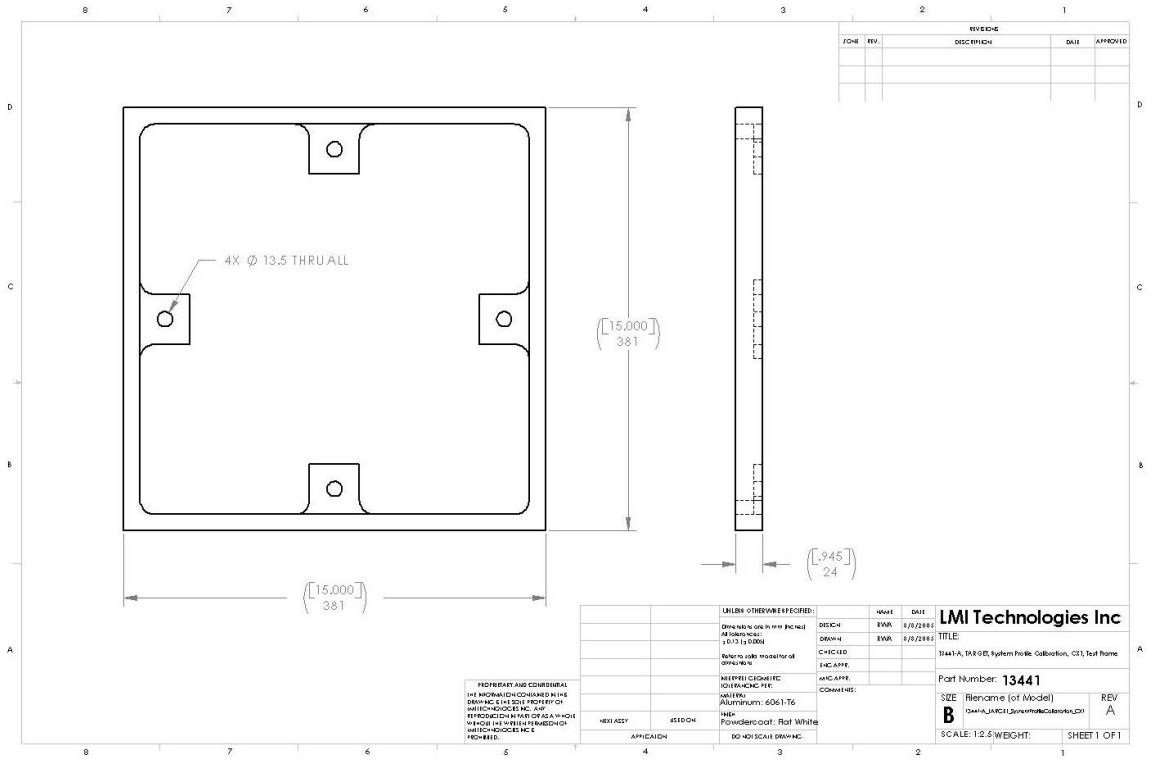
The sensor arrangement shown in the figure below provides a 610mm (24") diameter scan zone to accommodate logs up to 20" in diameter.



To design other sensor configurations, the user can reproduce the sensor scan zone in a CAD system, and manipulate the location and orientation of each sensor in the ring to achieve the desired system scan zone. This will also facilitate design of the system calibration target.

5.4 Calibration Target

The system calibration target is required to perform a system calibration. This process locates each sensor with respect to a global coordinate system defined relative to the target. Transformation parameters for each sensor in the system are acquired during the system calibration process and are used by the Station to transform profile data from the multiple sensors into a single coordinate system aligned with the downstream log processing equipment (eg saws, chipper heads). The target illustrated below is designed for the 4-sensor "X" configuration shown above.



The principle for designing a target for an alternate sensor configuration is as follows. Each sensor must be able to view two surfaces meeting at a vertex. The ideal is to locate the vertex on the centerline of the sensor's laser fan, with the two surfaces at 90° to each other and symmetrical about the centerline. The surfaces should also span as much of the Field Of View (FOV) of the sensor as possible. However, it is not always possible to achieve this. The designer can use an angle larger or smaller than 90°, relax the symmetry requirement, and shift the vertex off-axis as necessary. It is preferable that additional surfaces on the target are not viewable by the sensor, but if they are, they should be at a large enough angle **(> 40°)** that the calibration software can separate the two sections of the scan profile.

6 Software

6.1 Overview

The user's Client, running on the host computer, communicates with a Server, running on the FireSync Station, using the FireSync Host Protocol. This is described in the *FireSync Host Protocol* Reference Manual. This section describes the FireSync Client, and the Client Interface.

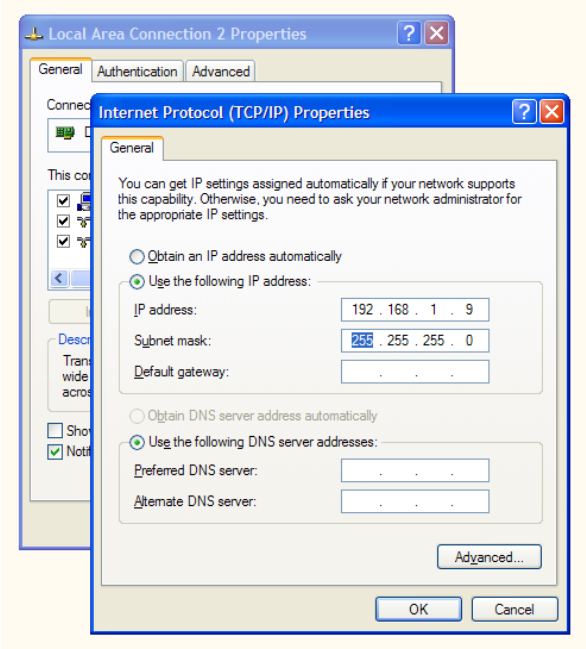
The FireSync Client is a Windows XP application that can be used to demonstrate, test, or diagnose problems with chroma+scan 20X5 systems. The Client Interface is a companion to the *FireSync Host Protocol*, and describes chroma+scan 20X5 specific aspects.

6.2 FireSync Client

FireSync Client is a software application that can be used to demonstrate, test, or diagnose problems with chroma+scan 20X5 sensors. This section describes the most common activities performed with the FireSync Client application.

6.2.1 Installation

The FireSync Client application is available for Windows XP. Obtain the software from LMI Technologies Downloads site and install it on a suitable Client machine. The Client machine should have a Gigabit Ethernet adaptor that can be configured for a static IP address. The FireSync Station typically ships with the address 192.168.1.10. Set the Client machine to an available address on the same subnet (e.g. 192.168.1.9) and then connect a CAT5e Ethernet cable from the Client machine to the FireSync Station.



6.2.2 Connection

After starting FireSync Client (kClient.exe) from the installation folder, use the lightning icon in the toolbar to display the *Connect...* dialog. When prompted, enter the IP address of the FireSync station to which you wish to connect.

6.2.3 Firmware Update

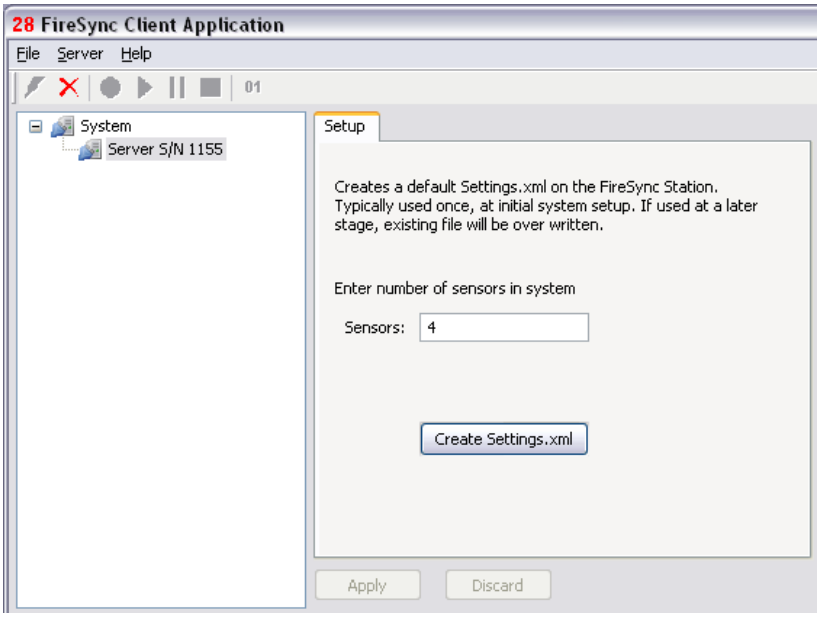
After connecting, the server will be displayed as “Server S/N 0”. This means that the Station is new from the factory and has not had the CS20X5 software installed on it. The next step is to upgrade the server. Select the server, then select *Upgrade* from the *Server* menu. You will be prompted to select an upgrade file. This file is located on the LMI Technologies support website.

