USER'S MANUAL

# chroma+scan 24x0

Version 5.4.5.4

**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.

LMI Technologies, Inc.
1673 Cliveden Ave.
Delta, BC V3M 6V5

Telephone: +1 604 636 1011
Facsimile: +1 604 516 8368
www.lmi3D.com

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# 1 Laser Safety

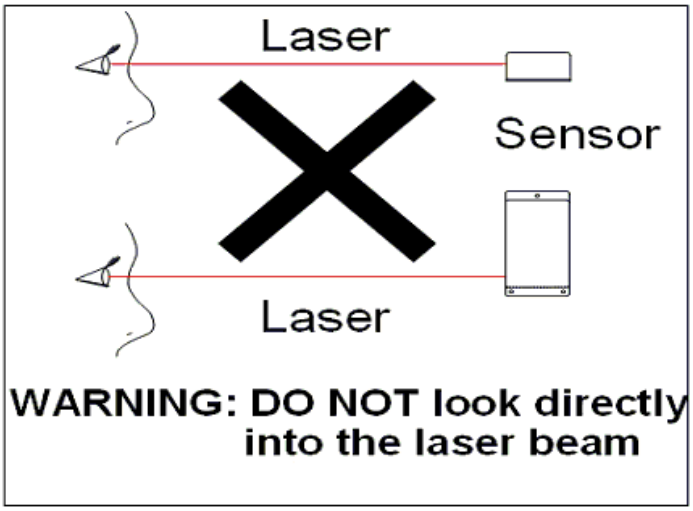
## 1.1 General Information

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

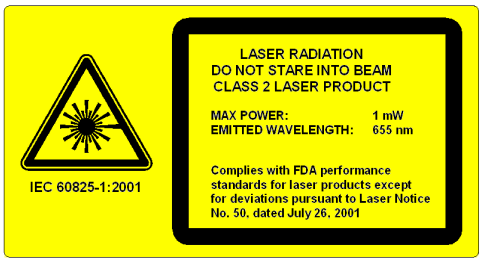
## 1.2 Laser Classification

### 1.2.1 Laser Classes

**Class 2/II laser products:**

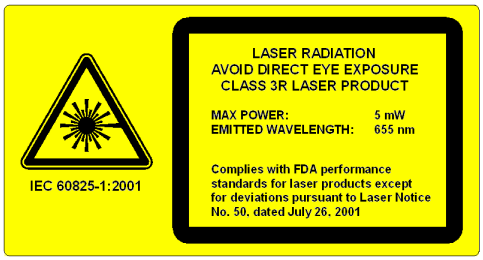
Class 2/II laser products would not cause permanent damage to the eye under reasonably foreseeable conditions of operation, provided that any exposure can be terminated by the blink reflex (assumed to take 0.25 sec). Because classification assumes the blink reflex, the wavelength of light must be in 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 chroma+scan 24x0 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 through the connector housing and to the electrical box containing the Master.

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, electric 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 Humidity (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.

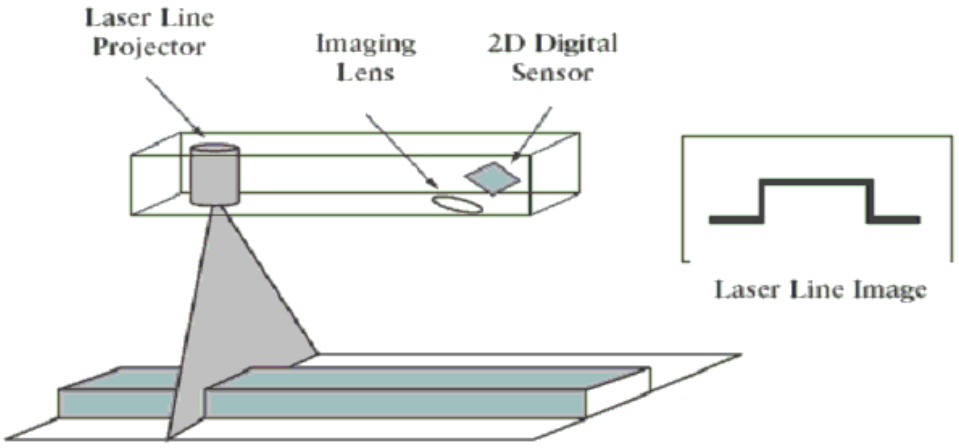
# 3 Product Overview

## 3.1 Introduction

The chroma+scan 24x0 is the new-generation, high-speed, high-density 3D profile scanning system for primary log optimization. The 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 24x0 sensors function on the principle of structured light triangulation. A semiconductor laser with special optics projects fans of light onto the target. Digital cameras mounted at an angle to the laser plane acquire images of the light pattern created on the target. These images contain the basic information needed to compute distances to the target.



## 3.3 Sensor Models

Two models exist in the chroma+scan 24x0 family: the chroma+scan 2420 and the chroma+scan 2440.


**chroma+scan 2420**


**chroma+scan 2440**

## 3.4 Features

The chroma+scan 2440 provides a 6” profile spacing, in a flexible 2’ sensor footprint, whereas the chroma+scan 2420 is a more economical choice, providing 12” profile spacing in a 4’ sensor footprint.

# 4 System

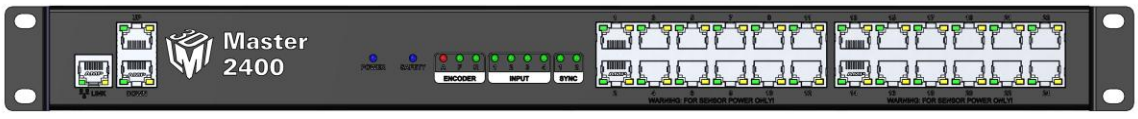
## 4.1 List of Components

A chroma+scan 24x0 system consists of following components:

- FireSync Master 400/800/1200/2400
- Station computer (Host computer)
- Client computer
- Network switch
- 48V Power Supply
- FireSync Network Cordsets
- Other cabling: Ethernet, Power & Encoder
- Scanner Frame
- System Calibration Target
- chroma+scan 24x0 sensor(s)

### 4.1.1 FireSync Master

The FireSync Master provides sensor power, safety interlock and broadcasts system-wide synchronization information (ie. time, encoder count, and digital I/O states) to all sensors. LMI Technologies provides a Master 400, 800, 1200, or 2400.




**Master 2400**

**Warning!** Use extreme caution wiring the FireSync master. Do not plug Ethernet equipment into the RJ45 ports.

### 4.1.2 Station Computer

A chroma+scan 24x0 system needs a Station computer in order to operate. This computer is not provided by LMI Technologies.

The station must have two Ethernet adapters. One Gigabit Ethernet adapter is connected to the sensors network via a gigabit Ethernet network switch. This adapter on must be assigned a static IP in the range 90.0.0.1 to 90.0.0.5. We refer to this as the “IN”

adapter. The second Gigabit Ethernet adapter must also be assigned a static IP of the user's preference. This is the "OUT" adapter.

After installing the chroma+scan 24x0 Station software this computer acts as a FireSync Host Protocol Server. "OUT" is to be used for the Host Protocol. The next step is to upgrade the Station and sensors by sending an upgrade package over the FireSync Host Protocol with a Client computer.

For more information about the FireSync Host Protocol, please refer to the in the *Host Protocol Reference* Manual. Refer to the *Station Setup Guide* for complete details on the FireSync Station.

### 4.1.3 Client Computer

The Client computer connects to the Station using the FireSync Host Protocol. This computer is not provided by LMI Technologies.

The Client computer must be equipped with a Gigabit Ethernet adaptor to communicate with the Station. The FireSync Host Protocol allows any OS for communication with the Station. However, the Client installer provided by LMI Technologies requires Windows XP or Windows 7.

### 4.1.4 Network Switch

The Network Switch connects all the sensors in the system to the Station and the Master. This switch must be Gigabit rated and have enough GigE ports to connect to each sensor plus two extra ports to connect to the Station and the Master.

A network switch is required in a chroma+scan 24x0 sensor system. This switch is not provided by LMI Technologies.

### 4.1.5 Power Supply

The user must provide a suitable +48VDC power supply for the system.

**These power supplies must be isolated! This means that DC ground is NOT tied to AC ground!**

LMI Technologies recommends use of a Phoenix Contact, QUINT, 10 Amp power supply (for +48VDC). This is a DIN rail mounted device that can be connected in parallel to increase the overall available power.

| | |
|---|---|
| Voltage | +48VDC |
| Model | QUINT-PS-100-240AC/48DC/10 |
| Order number | 2938248 |

### 4.1.6 FireSync Network Cordsets

The FireSync Network cordset is a cable that contains two CAT5e cables within one shroud. One of these CAT5e cables is used to carry data between a sensor and a

network switch, and the other cable is used to send power, safety interlock, and synchronization signals to a sensor.

Shielded FireSync cordsets and shielded FireSync cable are optionally provided by LMI Technologies by customer request.

### 4.1.7 Other Cabling

**Ethernet**

Shielded CAT5e Gigabit Ethernet cable is used to connect a Station to a client PC. This cable will connect to the Station OUT.

**Power**

The 48VDC power supply must be connected to the master. Section 5.6.4 contains information about the power cable and connector.

**Encoder**

The user must provide a suitable encoder. The requirements are:

- Differential quadrature output (maximum 18 V)
- +5VDC power supply input

The encoder interface on the Master provides the following:

- X4 quadrature decoding
- Maximum 300kHz count rate
- +5VDC to power the encoder

The user should choose an encoder with the appropriate number of pulses per revolution to match the transport mechanism and speed.

