



## Laser Measurement System

Product Manual v 1.1  
12/10/2005

## Introduction

Welcome to the Eclipse Laser Measurement System, the state of the art in automotive frame measurement. The end result of the measurement defines the XYZ position of points in space, each associated with a “target”. This measured data is compared to an as built data base and the differences displayed.

This manual is intended not only to introduce you to the system, and to educate you about its individual components, but also to serve as a reference guide to help you through the process of operating the Eclipse system easily, efficiently and profitably.

The manual covers three major sections:

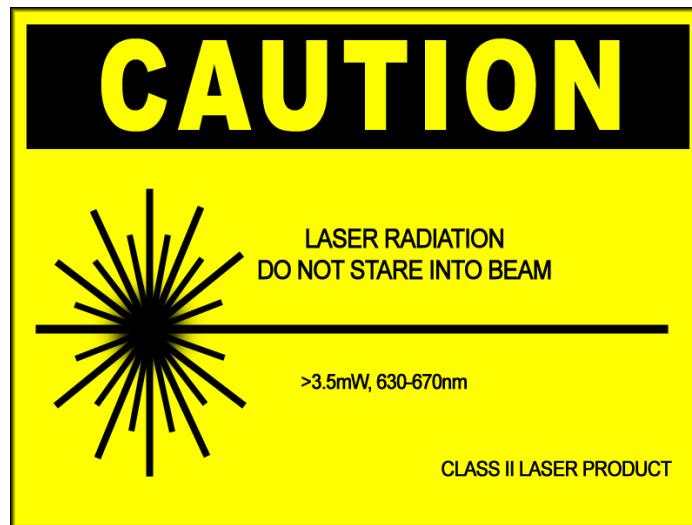
- An introduction to the hardware of the system including detailed information about each of the system components.
- An introduction to the software of this system, including explanations of the operation of each of the screens, as well as walk-throughs of typical software functions.
- A thorough troubleshooting section to assist you if you run into questions, and a list of support contacts to help if the troubleshooting doesn't have what you're looking for.

While we hope this serves as a functional guide on the operation of the Eclipse System, it is not intended to replace the in-depth training an auto body frame alignment technician needs to properly understand and apply the information that this system is capable of providing. If you have questions about the frame repair process, please don't hesitate to give us a call, and we will refer you to the appropriate local training facility.

## General Warnings

The Eclipse Laser Measurement system has been designed to withstand the rigors of the auto body shop environment, but as with any highly sophisticated piece of equipment, a few warnings are appropriate.

### Eye Safety



Complies with Title 21 of the C.F.R as applicable.

The two lasers used within the Eclipse Laser Measurement system operate below the eye-safe range of 3.5mW. If the laser beam does strike the eye it can be uncomfortable, so please take measures to not stare directly into the beam.

### FCC Regulations

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following conditions:

- (1) this device may not cause harmful interference
- (2) this device must accept any interference received, including interference that may cause undesired operations.

Changes or modifications not expressly approved by Research Technologies Inc. void the user's authority to operate the equipment.

### Physical Care

The Eclipse Laser scanner is a precision optical instrument, do not drop or subject the head to impacts, as it could misalign the calibrated lasers, and reduce the accuracy of, or disable, measurement functions.

The Eclipse Laser Scanner is painted with a highly durable powder coat finish. It is designed to withstand typical abrasion, chemicals, oils, and water. It is not impervious to damage however, so please treat it with care. The finish can be cleaned with any

normal household cleaner, sprayed onto a cleaning rag, and gently wiped clean. Please avoid bleaches, abrasives, or spraying a large amount of fluid directly onto the scanner.

## **Preparation for System use**

Plug-in the cabinet and turn on the system power switch on the lower rear of the cabinet. Check the Targets are charging in the first draw. The Blue indicator lights on the sides of the target will be lit when they are on rapid charge. A continuous trickle is ongoing even when the Target lights are on or not on.

## **System Setup and Operation**

Please setup your Eclipse Measurement system according to these steps.

### **1. Turn on Computer Workstation**

The Eclipse Computer Workstation must be on for the measurement system to function. Power switches are the front of the computer in the bottom compartment of the System Cabinet. Upon turn on, the keyboard should light up, and normal boot diagnostics should appear on the LCD screen.