Once the upgrade is complete, the entire system must be power cycled. After this is performed, reconnect with kClient.

Follow this procedure whenever a firmware update is released by LMI.

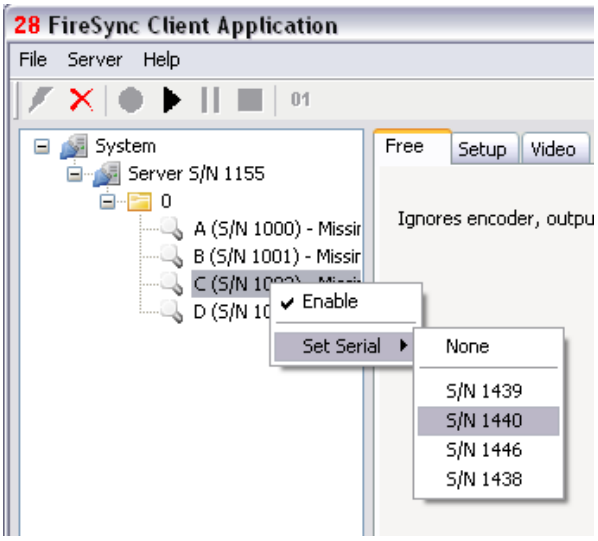
6.2.4 Server Configuration

The FireSync station ships from LMI empty, with no settings files. The very first time the client connects to the station, it detects that there is no settings file and displays the *Setup* tab when selecting the Server node in the device tree. Enter the number of sensors in the system and press the *Create* button.

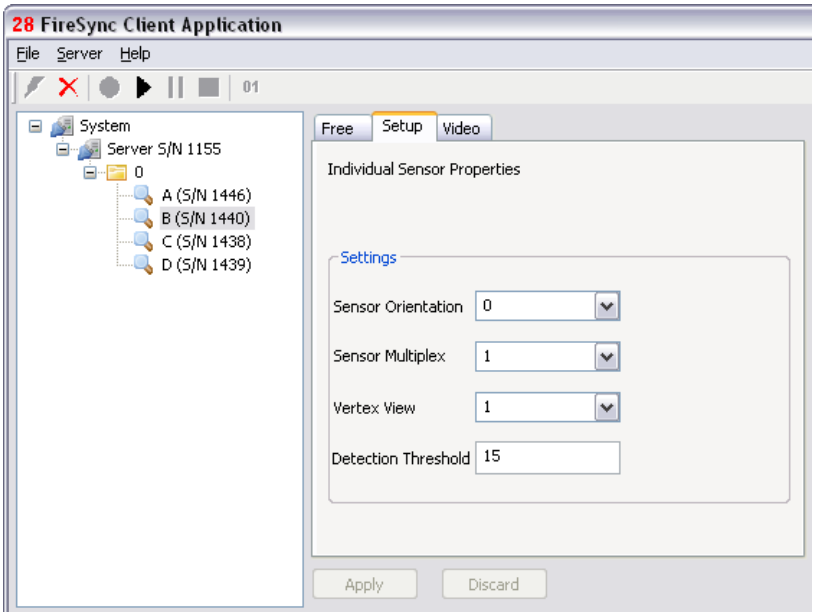


The system topology is now shown in the top left corner of the application. The center part of the application shows configuration tabs, and the right half of the application is occupied by visualization tabs. Selecting the Server entry in the device tree will bring up system level configuration tabs to the right. Selecting individual sensors in the device tree will bring up tabs to configure sensor specific settings.

Right-clicking an entry in the device tree brings up a pop-up menu. Assign a serial number to each of the entries in the device tree, as shown below. A sensor can also be temporarily disabled through this menu.



Select an individual sensor to bring up its configuration tabs, and then select the *Setup* tab. A sensor has an orientation, a multiplex time slot, and is viewing a particular vertex of the system calibration target.



Orientation is a value that can be 0 or 1. This indicates the sensor's orientation relative to the scanning direction. If the model number label on the sensor is towards the out feed of the system, the value should be set to 1, otherwise 0.

Multiplex is a value that can be 0 to 3. This indicates the sensor's system time slot. If any sensor in the system uses the 2nd or 3rd slot, scanning speed will be reduced.

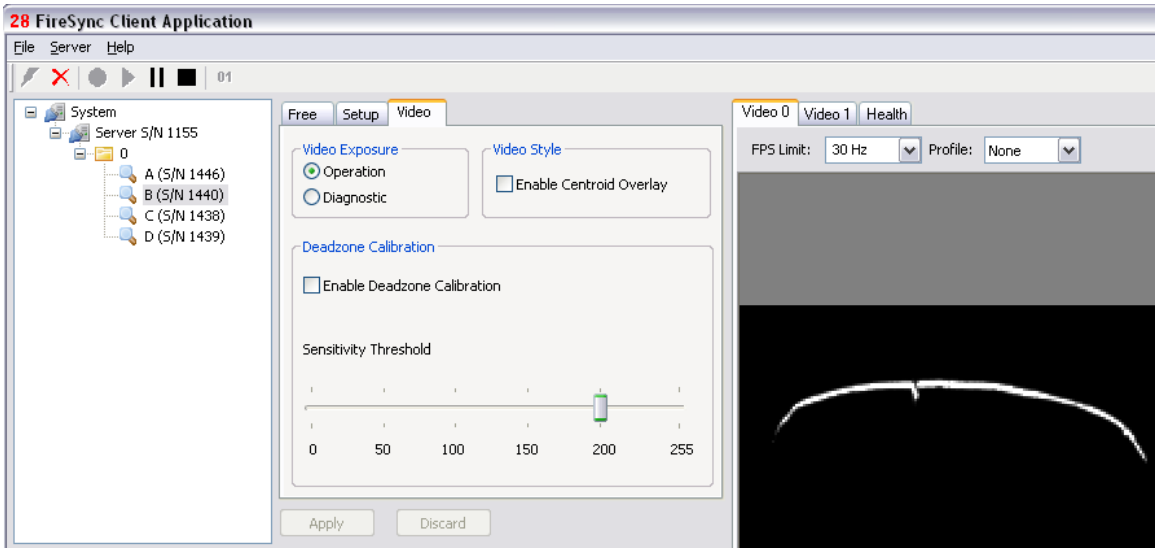
Vertex view is a value that defines the vertex of the system calibration target which this sensor is viewing. Target is shown on the right, in the vizualizer tab, as viewed from the out feed. The vertex number is shown in red. **Note that each sensor has to be assigned a unique vertex view for proper system operation.**

Detection threshold is a value that is the percentage of data points needed to trigger accurate object detection in sensor.

NOTE: It is highly recommended that once the Server Setup is complete and the system is operating as desired that the user creates a **Backup** of all Stations in the system. Select the server, click on the *Server* tab, and select *Backup.*

6.2.5 Video Mode

Select a sensor in the device tree, and then select the *Video* tab. Press the *Play* button (black triangle) in the toolbar, and observe the incoming video images from each camera (Video-0, Video-1 tabs). If there is an object within the field of view of the sensors, you will see laser images appear in the display. Note that you can right-click on the image display for options. Press the *Stop* button (black square) to finish.