### 4.1.8 System Calibration Target

System calibration can be used to identify the location and orientation of each sensor with respect to a calibration target positioned in the measurement range of the sensor(s). After successful system calibration ranges from the sensor(s) are transformed to a new, common coordinate system.

The dimensions of the target can be configured manually, which allows for optimal flexibility in choosing a target. There are, however, properties that affect the chance on successful calibration. Here are some guidelines for choosing the right target shape, size, and positioning:

- Take a large (400mm X 400mm X …mm), bar shaped object
- Make sure the sensors clearly see an edge vertex, ideally a right angle. Seeing the letter “V” when not calibrated, is ideal.
- Make sure as many points as possible are visible along each side of the vertex
- Avoid having objects in the FOV other than the calibration target

### 4.1.9 Sensors

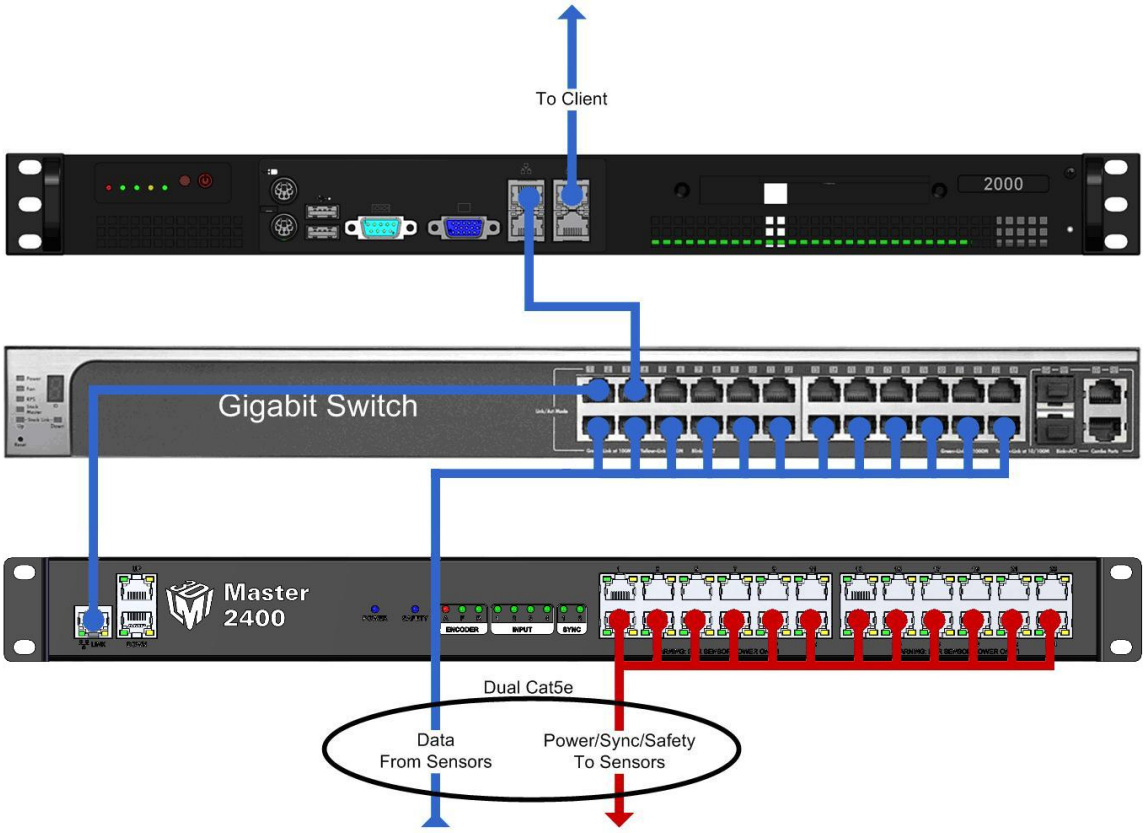
Within a single chroma+scan sensor system various models can be used. Configurations in which sensors are mounted opposing each other are allowed. When working with more than one sensor the following restriction applies:

**Laser lines may only intersect if the intersecting lines are from sensors in different groups. The maximum number of groups is two.**

It is possible to use different configurations of sensors within each of the two groups, and no symmetry or alignment between groups is required.

## 4.2 Connections

The following illustration demonstrates how to connect the various components.




### 4.2.1 Power to Master 1200/2400

The 48 VDC power supply is wired to the Phoenix connectors on the Master. This powers the Master and is distributed to all the connected sensors in the system.

### 4.2.2 Master 1200/2400 to Sensors

Each sensor in the system is connected to the Master in order to receive power and synchronization signals. This connection is made using the FireSync Network Cordset.

The single connection at the sensor end is through the circular connector on the sensor. The connection at the Master end is from the black jacketed RJ45 cable. The yellow jacketed RJ45 cable end is connected to the Network Switch. Do not connect the yellow jacketed connector to a port on the master!

### 4.2.3 Safety Interlock on Master 1200/2400

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 between +12V and +48V across the laser safety +/- connection.

### 4.2.4 Sensors, Master 1200/2400 and Station to Gigabit Switch

The Gigabit switch connects all the sensor data lines with the Master and the Station.

Each sensor in the system connects to the Gigabit Switch with the yellow jacketed RJ45 cable end of the sensor Network Cordset.

The Master 1200/2400 connects to the Gigabit Switch via the “Link” port on the Master.

The Station connects via its “IN” port to the Network Switch.

### 4.2.5 Client computer

The Client computer is connected to the Station’s “OUT” Gigabit Ethernet adapter.

# 5 Specifications

## 5.1 Models

chroma+scan 24x0 sensors are available in two current models:

chroma+scan 2420: 4 Line Profiles, 12” Spacing, 120Hz, 4’ Footprint

chroma+scan 2440: 4 Line Profiles, 6” Spacing, 120Hz, 2’ Footprint

These models all provide the same profile scan zones with a choice of 6” or 12” profile spacing available in 2’ or 4’ sensor footprints.

## 5.2 Performance

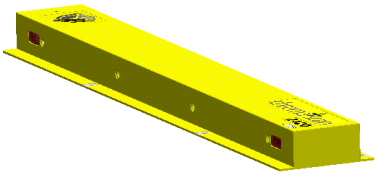
| | | |
|---|---|---|
| Range Accuracy | | |
| chroma+scan 2420 | ±2.54 mm | ±0.100 in |
| chroma+scan 2440 | ±3.175 mm | ±0.125 in |
| Profile Resolution | | |
| chroma+scan 2420 | 2.0 mm | 0.079 in |
| chroma+scan 2440 | 2.0 mm | 0.079 in |
| Scan Resolution @ 2.3m/s (450 fpm) | 19.05 mm | 0.750 in |

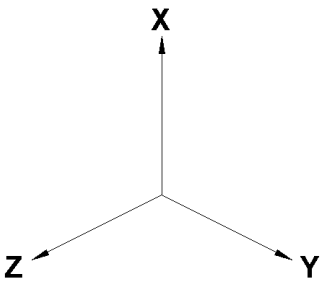
## 5.3 Environment

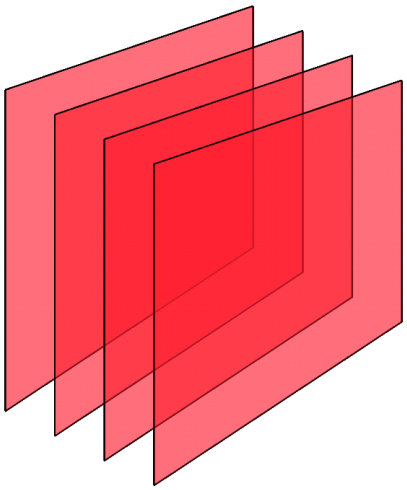
| | | |
|---|---|---|
| Operating Temperature | 0 - 50°C | 32 - 122°F |
| Input Power | +48VDC | |
| Housing | IP67, Powder Coated Aluminum | |

## 5.4 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.** |

**Note:** The direction of the X-axis can be changed on sensor by sensor basis. This is controlled by the "Orientation" field in the configuration file. Please refer to section 6.4.3.

## 5.5 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.

## 5.6 Master 2400

### 5.6.1 Mechanical Information

| | |
|---|---|
| Link, UP, DOWN, Sensor ports | RJ45 |
| Power & Safety connector | Phoenix Contact MC 1,5/ 6-STF-3,5 |
| Encoder connector | Phoenix Contact MC 1,5/ 8-STF-3,5 |

| | |
|---|---|
| Input & Output connector | Phoenix Contact MC 1,5/ 12-STF-3,5 |
| Ext. Sync. connector | Phoenix Contact MC 1,5/ 4-STF-3,5 |

### 5.6.2 Electrical Information

| | |
|---|---|
| Power Supply voltage | +48 VDC |
| Power Supply current (Max.) | 10A |
| Encoder signal voltage range | +0.475 VDC to +18 VDC |
| Digital Input voltage range | Logical LOW: 0VDC to +0.1 VDC<br><br>Logical HI: +3.4 VDC to +5 VDC |

The +48VDC power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.

If the user wishes to connect a higher voltage signal to the Digital Inputs, an external current limiting resistor must be used. The input already has an internal 330Ω resistor. Add an external resistor of the appropriate value such that the current to this input is **less than 15mA**.