### **2. Place and turn on Laser Scanner**

Remove the Eclipse Laser Scanner from the slide in the bottom compartment of the System Cabinet. Connect the power supply to 110 AC, and place the scanner underneath the car being measured. The laser should be on near the same horizontal plane as the car frame, and for best performance, located near the center of the automobile. Turn on the Laser Scanner, to create the reference plane of light to which you should setup the targets.

### **3. Start Eclipse 3D software is running**

To start the program, please double-click on the Eclipse 3D icon on the desktop. The software suite controls the communications interface between the targets and the computer. The measurement system will not function without the computer running the Eclipse 3D suite.

### **4. Select automobile model**

For the software to be able to supply the user with spec points, the specific automobile model, make, and year must be selected.

### **5. Locate a spec point to attachment to**

If you use the right button on the mouse to click on a spec point, a dialogue with information about that point will appear, including a picture (if available) of what exact point you should use for mounting the target. This dialogue will also show a suggestion of stem length, given an undamaged point.

### **6. Secure a Universal Attachment to the attachment point**

Following the location of the spec point you selected, attach a Universal Attachment to the bolt or chassis penetration that the spec point calls out. The term “attachment” is used to describe a mechanical coupler between the target stem, and the reference points on an auto body frame.

**7. Attach Stem to a Target**

Select the appropriate length stem to hang from the attachment that will place the plane of the laser beams onto the red active area on the front of the target. Connect the Hirose end of the stem to the Hirose receptacle on the target. Examine the LED indicators on the target to ensure that it completes the startup sequence.

**8. Mount Stem on Universal Attachment**

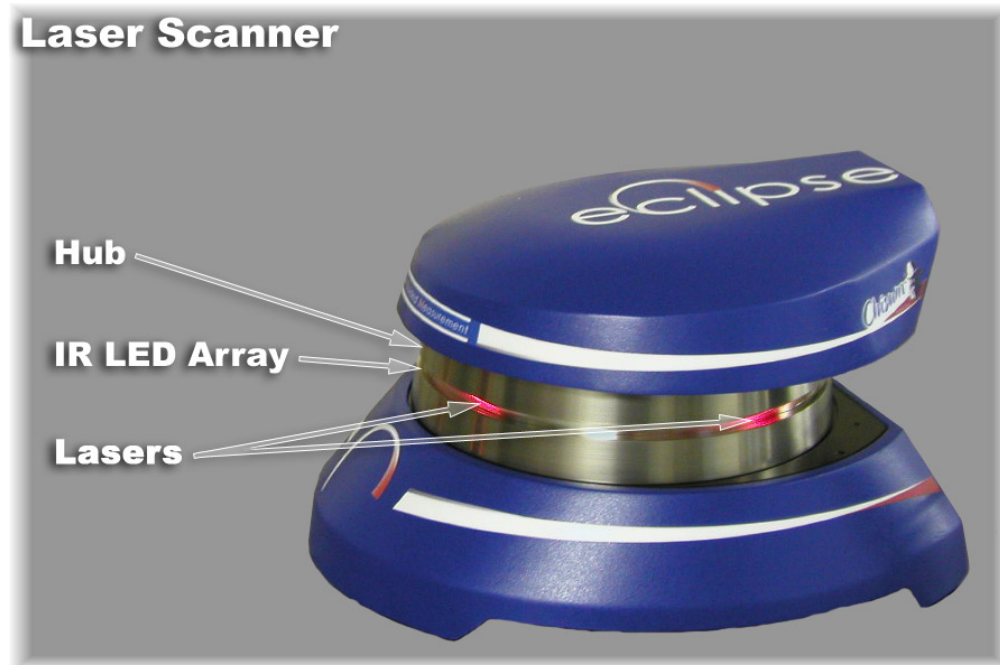
Insert the ball end of the stem into the ball receptacle on the universal attachment. Face the target so that the red active area is pointed directly at the Laser Scanner. Ensure that nothing obstructs the plumb hanging of the target assembly, and observe the LED indicators to ensure that the target is receiving laser strikes as well as sync pulse from the Laser Scanner.

**9. Assign Target to Spec Point in software**

Upon successful power up of the target, an icon representing it should appear in the "target corral" window within the Eclipse 3D Software. Using the Mouse, left click and hold on the new target icon, and drag it over the spec point that the target is mounted to. The spec points will change color as your mouse rolls over them, and if available, the picture of the attachment point will display. When you have the target over the correct spec point, release the left mouse button, and the target will assign to that spec point. At this point the software will begin to calculate the best-fit position of that target relative to the spec point, and the other targets in the measurement system.