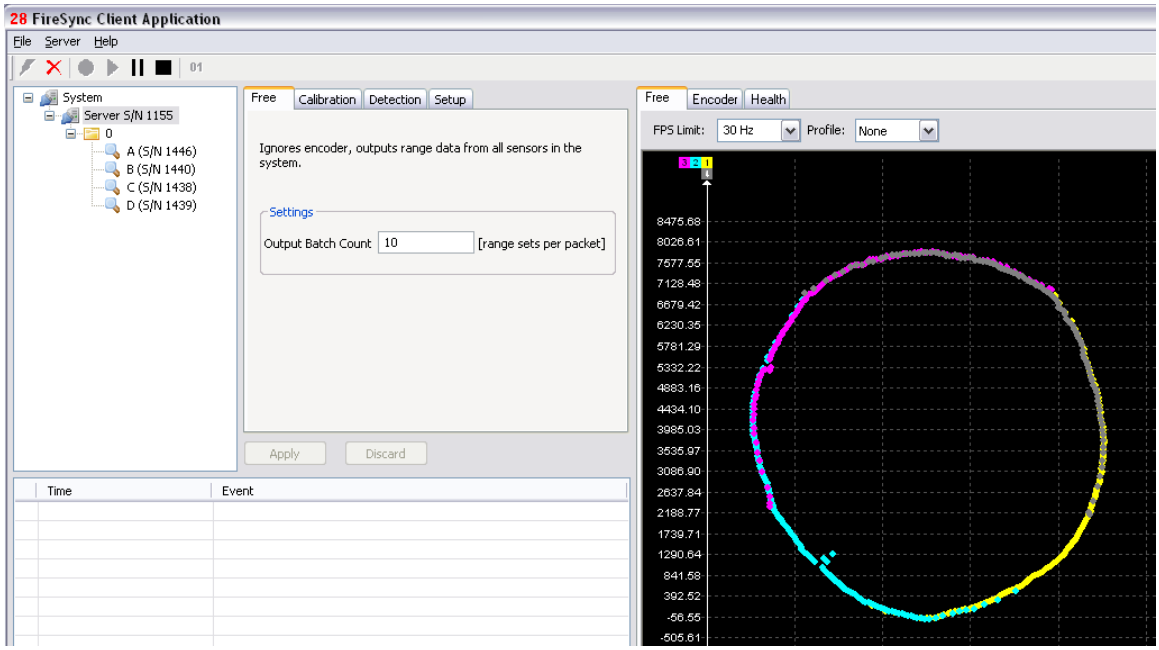
Video can be delivered with different exposure. *Operation* shows video at the exposure period used during full speed scanning in saw mill operation. *Diagnostic* is showing video with a long exposure and slow frame rate. This can be useful to reveal from where unwanted light is showing up in the view of the cameras in the sensor. It is also possible to show detected spots in the video by enabling *Display Centroids*. Note that it is not possible to change video mode or turn on and off centroids during data streaming. Stop the system, change mode, and the start the system again.

The *Video* tab also allows the user to set sensor dead zones to filter out point light sources which have a **fixed** location in the view of the sensor (e.g. a floodlight in the ceiling). The dead zone calibration is performed as the video is running. The dead zones are indicated in the video with red. Adjust the size of the zones with the slider. The dead zones will be committed to the sensor when the system is stopped by pressing the *Stop* button. Make sure there is no object in the scanner frame before enabling this feature. **To remove all dead zones from a sensor, set the slider to 255, and then press *Stop* to commit an empty bit mask to the sensor**. The dead zone calibration should be considered a calibration step, similar to system calibration. It is *not* recommended to write dead zone files to the sensor storage on a regular basis, due to the slow write time (normally 3 seconds, but occasionally up to 2 minutes).

Note! When Centroid Overlay is enabled, the Deadzone Calibration is disabled. Dead zone calibration should not be performed when the video contains centroid data, since it directly modifies the pixel content of the image stream, resulting in invalid masks.

6.2.6 Free Mode

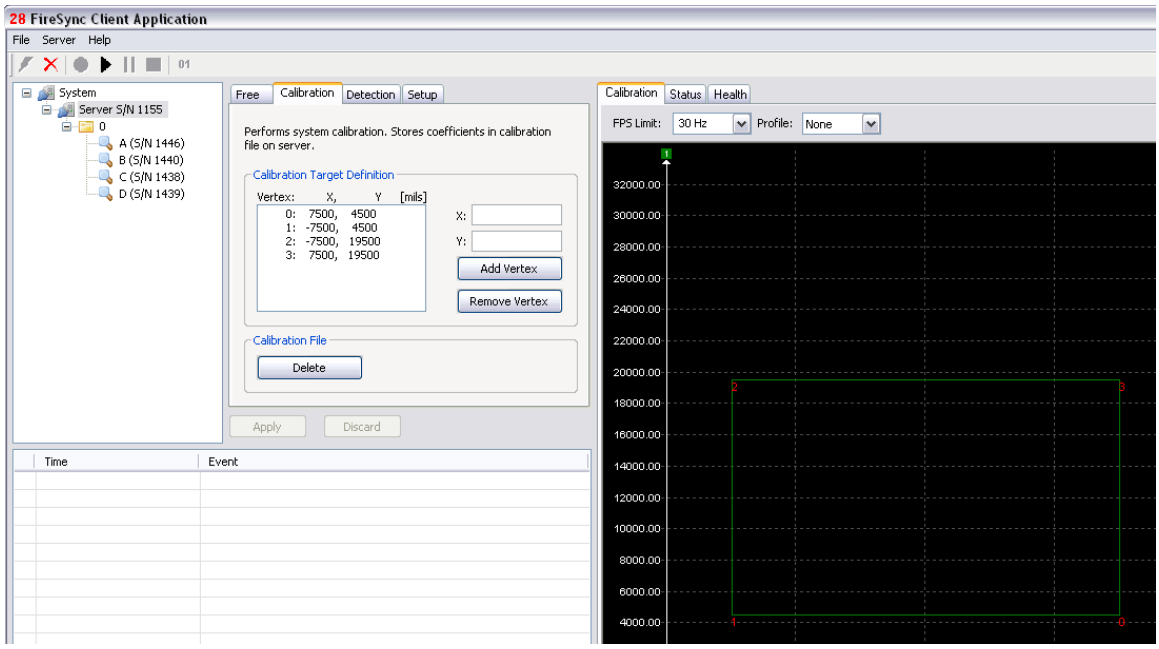
Select the server in the device tree, and then select the *Free* tab. Press the *Play* button (black triangle) in the toolbar, and observe the incoming profile data from each sensor. You can right-click on the graphic display for options. Note that there is also a *Free* tab for each sensor in the device list. These sensor-level *Free* tabs can be used to isolate the data from a single device. Press the *Stop* button (black square) to finish.


28 FireSync Client Application
File Server Help
System
Server S/N 1155
0
A (S/N 1446)
B (S/N 1440)
C (S/N 1438)
D (S/N 1439)
Free Calibration Detection Setup
Ignores encoder, outputs range data from all sensors in the system.
Settings
Output Batch Count 10 [range sets per packet]
Apply Discard
Time Event
Free Encoder Health
FPS Limit: 30 Hz Profile: None
8475.68
8026.61
7577.55
7128.48
6679.42
6230.35
5781.29
5332.22
4883.16
4434.10
3985.03
3535.97
3086.90
2637.84
2188.77
1739.71
1290.64
841.58
392.52
-56.55
-505.61

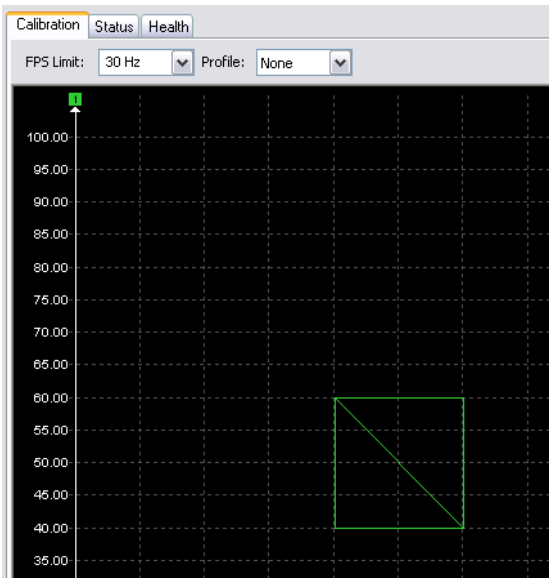
6.2.7 Calibration Mode

In order to receive data from all sensors in a common world coordinate frame, a system calibration has to be performed. This is done by placing a system calibration target, with a given shape and location, in the scanner frame. Each sensor has to view a specific vertex (or corner) of the target and this has to be specified in the Setup tab for each sensor **before** performing the system calibration.