### 5.6.3 LED Indicators

| **Indicator LED** | **Description** |
|---|---|
| Link Green LED | Blinking: Ethernet traffic detected |
| Link Yellow LED | On: Connected<br><br>Off: Not connected |
| UP Green LED | Reserved for future use |
| UP Yellow LED | Reserved for future use |
| DOWN Green LED | Reserved for future use |
| DOWN Yellow LED | Reserved for future use |
| Power | Device is powered on |

| | |
|---|---|
| Safety | Indicates the status of the Safety Interlock circuitry. The “On” state indicates that all sensor light sources are active |
| Encoder A | Encoder alarm:<br>The encoder alarm is turned on when one of the encoder’s differential voltage signals (A, B or Z) fall below 0.475 volts |
| Encoder F | On continuously: Forward motion with no indexing is detected<br>Blinking: Forward motion with indexing is detected |
| Encoder R | On continuously: Reverse motion with no indexing is detected<br>Blinking: Reverse motion with indexing is detected |
| In 1 | Digital input port 1 active |
| In 2 | Digital input port 2 active |
| In 3 | Digital input port 3 active |
| In 4 | Digital input port 4 active |
| Out 1 | Digital output port 1 active |
| Out 2 | Digital output port 2 active |
| Sensor Port Green LED | On: Power over Ethernet device detected and powered<br>Blinking: Error |
| Sensor Port Yellow LED | Unused |

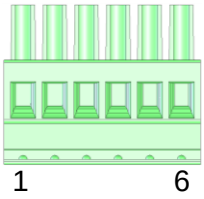
### 5.6.4 Terminal plugs

The Master uses four Phoenix Contact (MC 1.5/ series) terminal plugs:

- Power and Safety interface
- Encoder interface
- Digital I/O interface
- External Sync interface

**Power and Safety (6-pin connector)**

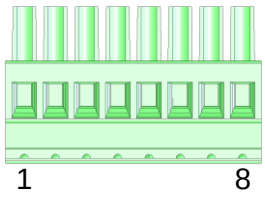
| Pin | Signal |
|---|---|
| 1 | +48VDC |




| | |
|---|---|
| 2 | +48VDC |
| 3 | GND(48V) |
| 4 | GND(48V) |
| 5 | Safety Control + |
| 6 | Safety Control - |

The +48VDC power supply must be isolated from AC ground. This means that AC ground and DC ground are not connected.

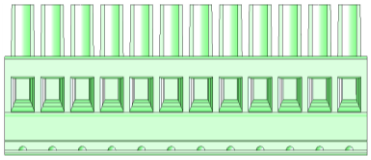
**Encoder (8-pin connector)**




| Pin | Signal |
|---|---|
| 1 | A+ |
| 2 | A - |
| 3 | B+ |
| 4 | B - |
| 5 | Z+ |
| 6 | Z - |
| 7 | GND |
| 8 | +5VDC |

**Digital I/O (12-pin connector)**

| Pin | Signal |
|---|---|
| 1 | Input 1 |
| 2 | Input 1 GND |
| 3 | Input 2 |
| 4 | Input 2 GND |
| 5 | Input 3 |
| 6 | Input 3 GND |



1 12

| | |
|---|---|
| 7 | Input 4 |
| 8 | Input 4 GND |
| 9 | Output 1 |
| 10 | Output 1 GND |
| 11 | Output 2 |
| 12 | Output 2 GND |

This connector does not need to be wired up for proper system operation

**External Sync (4-pin connector)**
The features of this connector are not currently supported.

## 5.7 Cordsets

### 5.7.1 Network Cordset

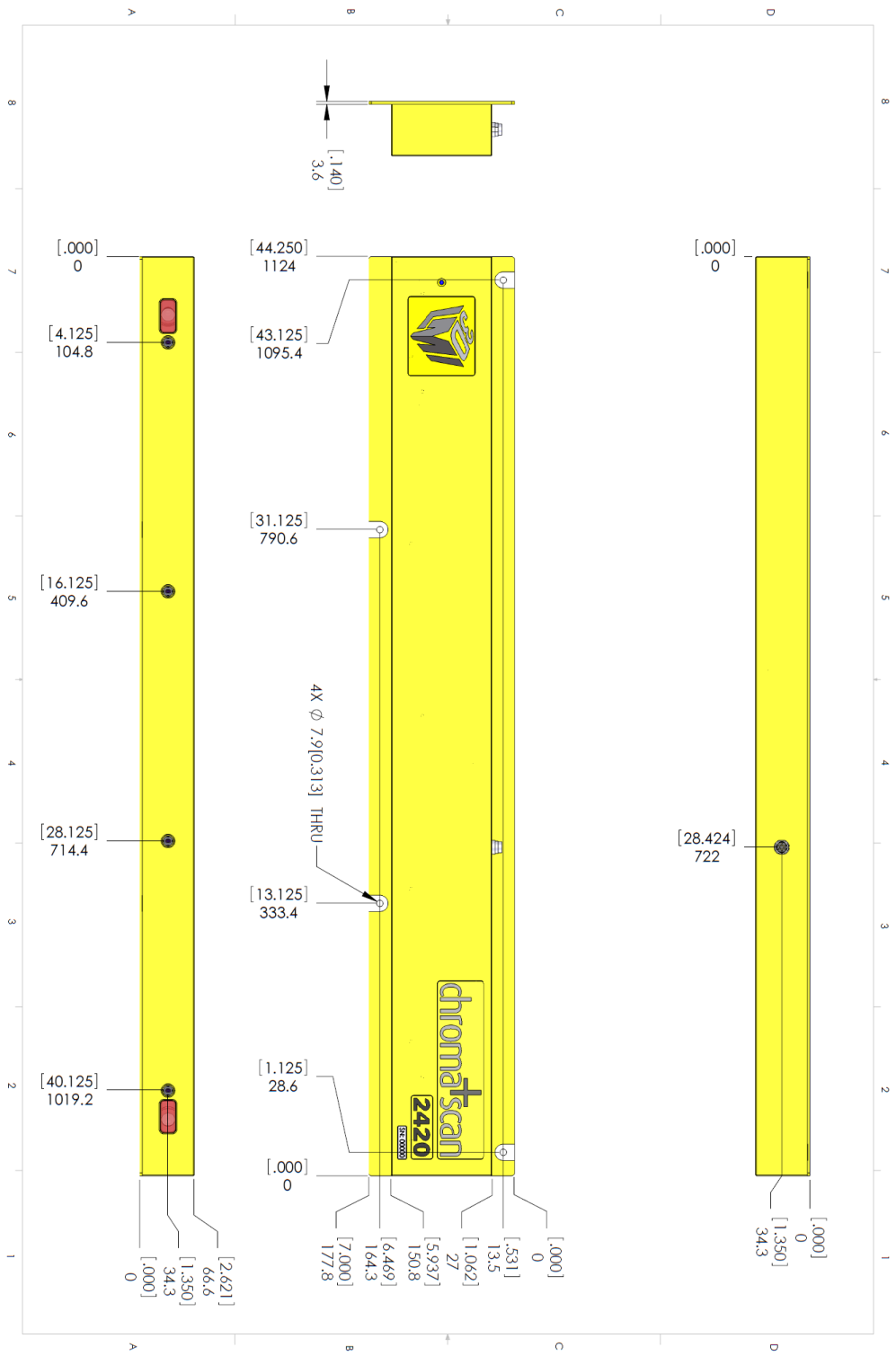
- Maximum length 50m (164’)
- RJ45 connectors (Master end)
- Binder 423-series 14-pin connector (sensor end, female)
- FireSync Dual CAT5e cable