**10. Repeat 5-9 until desired points are targeted**

Follow the steps until all of the points on the frame that you want to measure are targeted. Most repairs require that the torque box (the center 4 targets within a spec) be measured, as well as several points near the outer edges of the car, front and rear, to create a baseline for best-fit analysis. It is always preferred to have more targets in the measurement system than to have less; additional targets that are within spec tolerance only serve to improve the assignment of damage to the locations that actually have damage.



### **Revolving Scanner Head**

The head is a precision balanced and mounted rotating platform for the pair of measurement lasers incorporated in this system. The IR LED Array is also mounted within a recessed groove in the head.

### **Laser Apertures**

These twin penetrations in the Revolving Scanner Head allow the measurement lasers mounted inside to reach the Smart Target PSD Sensors.

### **IR LED Array**

This set of 16 high-output Infrared wavelength LED devices send a synchronization signal to the Smart Targets, allowing them to timestamp the arrival of the laser strikes accurately. The light emitted by the diodes is entirely invisible to the naked eye, you should *not* be able to see any light from them at all.

### **Power Switch**

This powers the Laser Scanner on and off. It does not control the operation of the Smart Targets, or any other element of the Eclipse System.

### **Fault Condition LED Indicator**

The Yellow LED on the rear switch panel of the Laser Scanner will illuminate if the scanner is experiencing a fault condition. This could mean that the laser system is malfunctioning, that the power supply is malfunctioning, or several other internal malfunctions. Please Refer to the troubleshooting section, or contact your Eclipse System service provider if the fault condition light is lit.

### **Power ON LED Indicator**

The Green LED on the rear switch panel of the Laser Scanner will illuminate when the scanner is receiving power and is switched on.

### **Operating RPM / Laser Activation LED Indicator**

The Red LED on the rear switch panel of the Laser Scanner will illuminate once the scanner has performed its startup self check, and has completed spin-up of the Revolving Scanner Head to operating RPM. The Scanner system prevents laser turn-on until the system has reached operating RPM to insure eye safety.

### **CPU Activity LED Indicator**

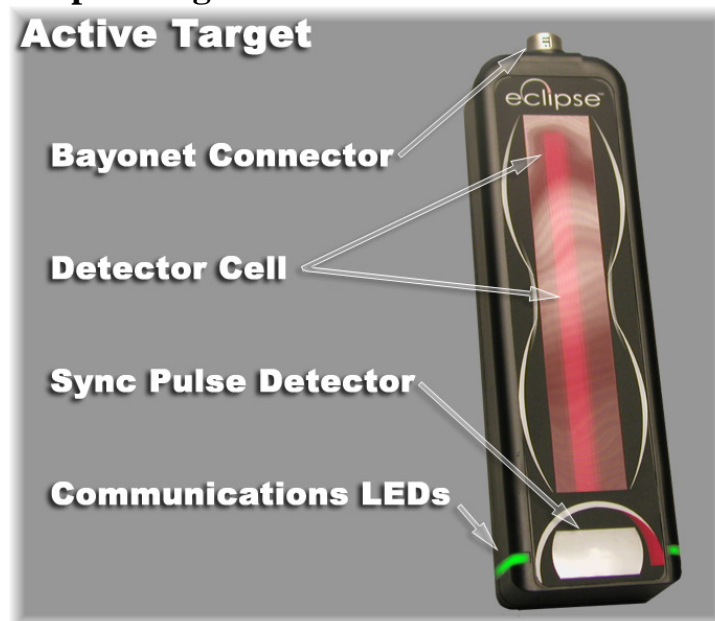
The Blue LED on the rear switch panel of the Laser Scanner will illuminate at a regular interval, confirming function of the CPU. If this light is not lit, or is lit constantly, please refer to the Troubleshooting section.

### **Power Cable Connector**

This is the connection port for the power cable. Please use only the power supply that ships with the Eclipse Measurement System, as it is properly calibrated for your Laser Scanner unit, use of any other power supply will void your warranty.

## **Eclipse Targets**

### **Active Target**



### **Target Housing**

The Target is made of high-impact ABS plastic, and contains the wireless radio communications system, rechargeable battery pack, and the measurement sensors and detectors which allow the target to report positional information to the Eclipse Computer Workstation

### **PSD Sensor**



The red colored vertical bar in the center of the target is the Photo Sensitive Diode Bi-cell that detects the laser strikes to determine the position of the target in 3D space. To function, the PSD must face the Laser Scanner so that the laser beams strike the target on the red bar.