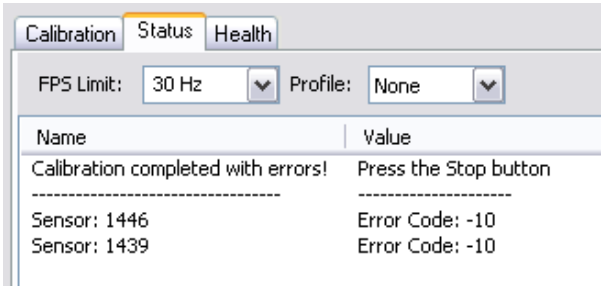
The shape of the system calibration target can be edited by the user. Select the server in the device tree, and then select the *Calibration* tab. The vertices of the system calibration target are shown in the list and corresponding target shape, with numbered vertices in red, is drawn in the visualizer tab to the right. Edit target definition by adding and removing vertices in the list. For log scanning, the vertices have to be given in clockwise order, viewed from the out feed of the frame. Please note that the calibration targets can only be added to or removed from the bottom of the definition list.



After a system calibration target shape has been given, the corresponding physical target placed in the frame, and the vertex view of all sensors has been specified, the system is ready to perform a system calibration. Select the server in the device tree, and then select the *Calibration* tab. Press the *Play* button (black triangle) in the toolbar, and wait for completion status to show as a green or red rectangle. When the calibration has completed press the *Stop* button (black square) to finish. (Occasionally, the system will perform a storage clean-up at the completion of system calibration. If this happens, kClient will be unresponsive for several seconds)



A more detailed status report is shown under the Status tab, where serial numbers of sensors, together with error codes, are reported in case of calibration failure.



Following is a description of error messages. If any other explicit error code is reported by the system, please contact LMI for support.

- **Nonconvergence** is indicating that there is a mismatch between the target definition file and the actual data from the sensor. The calibration routine is trying to fit the sensor data to the target definition, within an acceptable error. In order for this to be successful, the target must have a correctly defined vertex that the sensor can measure data from, without interfering extraneous data.

- **Insufficient Data** is indicating that there is not enough data points measured from the target. The calibration routine requires at least 10 data points from each surface of the target and at least 20 data points in total.

- **Invalid View** is indicating that the sensor has been assigned a vertex view not defined in the target definition.

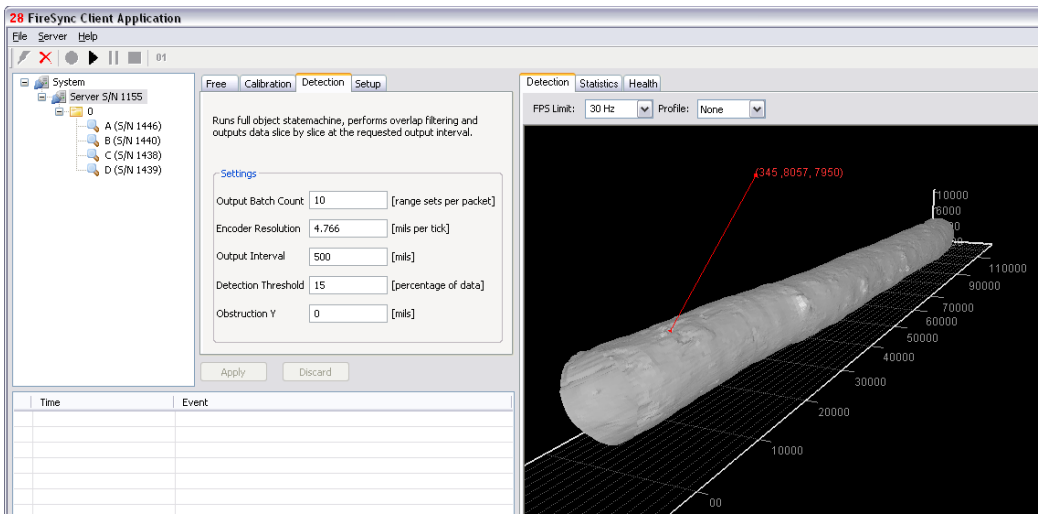
6.2.8 Detection Mode

Select the server in the device tree, and then select the *Detection* tab. Note that system calibration has to be performed first, in order for Detection Mode to run. Before running the system, enter values for the five parameters needed for the Detection Mode:

- Output Batch Count is number of profiles batched together in a single message.
- Encoder Resolution has to be measured on the conveyor and is given in micro inches per pulse.
- Output Interval is the requested distance in mils between delivered scans.
- Detection Threshold sets the sensitivity to trigger an object to be scanned.
- Obstruction Y removes any data from the scan below the given Y value in the world coordinate frame.
- Overlap Filter Enable allows control to enable or disable overlap filtering, which attempts to remove multiple measurements from the same physical location of an object being scanned.

Press the *Apply* button to commit the settings to the system. Press the *Play* button (black triangle) in the toolbar, run a log through the scanner frame, and observe the result when the scan is complete. Press the *Stop* button (black square) to finish. You can right-click on the graphic display for options.

The 3D model can be manipulated with the keyboard and the mouse. Simply clicking on the model with the left mouse button will bring up profiling information. Select Profiling Mode in the drop-down menu above the display. Hold Ctrl and Shift down on the keyboard, and use the mouse buttons to zoom, rotate and translate the model.



Note! Use care with the Output Interval setting. kClient can only render a 3D model up to a size of 1500 slices. If this limit is exceeded, nothing will show on the screen!

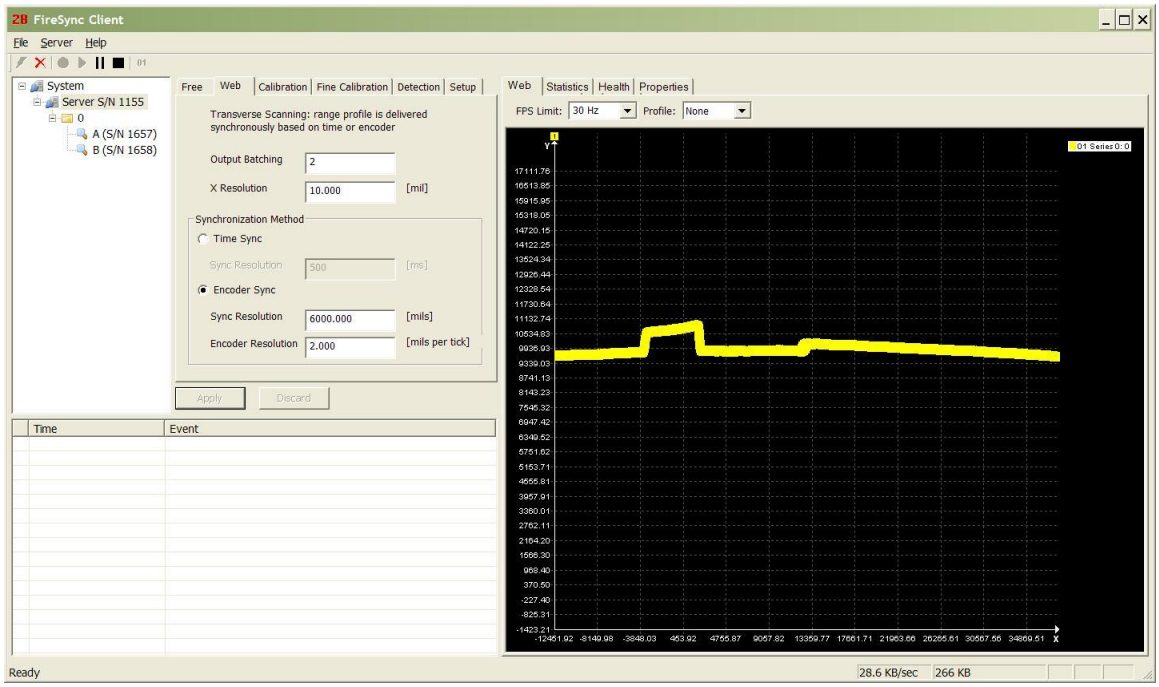
6.2.9 Web Mode

Web mode is a system mode exclusively used for transverse scanning. The *Server Web* tab, shown below, contains settings that affect the operation of *Web* mode. When selected, this tab enables *Web* mode; the *Play*, *Pause*, and *Stop* buttons can be used to run the system.