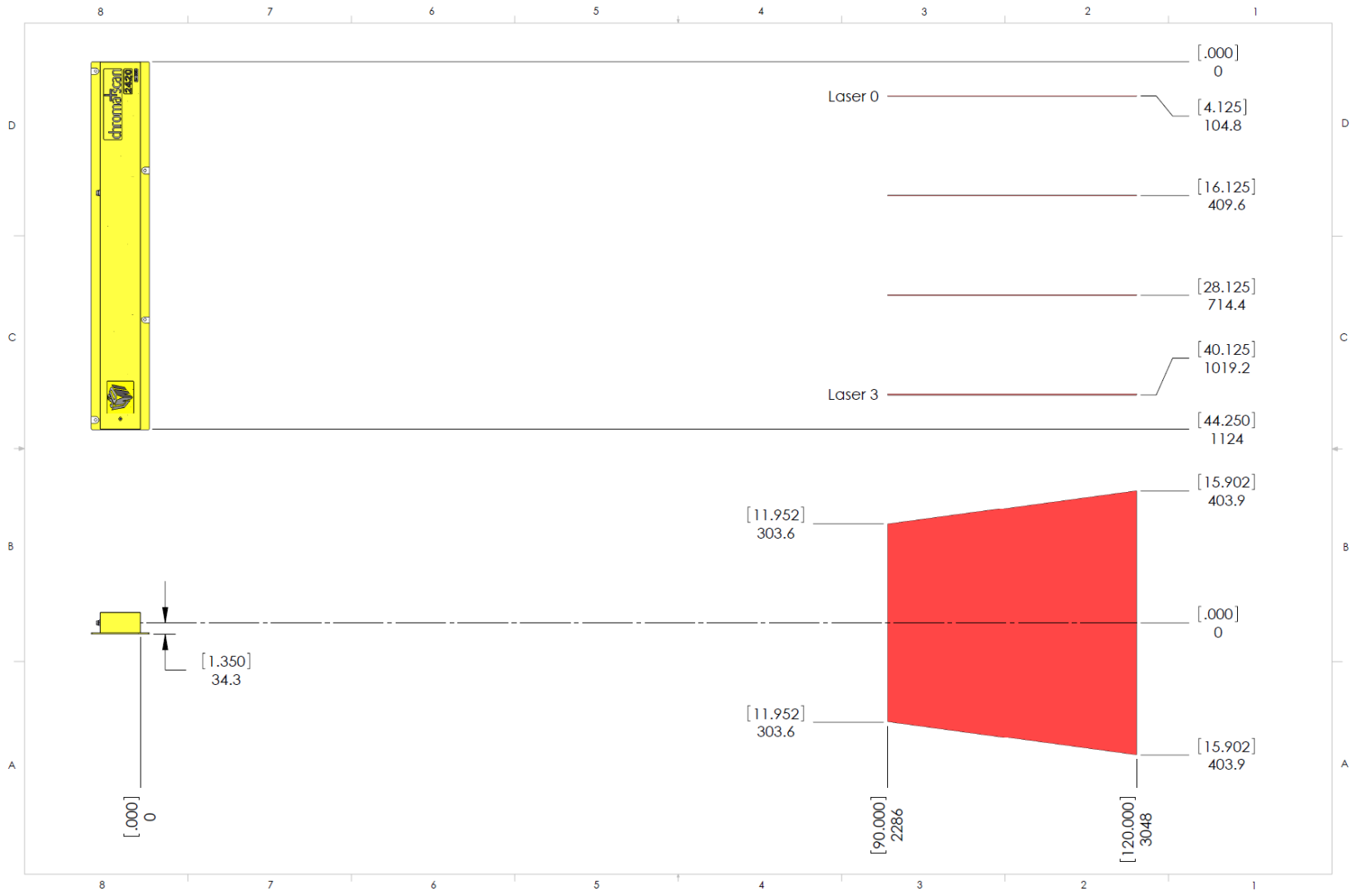
### 5.7.2 Ethernet Cable

- Maximum length 100m (328’)
- Solid-Core UTP cable
- RJ45 connectors
- CAT5e cable

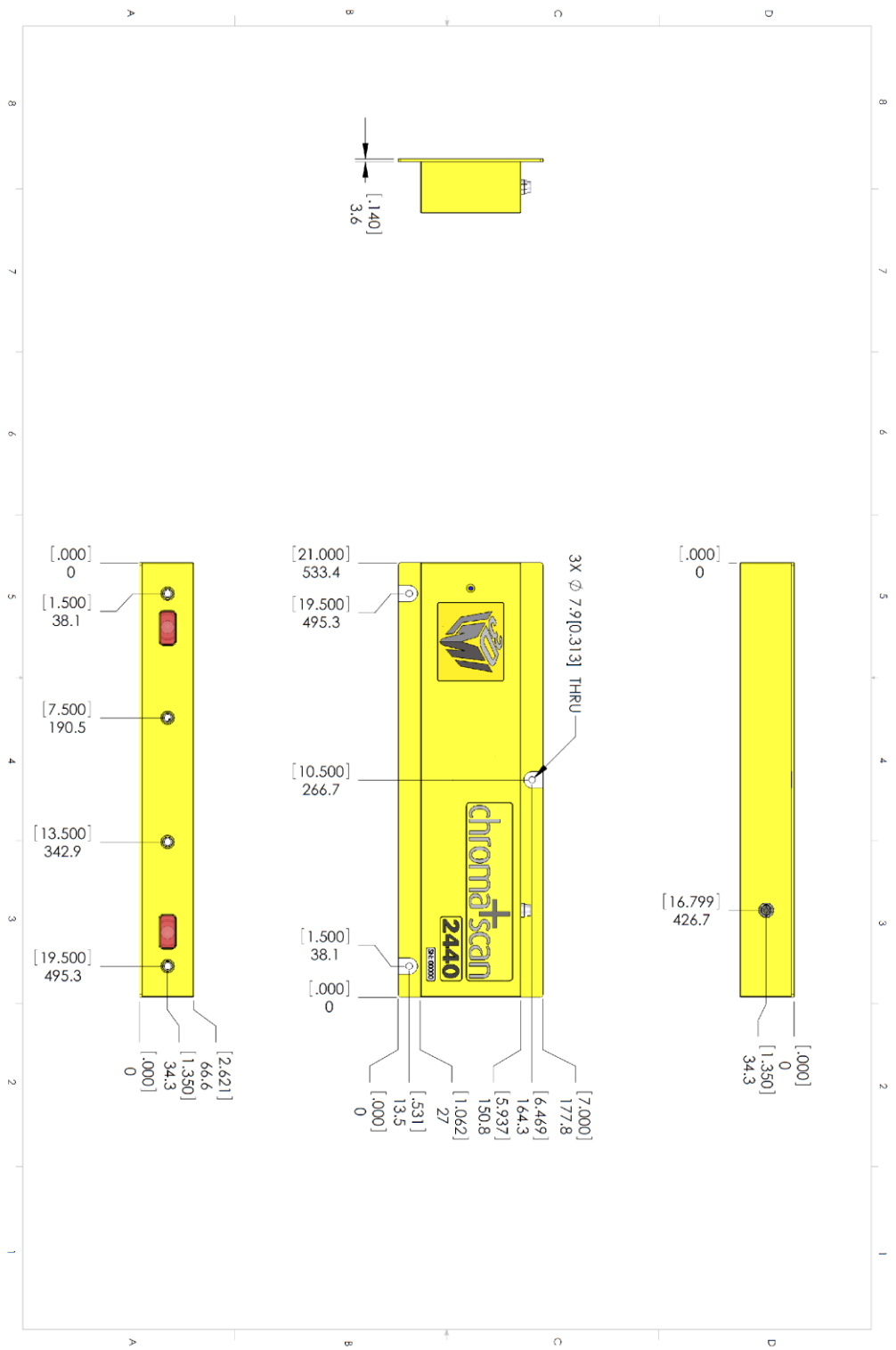
## 5.8 Dimensions & Mounting

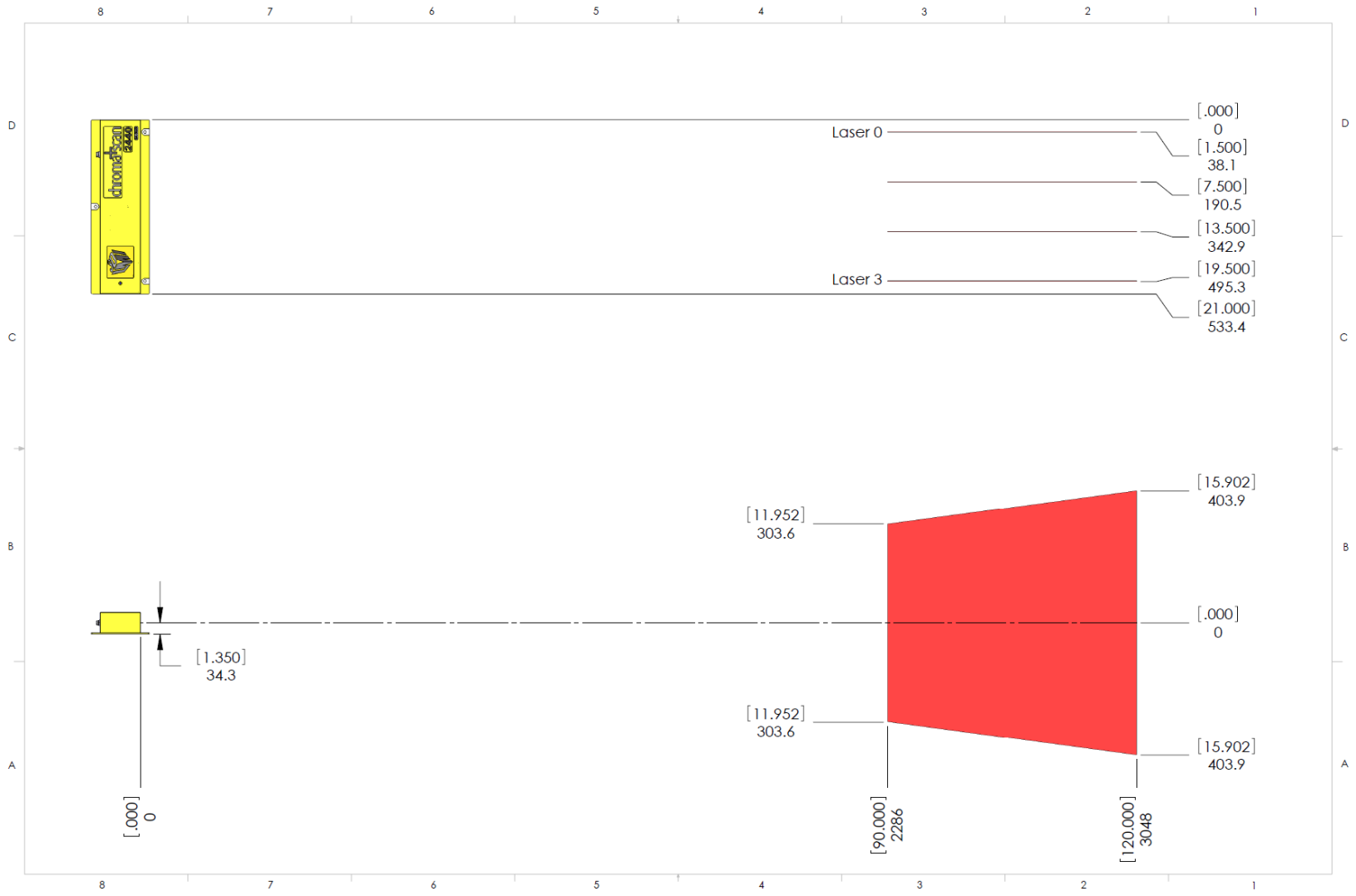
### 5.8.1 chroma+scan 2420




[.000]
0
Laser 0
[4.125]
104.8
[16.125]
409.6
[28.125]
714.4
[40.125]
1019.2
Laser 3
[44.250]
1124
[15.902]
403.9
[11.952]
303.6
[.000]
0
[1.350]
34.3
[11.952]
303.6
[15.902]
403.9
[.000]
0
[90.000]
2286
[120.000]
3048