### **Sync Detector**

The gray oval at the bottom of the target is a lens that collects the infrared light emitted by the sync array on the scanner, which allows the target to accurately timestamp the incoming laser strikes. To function properly the sync detector must have a line of sight to the revolving scanner head.

### **Bayonet Stem Connector**

This connector allows the target to receive any of the Eclipse Target Stems. Use whatever stem brings the red active area on the target onto the same plane as the laser beams. The stem connector also serves as the target's power switch, disconnecting the target from the stem will turn it off, and prepare it for recharging.

### **LED Indicators**

Located near the bottom of the target on either side, the LED Indicators provide the user with direct communication as to the status of the target. Each target has a sequence of startup that is indicated by the LED's, as well as conditions and behaviors that are also shown by this versatile display.

Startup: Flash Sequence, ending in steady red

Acquire Laser Strikes: Blue

Acquire Sync Pulse: Green

Acquire Both: Switches to off, waiting for Indicator Mode signal from Workstation.

In Indicator Mode: Smooth color display, from red as furthest from spec, to orange and yellow, and finally to green as within on-spec tolerance (+/- 1mm)

Communication with Workstation: Slight Blink in current color.

In Charging Mode: Blue indicates fast charge, off indicates charge completed.

### **Charging Tabs**

These allow the target to charge in the charging tray, located in the top drawer of the System Cabinet. When the tabs are properly aligned with the charging points in the drawer, the LED Indicators on the smart targets will illuminate, indicating charging status.

## Eclipse Target Stems



### Ball End Connector

This smooth connector allows the stem to mount to the four point plastic housing on the Universal Attachment, as well as several other system components. It allows the weight of the target to drive to true plumb, insuring proper measurement accuracy.

**Stem Shaft** features a scratch resistant aluminum shaft, and is available in 7 lengths to insure that your target is visible to the laser no matter how severe the damage is to a given point.

**Stem Connector** serves as the mechanical interface to the Smart Target. To connect the two, just align the connector and press, twisting if the alignment is incorrect. To disconnect, retract the external silver band on the stem, and pull straight out. The Hirose also functions as the power switch for the target.

**Stem Ball Receptacle** is the receiver for the ball end of the Target Stem. It retains the stem securely, while allowing it to plumb for accurate measurements.

**Attachment Ball Grip** connector at one end, to receive the stem ball connector and let it pivot freely so that the target hangs plumb to gravity.

**Attachment Magnet coupler** provides the holder for the powerful magnet.

**Attachment Universal Adaptor** gives the centering ability with different sizes to match the hole, use the outside of the adaptor ring, or a bolt head, use the inside of the adaptor ring.

## **Eclipse Computer Workstation**

### **Computer Workstation**

This is a custom-built 3D workstation, designed to properly execute the advanced display system of the Eclipse 3D Measurement software in real-time. It has a DVD-ROM drive to read the largest data format, as well as industry standard 10/100 Ethernet networking.

### **LCD Monitor**

The LCD screen is capable of displaying the 1024x768 resolution required by the Eclipse 3D Measurement Software, in full 32bit color mode. The power button is on the far right hand side of the bezel.

### **Communications Antenna**

This is the antenna for the wireless communications system between the targets and the workstation.

It communicates over the 900Mhz band to ensure long range and high reliability. Do not cover the antenna with metal or other materials that might obstruct the wireless signal; if the antenna is broken or obscured, it will not be able to maintain a communications connection to the targets.

## **Eclipse 3D Software Suite**

### **Overview**

Eclipse 3D is a software suite, which solves the problem of quality user interface, mathematical analysis and information display to automotive frame repair software. The software is divided into three screens, one for data entry, one for the measurement and repair of auto body frame damage, and one for the reporting of the results of said repairs, or reporting the current state of damage for a frame.

### **Repair Data**

The data entry system consists of a screen with a body of fields for entering and editing the information regarding a given frame repair. Fields are included for customer data, automobile data, insurance company data, and repair technician data. The contents of these fields are saved into a database of repair information that stores all of the information regarding each individual measurement and repair done by a given workstation. The data is stored in such a format that it can be transferred to other workstations, and archived for later retrieval. The data is also accessible by the other screens for uses appropriate to each screen.