Web mode offers two methods of synchronization data delivery: encoder-based and time-based. The profile points are sampled in order to produce fixed-resolution outputs.

Note that in order to operate in *Web* mode, the system must undergo system calibration. Without the system calibration, no data will be delivered to the Client from the Server.

Note: The system should be recalibrated after any settings changes (server, group, or sensor), in order to ensure correct behavior in *Web* mode.



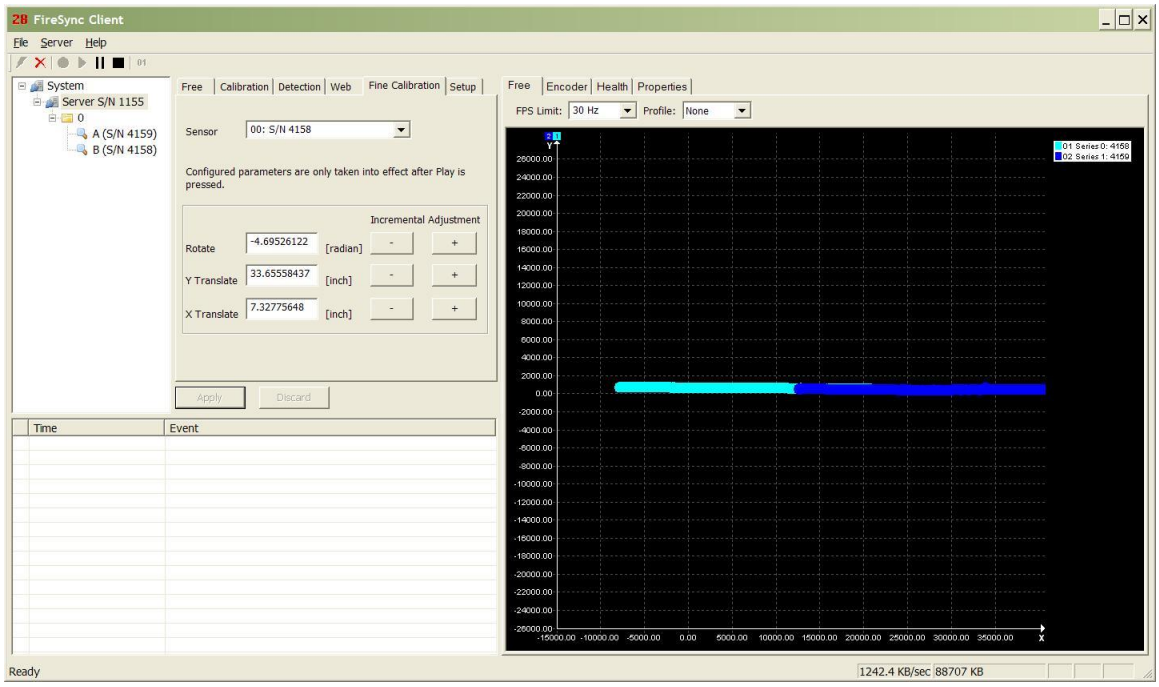
Output Batching		
X Resolution		The x-resolution of profile outputs, in mil per sample.
Time Sync		Time-based synchronization. Disable encoder sync.
	Sync Resolution	Time interval (ms) between scans.
Encoder Sync		Encoder-based synchronization. Disable time sync.
	Sync Resolution	Distance (mil) between delivered scans. Please note that

		the encoder resolution must be a positive value for proper operation.
	Encoder Resolution	Conveyor's resolution (mil per encoder pulse). Please note that the encoder resolution must be a positive value for proper operation.

6.2.10 Server Fine Calibration Tab

The *Server Fine Calibration* tab, shown below, is used to fine-tune the system calibration. This feature is targeted for transverse scanning where it is necessary to fine tune the system calibrated profile data from adjacent sensors. After the system calibration, the system determines the calibration coefficients for each sensor. These coefficients can be modified (fine tuned) from this tab.

This tab enables *Free* mode. When *Play* is pressed, the system calibrated profile data is visualized. This is helpful for the users to make small adjustments to the system calibration coefficients applied to each sensor.



Please note that the adjusted coefficient will only be applied when the system is not running. That is, the user must start/stop the system in order for the modified coefficients to take effect.

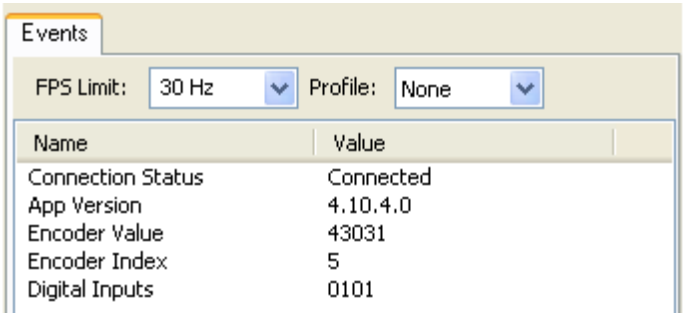
Sensor		Select the sensor for the fine calibration.
	Rotate	Specify the angle of rotation for the profile data of the selected sensor. [in radians]

	Y Translate	Specify the distance of translation in the Y axis for the selected sensor. [in inch]
	X Translate	Specify the distance of translation in the X axis for the selected sensor [in inch]

6.2.11 Event Channel

If kClient detects a connection on the host PC to the sensor network (ie 90.X.X.X subnet) it will enable use of the Event channel. To make this connection, use a Station cordset to connect an available Ethernet port on the host PC to an available sensor port on the Master (or Slave).

Once this connection has been established, click on the *Event Channel* icon 01 (next to the stop button). Click on the *System* tab, and the Event indicators will be displayed in a visualization tab, as shown below. Note that these indicators are identical to some of those in the Health channel; however, these update at a rate of 100Hz versus 2Hz in the Health channel.



6.3 Client Interface

The Client communicates with a Server running on the FireSync Station using the FireSync Host Protocol, as described in the *FireSync Host Protocol* Reference Manual. The following sections describe aspects of communication that are specialized for the chroma+scan 20X5 series.

6.3.1 Settings

Settings are stored in a file on the FireSync Station called "Settings.xml". The Client can access or modify this file using the FireSync Host Protocol *Read File* and *Write File* commands.

Note that all settings that deal with distances or positions use the unit “mils”, which is a thousand of an inch. One mil is 0.0254 millimeter.