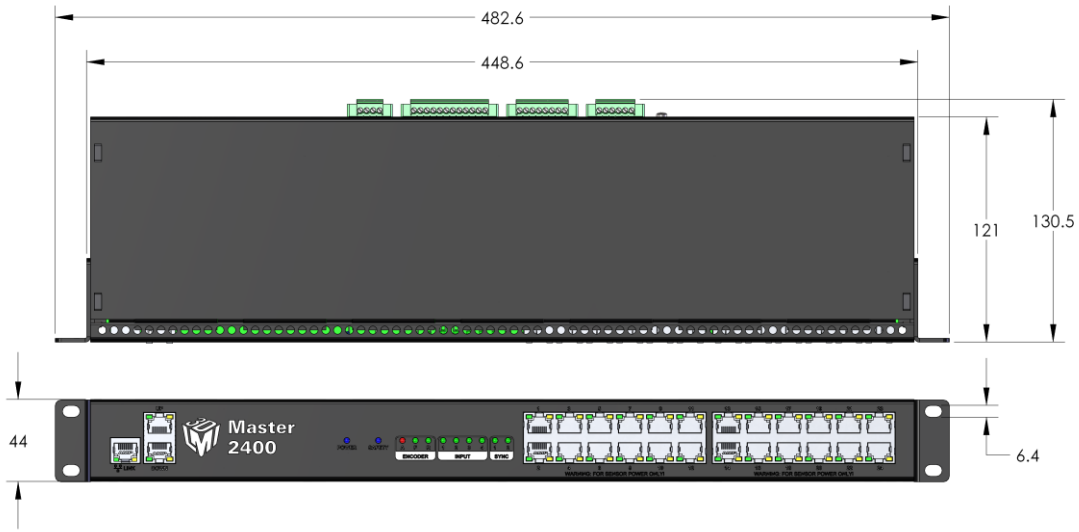
## 5.8.2 chroma+scan 2440




Laser 0
Laser 3
[.000]
0
[1.500]
38.1
[7.500]
190.5
[13.500]
342.9
[19.500]
495.3
[21.000]
533.4
[15.902]
403.9
[11.952]
303.6
[.000]
0
[1.350]
34.3
[11.952]
303.6
[15.902]
403.9
[.000]
0
[90.000]
2286
[120.000]
3048

### 5.8.3 Master 2400

Dimensions are in millimeters (mm)



# 6 Software

## 6.1 Components

The following table lists the provided software files. All files can be downloaded from the LMI Technologies support website.

| Name | Description |
|---|---|
| 14394-x.x.x.x_SOFTWARE_FireSync_Station.exe | Station installer. This installer provides FireSync Station (kStation.exe) |
| 14379-x.x.x.x_CLIENT_chroma+scan_24x0.exe | Client installer. This installer provides FireSync Client (kClient.exe) and C-language source code to communicate with the Station. |
| 14380-x.x.x.x_UPGRADE_chroma+scan_cs24x0.dat | Upgrade packge. This file can be used to upgrade the chroma+scan 24x0 system. |

The software interface to the Station, referred to as “the FireSync Host Protocol”, is OS independent. However, the Station and Client installers require Microsoft Windows XP or Windows 7.

## 6.2 Operation Modes

The system can operate in different operation modes, each of which has a specialized purpose. The following table defines the chroma+scan 24x0 modes.

| Name | Description |
|---|---|
| Video | This operation mode will send out images from one sensor in the system at a low, fixed frame rate. Video mode is used for diagnostics. |
| Free | Free mode transmits ranges from the system on a time based interval. |
| Calibration | Calibration mode performs a system calibration. It creates a uniform world coordinate system for all sensors in the system. The output messages |

| | |
|---|---|
| | contain a status flag to indicate the progress of the calibration. |

As the system runs, data will be transmitted to the Client computer in the *FireSync Result Format*. The general format is described in the *Host Protocol Reference* Manual on page 28. Refer to 6.4.4, 6.4.5 and 6.3.6 for detailed information on how the data can be interpreted in the various operation modes.

## 6.3 FireSync Client

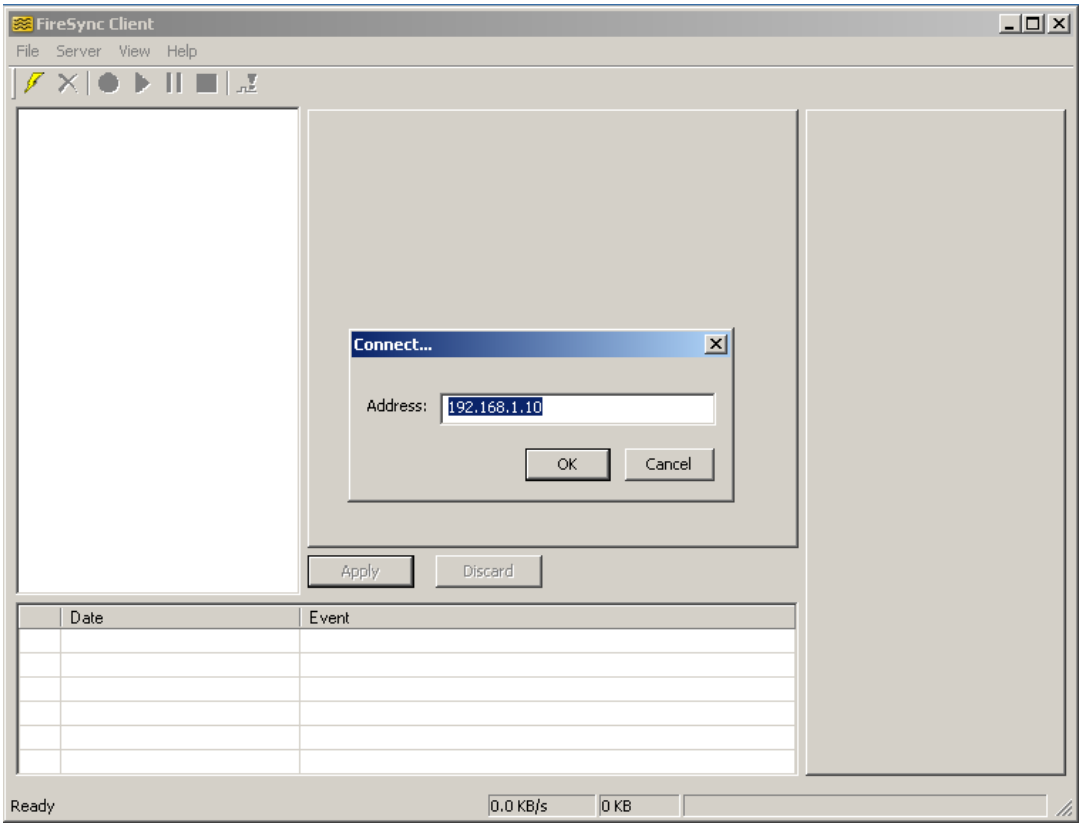
FireSync Client (kClient.exe) is a software application that can be used to set up, demonstrate or diagnose the operation of the chroma+scan 24x0 system. The following sections describe the most common activities performed with the FireSync Client application.

### 6.3.1 Installation

The FireSync Client application is available for Microsoft Windows XP and Windows 7. Obtain the software from LMI Technologies and install it on a suitable Client Computer.

### 6.3.2 Connection

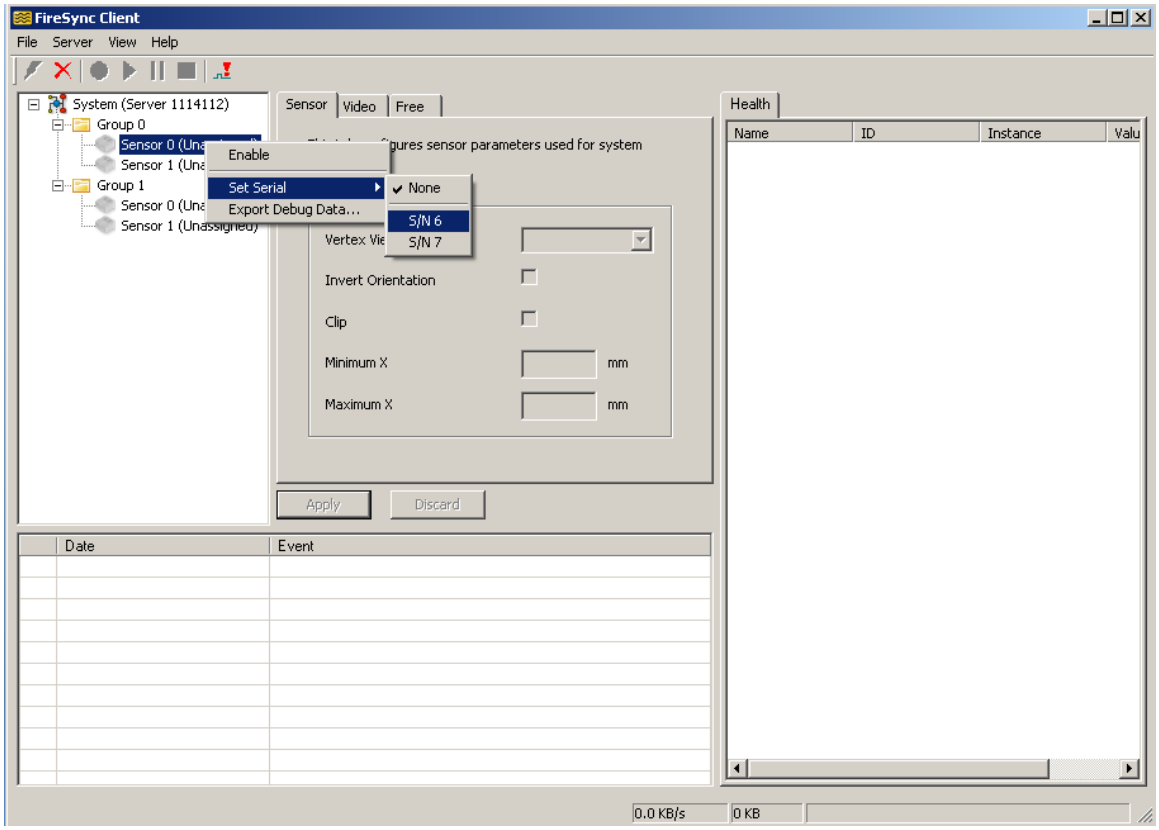
After starting FireSync Client, use the lightning (left-most) icon in the toolbar to display the "*Connect…"* dialog. To connect to the, enter the public IP address of the machine running FireSync Station and then click "*OK"*.