The following example illustrates the format of the Settings.xml file for a system with 2 sensors:

```
<?xml version="1.0" ?>
<SensorGroup>
  <Name>System</Name>
  <OutputBatchCount>10</OutputBatchCount>
  <EncoderResolution>4.788</EncoderResolution>
  <OutputInterval>500</OutputInterval>
  <DetectionThreshold>20</DetectionThreshold>
  <OverlapFilterEnable>1</OverlapFilterEnable>
  <IoStateOutputEnable>0</IoStateOutputEnable>
  <ObstructionY>0</ObstructionY>
  <VideoStyle>0</VideoStyle>
  <VideoExposure>0</VideoExposure>
  <MaxSlices>0</MaxSlices>
  <Web>
    <SynchronizeMethod>0</SynchronizeMethod>
    <XResolution>10.00</XResolution>
    <SyncResolution>
      <Distance>6000</Distance>
      <Time>500</Time>
    </SyncResolution >
  </Web>
  <CalibrationTarget>
    <Vertex>
      <X>7500</X>
      <Y>4500</Y>
    </Vertex>
    <Vertex>
      <X>-7500</X>
      <Y>4500</Y>
    </Vertex>
    <Vertex>
```

```
      <X>-7500</X>
      <Y>19500</Y>
    </Vertex>
    <Vertex>
      <X>7500</X>
      <Y>19500</Y>
    </Vertex>
  </CalibrationTarget>
  <Capture>
    <Enabled>0</Enabled>
    <Source>0</Source>
    <Divisor>1</Divisor>
  </Capture>
  <Members>
    <SensorGroup>
      <Name>0</Name>
      <Members>
        <Sensor>
          <Name>B</Name>
          <SerialNumber>1095</SerialNumber>
          <Enabled>1</Enabled>
          <VertexView>1</VertexView>
          <Orientation>0</Orientation>
          <Multiplex>1</Multiplex>
           <DetectionThreshold>15</DetectionThreshold>
        </Sensor>
        <Sensor>
          <Name>A</Name>
          <SerialNumber>1096</SerialNumber>
          <Enabled>1</Enabled>
          <VertexView>0</VertexView>
          <Orientation>1</Orientation>
          <Multiplex>0</Multiplex>
           <DetectionThreshold>15</DetectionThreshold>
        </Sensor>
      </Members>
    </SensorGroup>
  </Members>
</SensorGroup>
```

The example above specifies the settings for a system with four sensors. System-level settings include the following entries:

Setting	**Description**
Name	Must be "System".
OutputBatchCount	The number of profiles batched together in a single message. **NOTE! In Detection Mode, batching is limited to 50**.

EncoderResolution		Encoder Resolution has to be measured on the conveyor and is given in mils per pulse. Used in Detection Mode.
OutputInterval		The requested distance in mils between delivered scans. Used in Detection Mode.
DetectionThreshold		The sensitivity to trigger an object to be scanned (percentage of total possible data points in entire system that have valid range values). Used in Detection Mode.
OverlapFilterEnable		Enables or disables overlap filtering in Detection mode. This filtering attempts to remove multiple measurements from the same physical location of an object being scanned. Multiple measurements occur when two sensors overlap their respective measurement zone. Note that the particular implementation of this filter might not work for every possible sensor mounting scenario. **NOTE for 2040 model! With this filtering enabled, the FireSync Station can only support up to 750 Hz operation in *Detection Mode*.**
IoStateOutputEnable		Enables (1) or disables (0) the transmission of the input state with the profile data in Free mode. **Note: This presence of this field in the settings is optional. If this field is absent in Settings.xml, the system disables the transmission of the input state by default.**
ObstructionY		Removes any data from the scan below the given Y value in the world coordinate frame (mils). Used in Detection Mode.
VideoStyle		The systems can overlay additional centroid information on video images. This setting enables (1) or disables (0) the overlay. Used in Video Mode.
VideoExposure		Images can be captured at normal exposure (0) or high exposure (1). Normal exposure is the standard exposure level used for laser profiling. High exposure is used to help identify potential sources of light interference. Used in Video Mode.
MaxSlices		Used for long term testing, with static object in view of sensors. Indicates the number of slices to be collected before automatically triggering end of object. **Leave at 0 for normal operation!**
Web		Contain options that are applicable only in Web mode
	SynchronizeMethod	Synchronization method used in Web mode. Encoder-based (0), or Timestamp-based (1)
	XResolution	X resolution of profile outputs, in mil per sample. Used in Web mode. .
	SyncResolution	

		Distance	Distance (mil) between delivered scans. Please note that the encoder resolution must be a positive value for proper operation. Used in Web mode when SynchronizeMethod = 0. Set this value such that its resolution is more than 20ms in time.
		Time	Time interval (ms) between scans. Used in Web mode when SynchronizeMethod = 1. Minimum sync resolution is 20ms.

The calibration target is defined by a series of vertices, which are (x,y)-coordinates in the world coordinate frame (mils). The vertices have to be given in clockwise order, viewed from the out feed of the frame, from the top of the file and down. The physical shape and location of the target in the frame has to match this definition in order to generate an accurate calibration.

The Capture settings determine the behavior of the system when capturing data for diagnostic analysis by LMI Technologies. **To use the system normally, please ensure that data capture is disabled by setting Capture/Enabled to *0***.

Sensor-level settings include the following entries:

Setting	**Description**
Name	Typically, the sensor name is a formatted string that defines the location of a sensor within the system. For the chroma+scan 20X5 series, the name is simply a letter, A, B, C, or D.
SerialNumber	The serial number of the sensor, which can be seen on the sensor housing.
Enabled	Enables or disables the sensor. Disabled sensors will not emit laser light and will not report results.
VertexView	Value is the vertex of the system calibration target which this sensor is viewing. **NOTE! Each sensor has to be assigned a unique vertex view for proper system operation.**
Orientation	Value can be 0 or 1. Indicates the sensor's orientation relative to the scanning direction. If the model number label on the sensor is towards the outfeed of the system, the value should be set to 1, otherwise 0.
Multiplex	Value can be 0 to 3. Indicates the sensor's system time slot. **NOTE! If any sensor in the system uses the 2nd or 3rd slot, scanning speed will be reduced for all sensors accordingly.**
DetectionThreshold	Sensor specific sensitivity to trigger an object to be scanned (percentage of total possible data points in single sensor that have valid range values). See section 6.3.4.4 for detailed description.

6.3.2 System Calibration Coefficients

When system calibration is performed, three coefficients are calculated which wholly describes the translation and rotation of each sensor's profile data. The system calibration coefficients are stored in a file on the FireSync Station called "Calibration.xml". The Client can access or modify this file using the FireSync Host Protocol *Read File* and *Write File* commands.

```
<?xml version="1.0" ?>
<SystemCalibration>
  <Sensor>
    <SerialNumber>4158</SerialNumber>
    <X>26.3210902319390</X>
    <Y>31.5457189290618</Y>
    <T>-4.66212431813159</T>
  </Sensor>
  <Sensor>
    <SerialNumber>4159</SerialNumber>
    <X>10.1147826092994</X>
    <Y>30.3783334812516</Y>
    <T>-4.69572804474210</T>
  </Sensor>
</SystemCalibration>
```

The example above specifies the coefficients for a system with two sensors. SystemCalibration level settings include the following entries:

Setting	Description
SerialNumber	The serial number of the sensor, as seen on the sensor housing.
X	Specify the distance of translation in the X axis for the sensor [in inch]
Y	Specify the distance of translation in the Y axis for the sensor [in inch]
T	Specify the angle (theta) of rotation for the selected sensor [in radiant]

In kClient, the content of this file can be modified in the Fine Calibration tab.

6.3.3 Speeds and Data Rates

Depending on sensor model and multiplex settings (in a system of several sensors) the speed and data rates will behave as described in the following table. If any sensor in the system uses the 2nd or 3rd slot, scanning speed will be reduced for all sensors accordingly. Note that data rates in this table represent the worst case, which is Free Mode with OutputBatchCount set to 1, i.e. no batching. With no batching the header takes about 6% of the message size. Batching will reduce this overhead. Data rates apply to a single sensor! For system data rates, multiply by number of sensors.

Model	2010/2011		2020/2021		2040/2041	
	Speed	Rate	Speed	Rate	Speed	Rate
Multiplex 0	250 Hz	0.48 MB/s	500 Hz	0.96 MB/s	1000 Hz	1.92 MB/s
Multiplex 1	250 Hz	0.48 MB/s	500 Hz	0.96 MB/s	1000 Hz	1.92 MB/s
Multiplex 2	167 Hz	0.32 MB/s	333 Hz	0.64 MB/s	667 Hz	1.28 MB/s
Multiplex 3	125 Hz	0.24 MB/s	250 Hz	0.48 MB/s	500 Hz	0.96 MB/s

6.3.4 Modes and Messages

The system can operate in different modes, each of which has a specialized purpose. The Client should use the FireSync Host Protocol *Set Operation Mode* command to set the current mode before sending the *Start* command.