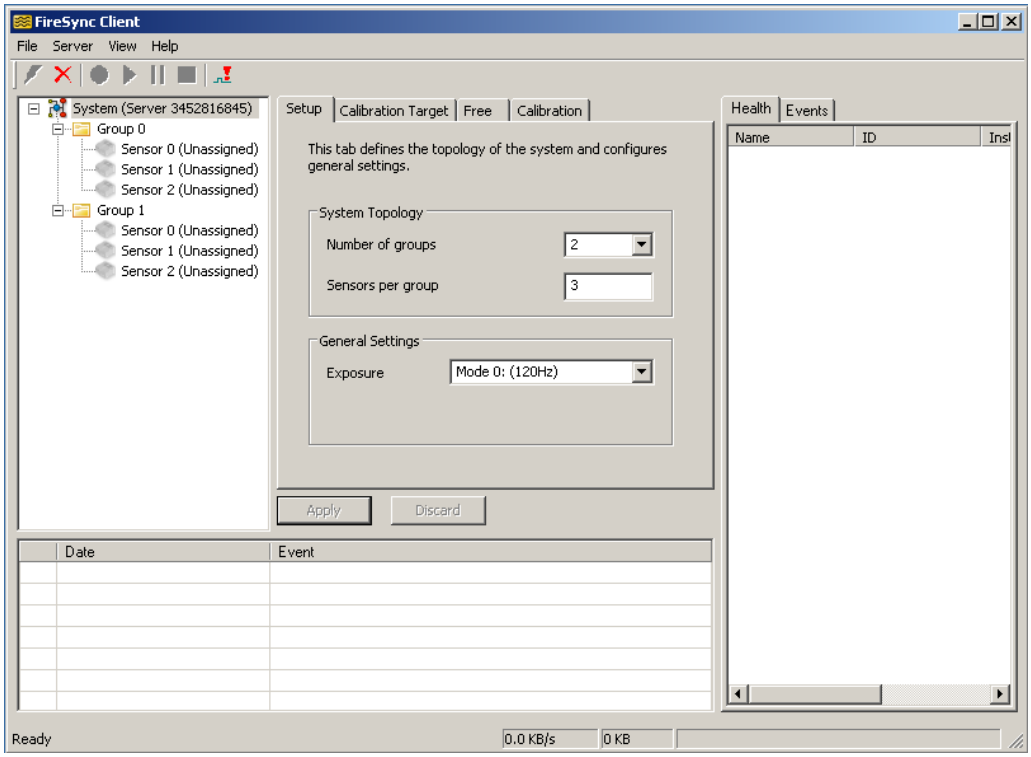
### 6.3.3 Navigation

Upon successful connection kClient provides access to configuration parameters and operation modes.

The system topology pane is shown in the top left corner of the application. This pane allows selecting the system, a group or individual sensors. Right-clicking an entry in the topology pane 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.

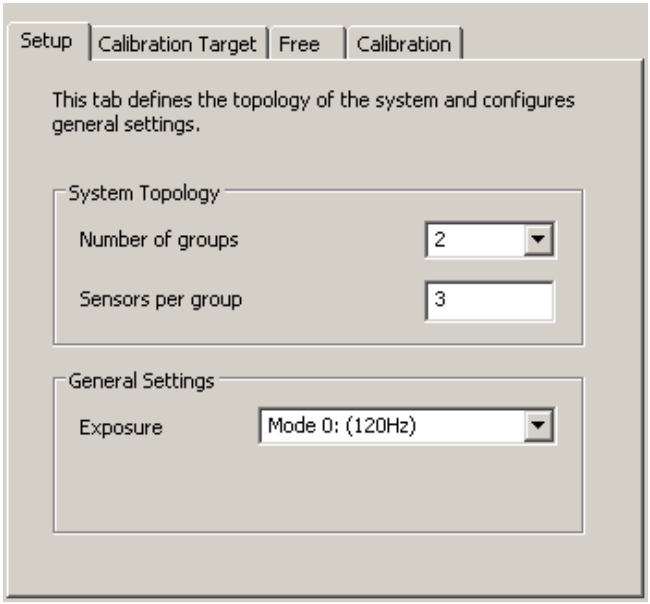


Clicking on a node opens a number of tabs relating to the selected node. These tabs are shown in the center part of the application.



Selecting the “System” entry in the device tree will bring up (configuration) tabs “*Setup*” and “*Calibration Target*” as well as the “*Free*” and “*Calibration*” (operation) tabs.

In the “Setup” tab, the number of groups and sensors per group can be defined. This will affect the topology pane. General settings can also be changed from the “Setup” tab.

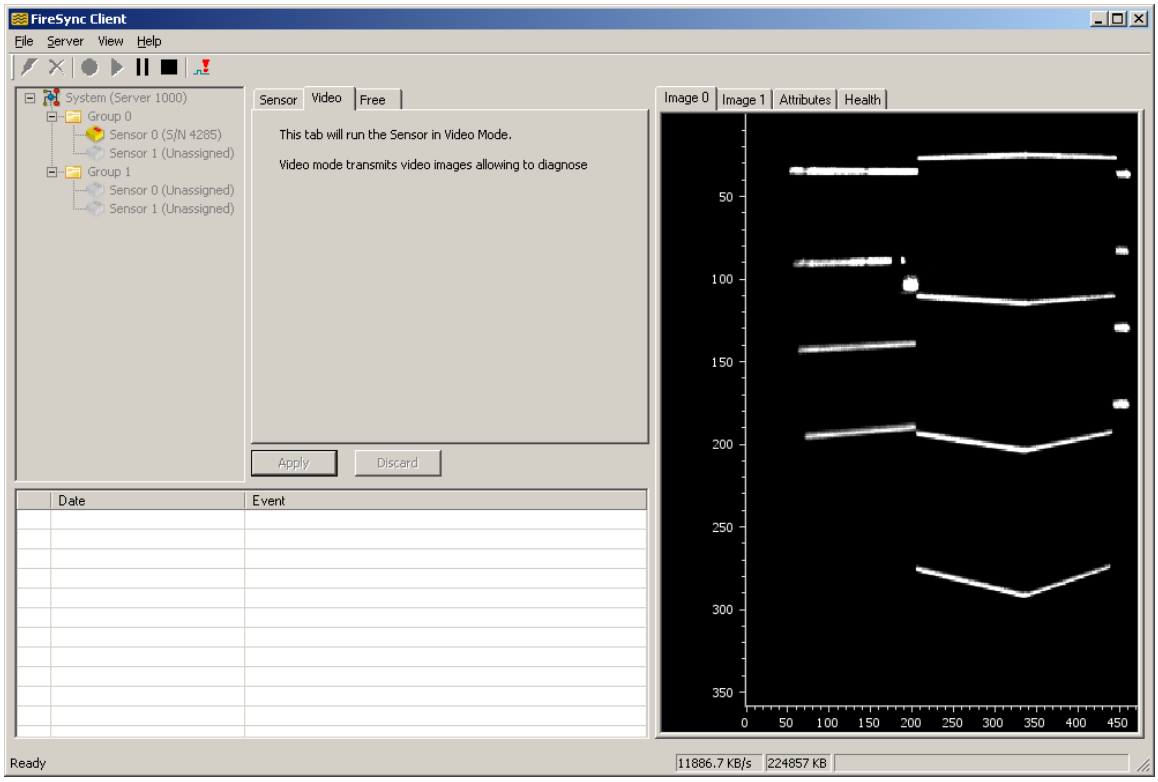



Where tab names match with the operation modes defined in …, the Run button (black triangle) in the toolbox becomes active.

After clicking on this button FireSync Client starts the system in the selected mode and visualizes the data in the leftmost part of the application window. Press the Stop button (black square) to finish.