As the system runs, data will be transmitted in a platform-independent binary format. The general rules for this format are described in the *FireSync Host Protocol* Reference Manual, in the section entitled FireSync Result Format. However, it is not *necessary* to consider the FireSync Result Format; chroma+scan 20X5 messages are described below as a stand-alone data format. Note that some fields that pertain to FireSync Result details are marked reserved in this document, where those fields are not strictly required to understand chroma+scan 20X5 messages.

Message specifications in this document use a shorthand notation for data types. All values are little-endian (least significant byte transmitted first).

Data Type	Size (bytes)	Description
8s	1	Signed 8-bit integer
8u	1	Unsigned 8-bit integer
16s	2	Signed 16-bit integer
16u	2	Unsigned 16-bit integer
32s	4	Signed 32-bit integer
32u	4	Unsigned 32-bit integer
64s	8	Signed 64-bit integer
64u	8	Unsigned 64-bit integer

6.3.4.1 Video Mode

The string name of this mode is “Video”. Use this string with the FireSync Host Protocol *Set Operation Mode* command to set the current mode to Video.

Video mode transmits video images at a low, fixed frame rate. Images are transmitted from all cameras in all enabled sensors. Diagnostic graphics may be overlaid on the images, depending on how the system is configured.

Video Message

Field	Type	Description
messageSize	64s	Total size of message (bytes)
messageId	64s	Type of message (2)
reserved[2]	64s	Reserved for internal use
deviceId	64s	Sensor serial number
viewIndex	64s	Camera index
height	64s	Image height
width	64s	Image width
reserved[2]	64s	Reserved for internal use
pixels[height][width][4]	8u	Image pixels (blue, green, red, reserved)

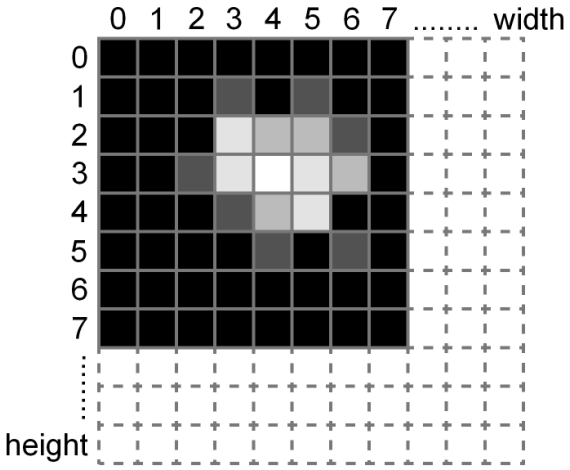
One important use of Video Mode is to be able to automatically generate a dead zone bit mask file for each camera in the sensor. This could, for example, be done with a simple threshold, but the user of the system is free to implement any algorithm to generate the bit mask, as long as the format of the bit mask file is respected. The file is a simple binary format that contains one unsigned byte per pixel, indicating whether that pixel should be masked or not. There is no header in the file, just a block of bytes that match the height and width of the image from Video Mode.

Dead Zone Bit Mask Format

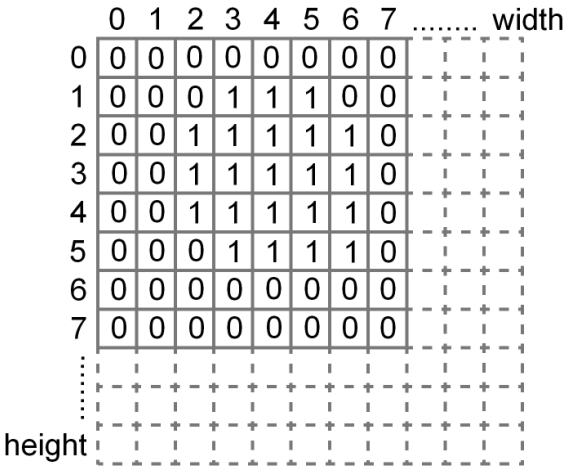
Field	Type	Description
mask[height][width]	8u	A value of 1 at a given pixel location is indicating that the pixel will not be used by the camera for measurements. A value of 0 leaves the pixel open for processing.

Note that the height and width of the mask has to be identical to the values in the video message. **The mask has to perfectly "fit" the camera image**. Also, make sure that the VideoStyle setting is 0. *The centroid overlay directly modifies the pixel content of the image stream and would cause an invalid mask*.

Here is an example to help describe the bit mask file definition.



Video Mode image with
example static light pattern



Example of possible
bit mask pattern

Use the FireSync Host Protocol *Write File* command to store the mask on the sensor. The string name of the file has to include the serial number of the sensor! Use the following string file name for camera 0, "\\SNXXXX\\mask0.bin", and for camera 1 use, "\\SNXXXX\\mask1.bin".

The dead zone calibration should be considered a calibration step, similar to system calibration. It is *not* recommended to write dead zone files to the sensor storage on a regular basis, due to the slow write time (normally 3 seconds, but occasionally up to 2 minutes).

6.3.4.2 Free Mode

The string name of this mode is "Free". Use this string with the FireSync Host Protocol *Set Operation Mode* command to set the current mode to Free.

In Free Mode, profile data is transmitted without any additional processing, except transformation to world coordinates if a system calibration has been performed. The resolution of the actual profile data is given by the field profileResolution, i.e. the data has to be multiplied by this factor for correct absolute values (mils). Note that invalid profile points are represented by the value (-32768).

Make sure to use the count field as there is no guarantee that this value will always follow the OutputBatchCount setting.

Note that two types of Free message can be transmitted depending on whether the end user wishes to include the input state in the message. By default, the input state is not included in the Free message. The messageID for the Free message without the input state is 0. If the input state is sent with the Free message, the message ID is 4.

Free Message (messageId = 0)

Field	Type	Description
messageSize	64s	Total size of message (bytes)

messageId	64s	Type of message (0)
reserved[2]	64s	Reserved for internal use
deviceId	64s	Sensor serial number
profileResolution	64s	Resolution of profile data (mils/unit)
reserved[4]	64s	Reserved for internal use
count	64s	Count of profile arrays grouped in message
width	64s	Count of range points per profile array
reserved[2]	64s	Reserved for internal use
attributes[count][2]	64s	Profile attributes (channels defined below)
points[count][width][2]	16s	Profile arrays (x, y)

Free Message (messageId = 0) - Profile Attribute Channels

Field	Type	Description
timestamp	64s	Capture time (microseconds)
position	64s	Capture position (encoder count)

Free Message with input state (messageId = 4)

Field	Type	Description
messageSize	64s	Total size of message (bytes)
messageId	64s	Type of message (4)
reserved[2]	64s	Reserved for internal use
deviceId	64s	Sensor serial number
profileResolution	64s	Resolution of profile data (mils/unit)
reserved[4]	64s	Reserved for internal use
count	64s	Count of profile arrays grouped in message
width	64s	Count of range points per profile array
reserved[2]	64s	Reserved for internal use
attributes[count][3]	64s	Profile attributes (channels defined below)
points[count][width][2]	16s	Profile arrays (x, y)

Free Message with input state (messageId = 4) - Profile Attribute Channels

Field	Type	Description

timestamp	64s	Capture time (microseconds)
position	64s	Capture position (encoder count)
inputState	64s	Input State

6.3.4.3 Calibration Mode

The string name of this mode is “Calibration”. Use this string with the FireSync Host Protocol *Set Operation Mode* command to set the current mode to Calibration.

In Calibration Mode, the Server finds the transformation coefficients for all the sensors, to bring the data into the world coordinate frame. These coefficients are automatically written to a file on the FireSync station named "Calibration.xml". **NOTE! Any already existing coefficients will be over written.** If needed, use the FireSync Host Protocol *Read File* command to save a backup of the file on the client. To eliminate the stored calibration data, use the FireSync *Delete File* command to remove "Calibration.xml" from the FireSync station.