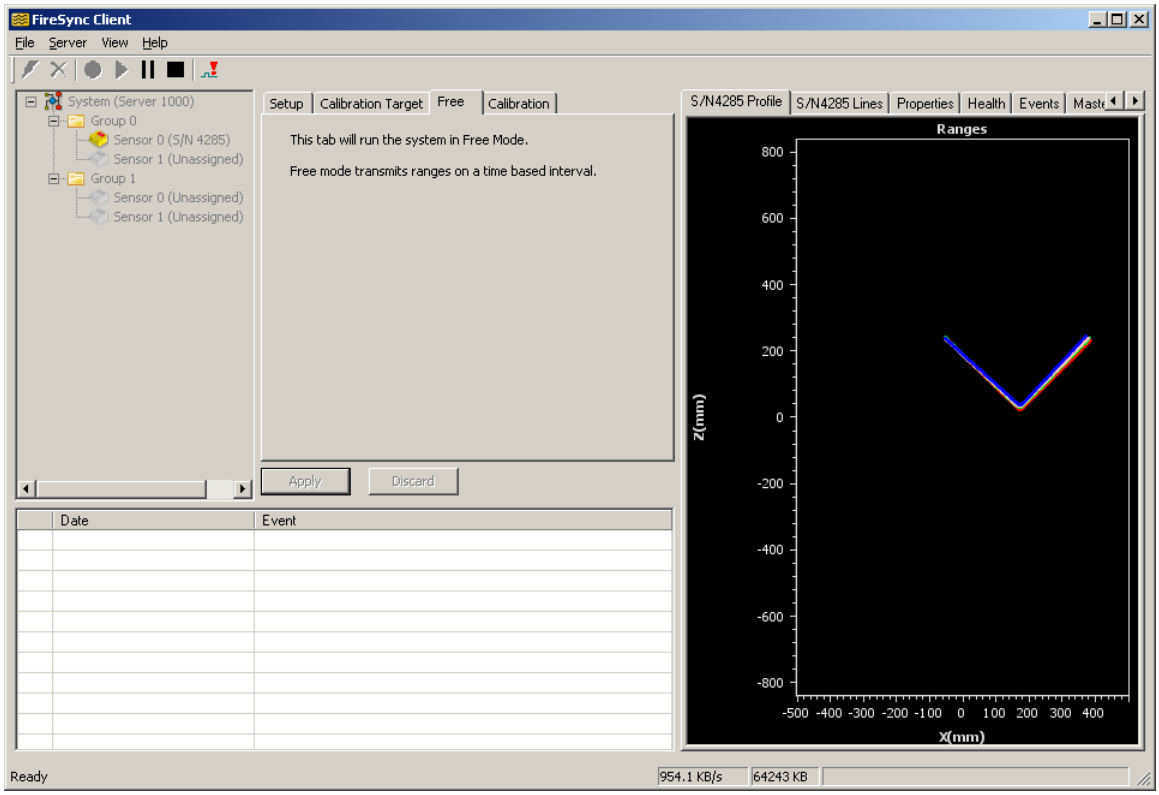
### 6.3.4 Video Mode

Select a sensor in the device tree, and then select the "*Video"* tab. Press the Run button (black triangle) in the toolbar, and observe the incoming video images from each camera. If there is an object within the field of view of the sensors, you will see laser images appear in the display.



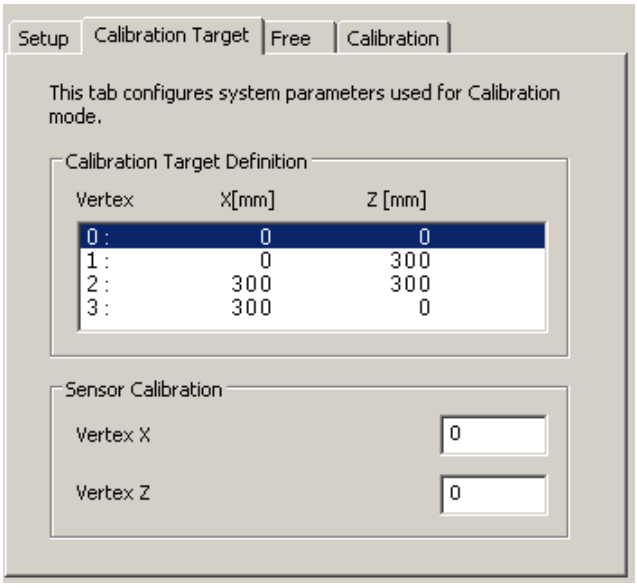
### 6.3.5 Free Mode

Select the server in the device tree, and then select the *"Free"* tab. Press the Run button (black triangle) in the toolbar, and observe the incoming profile data. 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.



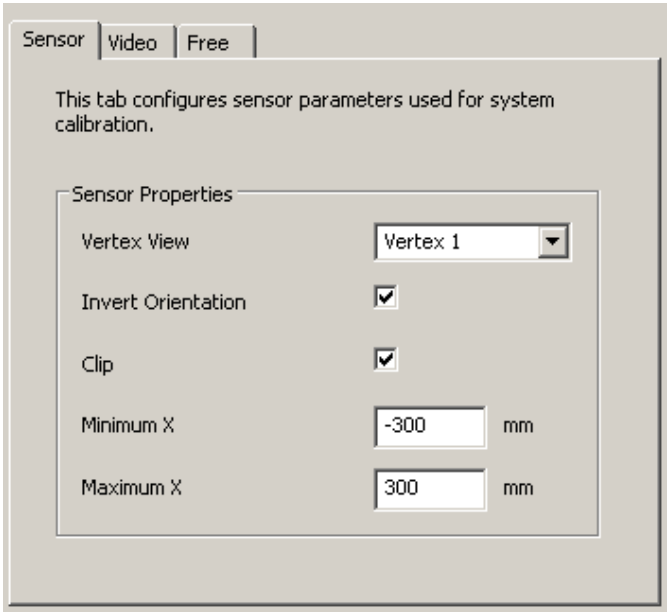
### 6.3.6 Calibration Mode

Before a system calibration can be performed, a target needs to be defined. Select the server in the device tree, and then select the Calibration Target tab. The default values define a target square target at X, Z = (0, 0) with a 300mm size.

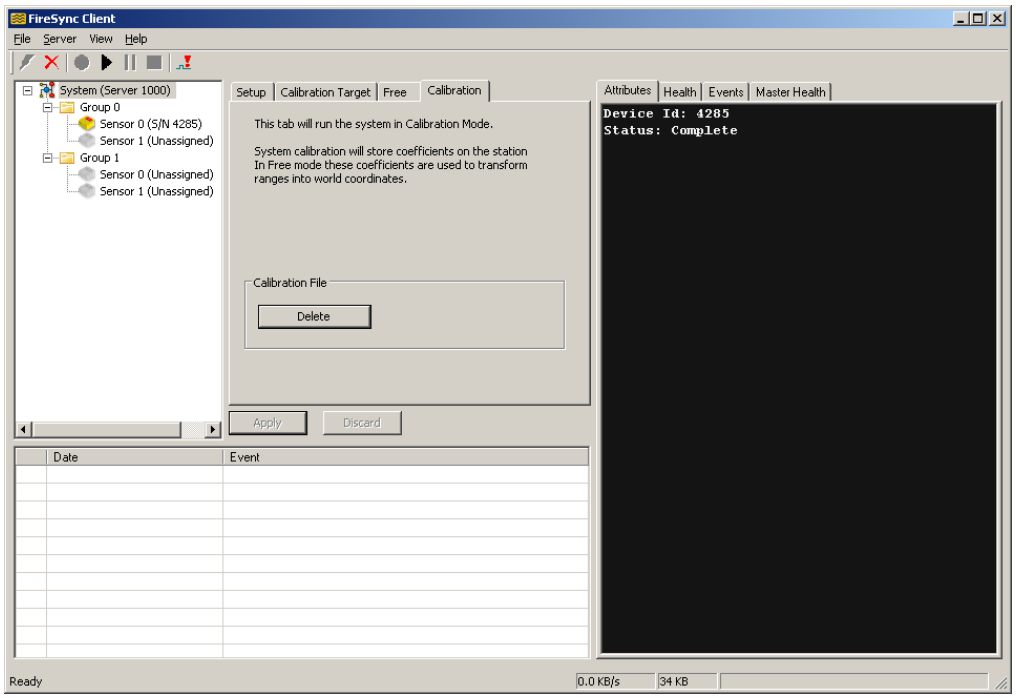



**Warning!** Always define vertices in clockwise order.

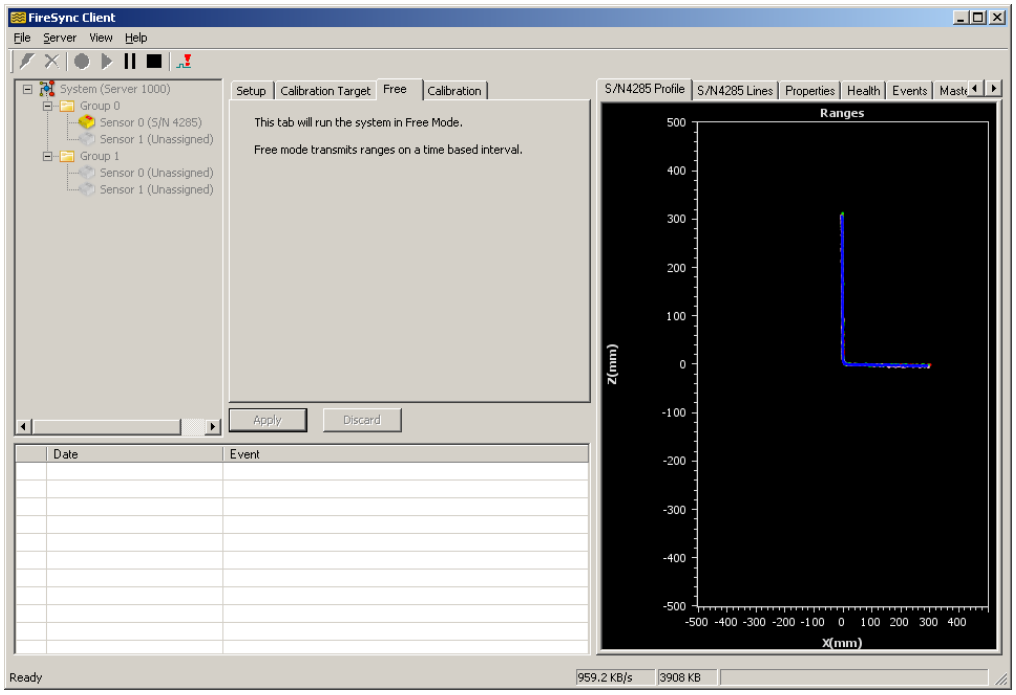
After that for each sensor a number of settings need to be specified. “Vertex View” indexes an entry in the calibration target definition. “Invert Orientation” can be used to mirror the X-axis of the sensor. The “Clip” field and belonging “Minimum X” and “Maximum X” fields allow masking out regions of the FOV.



Press the Run button (black triangle) in the toolbar, and observe the calibration status for each sensor. When *"Complete"* is indicated Stop button to finish system calibration.




After system calibration the ranges from the sensor will be transformed according to the calibration target definition and the associated vertex view for each sensor.



## 6.4 Software Interface

### 6.4.1 The FireSync Host Protocol

The FireSync Host Protocol enables communication between any FireSync based sensor system and any Operating System that supports TCP/IP. Besides the general FireSync Host Protocol rules some specific rules apply for the chroma+scan 24x0 system.

The next sections describe the aspects of communication that are specialized for the chroma+scan 24x0 system. Please see the *FireSync Host Protocol Reference* Manual for a detailed description of the protocol and use this manual for the specialized aspects.

### 6.4.2 Zen Api and example source code

The chroma+scan 24x0 installer ships with a C-language source code that implements the FireSync Host Protocol and all the supported modes.

The source code is split up into two projects:

- the Zen API (zApi)
- example code that uses the Zen API

The Zen API is LMI's common library for that provides basic classes for things like: networking, threading and XML parsing. The example code shows how to use the Zen API in a console based application and provides basic functionality to operate the chroma+scan 24x0 system.

After installing the chroma+scan 24x0 client package, various files and folders are found inside the installation folder. The following table provides an overview of these entities.

| **Name** | **Description** |
|---|---|
| Bin | Place holder for executables |
| include | Zen Api include files to compile your application against |
| Lib | Place holder for import library to link your application against |
| example | Example source for chroma+scan 24x0 |
| zApi | Zen Api source files |

The top-level directory contains documentation for the Zen API.

### 6.4.3 System Settings

The chroma+scan 24x0 system is configured by an XML file inside the storage of the Station. This file is called *“Settings.xml”*. Use the *“Write File”* host protocol command to write transfer settings into the Station.

The following example illustrates the format of the *"Settings.xml"* file:

```
<?xml version="1.0" ?>
<SensorGroup>
  <Exposure>0</Exposure>
  <VideoMode>
    <Sensor>1234</Sensor>
  </VideoMode>
  <FreeMode>
    <OutputBatchCount>1</OutputBatchCount>
  </FreeMode>
  <CalibrationTarget>
    <Vertex>
      <X>0</X>
      <Z>0</Z>
    </Vertex>
    <Vertex>
      <X>0</X>
      <Z>300</Z>
    </Vertex>
    <Vertex>
      <X>300</X>
      <Z>300</Z>
    </Vertex>
    <Vertex>
      <X>300</X>
      <Z>0</Z>
    </Vertex>
  </CalibrationTarget>
  <Members>
    <Group>
      <Name>Group 1</Name>
      <Members>
        <Sensor>
          <Name>Sensor 0</Name>
          <SerialNumber>1234</SerialNumber>
          <Enabled>0</Enabled>
          <VertexView>0</VertexView>
          <Orientation>0</Orientation>
          <Clip>0</Clip>
          <XMin>0</XMin>
          <XMax>0</XMax>
        </Sensor>
        <Sensor>
```

```
          <Name>Sensor 1</Name>
          <SerialNumber>4294967295</SerialNumber>
          <Enabled>0</Enabled>
          <VertexView>0</VertexView>
          <Orientation>0</Orientation>
          <Clip>0</Clip>
          <XMin>0</XMin>
          <XMax>0</XMax>
        </Sensor>
      </Members>
    </Group>
  </Members>
</SensorGroup>
```

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

| **Setting** | | | **Description** |
|---|---|---|---|
| Exposure | | | Specifies whether high or low exposure is used. This set the sensor speed to either, 120Hz, 90Hz or 60Hz |
| Video | | | Contain options that are applicable only in Video mode |
| | Sensor | | Serial Number of the sensor from which to show video data |
| Free | | | Contain options that are applicable only in Free mode |
| | OutputBatchCount | | The number of profiles batched together in a single message. **NOTE! Currently unsupported.** |
| CalibrationTarget | | | Defines the calibration target geometry. Needs at least three vertex sections. |
| | Vertex | | |
| | | X | Translation coefficient X in millimeters |
| | | Z | Translation coefficient Z in millimeters |
| | | T | Rotation coefficient in radians |
| Members | | | Contains one or two groups |
| | Group | | |
| | | Name | Must be unique |
| | | Members | Contains variable number of sensors |

| | | | | | |
|---|---|---|---|---|---|
| | | | Sensor | | |
| | | | | Name | Must be unique within a group |
| | | | | SerialNumber | Indexes one vertex in the CalibrationTarget section |
| | | | | Enabled | Enables / Disabled the sensor |
| | | | | VertexView | Indexes one vertex in the CalibrationTarget section |
| | | | | Orientation | Invert (mirror) X-axis for this sensor …<br>0: Default orientation (as in section 5.4)<br>1: Inverted orientation |
| | | | | Clip | Enables X clipping |
| | | | | XMin | Minimum X |
| | | | | XMax | Maximum X |

### 6.4.4 Video Mode Result Format

Video mode transmits video images at a low, fixed frame rate. Video mode messages have one data block and Message Identifier (ID) 0. The *Get Mode* and *Set Mode* Host Protocol commands use the string *"Video"* for this mode.

**Video Message Attributes**

| Field | Type | Description |
|---|---|---|
| deviceId | 64s | Sensor serial number |
| viewIndex | 64s | Camera index |

**Video Message Descriptors [0]**

| Field | Value | Description |
|---|---|---|
| Length0 | height | Image height |
| Length1 | width | Image width |
| Length2 | 0 | N/A |

**Video Message Data [0]**

| Field | Type | Description |
|---|---|---|
| pixels[height][width] | 8u | Image pixels |

### 6.4.5 Free Mode Result Format

In Free mode, range coordinates are transmitted as (X, Z) pairs. Free mode has at least two data blocks. The first (odd) data block contains information about the sequence index, capture time, capture position and digital input states. The second (even) data block contains the actual (X, Z) pairs for each line. To reduce the network overhead Free Mode supports output batching. Output batching affects the number of data blocks. Since even and odd data blocks belong together, the number of data blocks will always be a multiple of two. Similarly the batch count can be determined by dividing the number of data blocks by two.

Free mode messages have ID 1 and use the string *"Free"* in the *Get Mode* and *Set Mode* Host Protocol commands.

**Free Message Attributes**

| Field | Type | Description |
|---|---|---|
| deviceId | 64s | Sensor serial number |
| xResolution | 64s | Unit of X values (microns) |
| yResolution | 64s | Spacing between laser lines (microns) |
| zResolution | 64s | Unit of Z values (microns) |
| nullRange | 64s | Value representing an invalid profile point |

**Free Message Descriptors [2 * batchcount]**

| Field | Value | Description |
|---|---|---|
| Length0 | 4 | Number of entries in:<br>Free Message Data[2 * batchcount] |
| Length1 | 0 | N/A |
| Length2 | 0 | N/A |

**Free Message Descriptors [2 * batchcount + 1]**

| Field | Value | Description |
|---|---|---|
| Length0 | lines | Number of lines. |
| Length1 | width | Number of ranges per profile. The number is determined by characteristics of the sensor during manufacturing. |
| Length2 | 2 | Number of channels is two: X and Z |

**Free Message Data [2 * batchcount]**

| Field | Type | Description |
|---|---|---|
| frameIndex | 64s | Sequence index within a view |
| Timestamp | 64s | Capture time (microseconds) |
| Position | 64s | Capture position (encoder count) |
| Input State | 64s | Digital inputs |

**Free Message Data [2 * batchcount + 1]**

| Field | Type | Description |
|---|---|---|
| ranges[lines][width][2] | 16s | Ranges: X and Z |

### 6.4.6 Calibration Mode Result Format

Calibration mode performs a system calibration. It creates a uniform world coordinate system for all sensors in the system. The output messages contain a status flag to indicate the progress of the calibration for each sensor in the system and each line. Calibration mode messages have a variable amount of data blocks, depending on the number of sensors. The Message ID is 4.

The *Get Mode* and *Set Mode* Host Protocol commands use the string *"Calibration"* for this mode.

**Free Message Attributes**

| Field | Type | Description |
|---|---|---|
| deviceId0 | 64s | Sensor serial number for 0th sensor |
| deviceId1 | 64s | Sensor serial number for 1h sensor |
| … | | |

**Calibration Message Descriptors [sensorcount]**

| Field | Value | Description |
|---|---|---|
| Length0 | lines | Number of lines |
| Length1 | 0 | N/A |
| Length2 | 0 | N/A |

**Calibration Message Data [sensorcount]**

| Field | Type | Description |
|---|---|---|
| Statistics0 | 64s | Status of calibration for 0th line |
| Statistics1 | 64s | Status of calibration for 1th line |
| … | | |

**Status codes**

| Status | Description |
|---|---|
| 1 | Complete |
| 0 | Busy |
| -1 | Error Code -1 |
| -2 | Error Code -2 |
| … | … |

# 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