A message is sent at the completion of the process to notify the client. (Occasionally, the system will perform a storage clean-up at the completion of system calibration. If this happens, the Server will be unresponsive for several seconds)

Calibration Completed Message

Field	Type	Description
messageSize	64s	Total size of message (bytes)
messageId	64s	Type of message (8)
count	64s	Number of error values sent with this message. A value of 0 indicates successful calibration, and the message will end after the reserved field.
reserved	64s	Reserved for internal use
deviceId(0)	64s	First error value, containing the serial number of the device reporting the failure.
errorCode(0)	64s	Second error value, containing the error code.
…		
deviceId(n-1)	64s	Last serial number.
errorCode(n-1)	64s	Last error code.

If the file "Calibration.xml" exists on the FireSync station, then Free Mode will automatically apply the coordinate transformation and deliver data in world coordinates. Also note that Detection Mode cannot run at all without a system calibration.

For a detailed description of error messages, see section 6.2.7.

6.3.4.4 Detection Mode

The string name of this mode is “Detection”. Use this string with the FireSync Host Protocol *Set Operation Mode* command to set the current mode to Detection.

NOTE! System calibration has to be performed before Detection Mode can run.

In Detection Mode, the Server runs an object state machine and automatically triggers the start and end of the object being scanned. The data is filtered for overlap between the sensor views, and transmitted on a slice by slice basis. Slices will be delivered to the requested interval as defined by the setting OutputInterval in Settings.xml, and will be batched together according to the setting OutputBatchCount. Note that the first and last batch of an object might not have exactly this number of slices. Always use the count field in the message!

The detection of the start and end of the object is not limited to the requested output interval. The sensors only send out range data at the requested interval, but regardless of this setting, an additional object detection trigger is run at the full speed of the sensor. This indicates a more accurate start and end of the log, but there is no actual range data available at this position. In order to communicate this more accurate log detection, a copy of the range data for the first slice with actual data is sent out at the start of the log, but together with the more accurate encoder count. Likewise at the end of the log, a copy of the range data for the last slice with actual data is sent out at the more accurate position of the end of the log.

In case of backwards encoder movement, i.e. chain or conveyor is moving backwards, no data will be sent. Data delivery will then resume when encoder is past the point where the backwards movement first started. In order to reset encoder, use the FireSync Host Protocol to send a *Stop* command.

The resolution of the actual profile data is given by the field profileResolution, i.e. **the data has to be multiplied by this factor for correct absolute values** (mils). Note that invalid profile points are represented by the value (-32768).

Detection Message

Field	Type	Description
messageSize	64s	Total size of message (bytes)
messageId	64s	Type of message (1)
reserved[2]	64s	Reserved for internal use
profileResolution	64s	Resolution of profile data (mils/unit)
objectId	64s	The object this message belongs to. The Id is a count of objects scanned from system start.
Reserved[4]	64s	Reserved for internal use
count	64s	Count of profile arrays grouped in message

width	64s	Count of maximum range points per profile array
reserved[2]	64s	Reserved for internal use
attributes[count][2]	64s	Profile attributes (channels defined below)
points[count][width][2]	16s	Profile arrays (x, y)

Detection Message - Profile Attribute Channels

Field	Type	Description
slicePos	64s	Capture position of slice (encoder count)
count	64s	Count of range points in this slice

At the end of the object a special end marker is transmitted to signal a complete log scan.

End Marker Message

Field	Type	Description
messageSize	64s	Total size of message (bytes)
messageId	64s	Type of message (9)
reserved[2]	64s	Reserved for internal use

6.3.4.5 Web Mode

The string name of this mode is “Web”. Use this string with the FireSync Host Protocol *Set Operation Mode* command to set the current mode to Free.

NOTE! System calibration must to be performed in order for Web Mode to run properly.

Web mode assumes that an array of sensors are mounted (and calibrated) to perform a transverse scan of some surface that spans larger than one sensor’s FOV. The purpose of Web mode is to determine a profile, in world coordinates, that represents the surface elevation of an object being scanned. The range values are stored in a 2D array, where a row of data represents the range measurements captured at the same time or same encoder count, depending on the synchronization method employed. Within each row, the range measurements are resampled via two linear interpolations. The first interpolation is applied to the y axis (axis of motion or time) to obtain even distance or elapsed time (y-resolution). Then, the second interpolation is applied to the x axis (across the laser line) to obtain x-resolution. The X values of each row can be reconstructed from *xOrigin* and *xResolution* included in the Web message. Similarly, the Y values (either in time or encoder count) can be reconstructed from yOrigin and yResolution in the Web message.

Please note that all profile range units (x, z) are scaled by the value defined in *profileResolution* in the Web message. i.e. **the data has to be multiplied by this factor (in mils/unit) for correct absolute values**. Note that invalid profile points are represented by the value (0x8000).

Web Message

Field	Type	Description
messageSize	64s	Total size of message (bytes)
messageId	64s	Type of message (5)
reserved[2]	64s	Reserved for internal use
synchronizeMethod	64s	Synchronization method used: Encoder-based (0), or Timestamp-based (1).
xOrigin	64s	x-offset (mils)
xResolution	64s	Distance between delivered x samples (mils)
yOrigin	64s	Starting encoder ticks when synchronizeMethod=0, or Starting time (ms) when synchronizeMethod=1
yResolution	64s	Encoder ticks between delivered scans when synchronizeMethod=0, or Time interval (ms) between scans when synchronizeMethod=1
profileResolution	64s	Resolution of profile data (mils/unit)
height	64s	Profile array height
width	64s	Profile array width
reserved[2]	64s	Reserved for internal use
values[height][width][1]	32s	Profile range values (unit)

6.3.5 Health Indicators

Chroma+scan 20X5 systems emit diagnostic messages containing health indicators at a regular interval. The message format is described in the *FireSync Host Protocol* Reference Guide, in the section entitled FireSync Health Data Channel. The indicators described in the Reference Guide are common to all LMI FireSync products.

The following sections describe the health indicators specific to chroma+scan 20X5 sensors and servers, which are sent out in addition to the ones described in the Reference Guide.

Note: currently, there are no custom indicators for CS20X5 sensors or servers. Consult the FireSync Host Protocol User's Manual for the complete lists of standard indicators.

7 Warranty

7.1 Warranty policies

The sensor is warranted for a predetermined number of years from the date of purchase from LMI Technologies Inc. This warranty period is defined by your business agreement in place with LMI Technologies. For exact warranty periods by product, please contact your Business Development Manager. Products that are found to be non-conforming during their warranty period are to be returned to LMI Technologies Inc. The sensor must be properly handled, installed and maintained, as described in Section 2: Proper Handling and Precautions. LMI will void the warranty of the sensor if the sensor has been improperly installed or mishandled.

The shipper is responsible for covering all duties and freight for returning the sensor to LMI. It is at LMI's discretion to repair or replace sensors that are returned for warranty work. LMI Technologies Inc. warranty covers parts, labor and the return shipping charges. If the warranty stickers on the sensors are removed or appear to be tampered with, LMI will void the warranty of the sensor.

7.2 Return policy

Before returning the product for repair (warranty or non-warranty) a Return Material Authorization (RMA) number must be obtained from LMI. Please call LMI to obtain this RMA number. Carefully package the sensor in its original shipping materials (or equivalent) and ship the sensor prepaid to your designated LMI location. Please insure that the RMA number is clearly written on the outside of the package. With the sensors, include the address you wish this shipment returned to, the name, email and telephone number of a technical contact should we need to discuss this repair, and details of the nature of the malfunction. For non-warranty repairs, a purchase order for the repair charges must accompany the returning sensor. LMI Technologies Inc. is not responsible for damages to a sensor that is the result of improper packaging or damage during transit by the courier.

8 Getting Help

If you wish further help on the component or product, contact your distributor or LMI directly. Visit our website at www.lmi3D.com for the agent nearest you.

For more information on Safety and Laser classifications, contact:

U.S. Food and Drug Administration
Center for Devices and Radiological Health
Document Mail Center – WO66-G609
10903 New Hampshire Avenue
Silver Spring, MD 20993-0002