### **Measurement**

The Measurement system is the heart of the Eclipse3D frame repair software. It allows the technician to select the as-built frame information for the car to be

repaired, observe the cars' actual state with the Eclipse measurement hardware, project the repairs necessary to return the car to the as-built state, and observe the car returning to that state by the manipulation of the frame by the repair technician.

### **I. Selection of as-built data.**

Eclipse 3D presents the end user with a choice of makes, then years, then models and trim levels to quickly narrow down to the exact car the technician is working on. From this selection the program reads the as-built data about that car into the Eclipse 3D best-fit analysis engine. A mockup frame of the car as-built is displayed by the program in 3D, so that the user can rotate, pan and zoom in space around the frame model, making it easy for the user to understand the relationship between the digital mockup and the real car.

### **II. Observation of Eclipse hardware data**

Eclipse 3D initiates communication with the targets and the scanner, polling them for data as they become active. The end user assigns each target to a specification point on the as-built data, creating a relationship between the car as-built measurements, and the observed measurements. This process is done by interaction with the 3D model; the targets appear as 3D objects and can be manually manipulated within the rendering window. Each target has a pop-up menu that shows its XYZ absolute and delta position relative to the scanner, as well as the detected stem length.

### **III. Comparative analysis**

Once the user installs a minimum of 3 targets within view of the scanner and assigns them to spec-points in the Eclipse 3D software, the computer can begin its best-fit analysis of those targets actual position relative to the as-built data. The scanner is only capable of measuring the targets relative to the scanner's position, and we know that location within a local coordinate map. However, the position of the spec points is built from a different reference, being from established data, not measured by our scanner. We must match to two disparate coordinate maps together, to insure 1) that the measured location of targets that are within a threshold of proximity to the spec point listed are marked as on-spec, and 2) that the measured location of targets that are outside of that threshold of proximity are assigned error to depict the direction and severity of their displacement. Best fit is a least-squares mathematical model, which iteratively solves for the most likely location of the targets by resolving a sum of the least squares analysis of the two disparate coordinate maps of XYZ positional data. It is this mathematical solution that allows damage to be properly assigned to locations that are out of spec.

Some cars have frame portions that are not built to as stringent a standard as the under-hood frame, most notably truck beds. The Eclipse 3D system allows each target to be included or excluded from the best-fit calculation, giving the technician the ability to fine tune his measurement, so that he can understand what areas are truly damaged. This model insures that the damage observed is correctly applied to the damaged sections of the car. This information gives the end user a confident analysis about where and how severely the frame is damaged.

Once the best-fit engine is enabled, each target can display its current location in numeric XYZ format, as well as Delta from spec XYZ values. Additionally, the frame model can be colored, depending on the delta of the targets position from the as-built position. In this mode, the frame is colored in a smooth gradient depicting damage, from red for the most damaged targets, to green for targets within the damage threshold. This threshold can be manually adjusted to exaggerate the visual impression of damage, or to hide all but the worst damage from the end user. This information can be reverse communicated to the Eclipse targets, by placing them in "indicator mode" their colored led indicators can be set to the color of their measured damage, so the color the target is on screen is the same as it is glowing under the car. This color updates as the targets move, so as the technician repairs the car, he can observe, in real-time, the positional status of a given target.

In addition, the engine can display vectors, which indicate the direction each target would need to move to return it to the as-built spec. These vector arrows are also manually adjustable, so that the user can exaggerate the arrows to better understand the orientation of the vectors, or minimize them to show only the most severely damaged points.

#### **IV. Observation of repair process**

Given this body of information, the repair technician is now free to use whatever method he has at his disposal to repair the damaged frame elements depicted by the Eclipse 3D software. Several features in the software further enable and facilitate this repair.

As the technician proceeds through the repair process, he may find it useful to "undo" or backup the view to a previous position, allowing him to compare previous states of the frame to current state. The "snapshot" interface allows at any point the technician to save a snapshot of the current position of all of the targets, as well as the view of the 3D rendering screen. This tool allows the technician to observe the frame before and after his repair efforts and gives him a powerful tool for learning the particular challenges of an individual repair.

In addition to the standard 3D view, an alternative method for observing a targets precise location, called Bulls-eye mode, allows the technician to focus on a single target. In this mode, the target is depicted on screen as a dot, glowing the color relative to its damage, which is placed on a crosshair display with concentric circles depicting demarcations in the distance of the target to the center. The center is where the as-built data reports the target is supposed to be. There is a colored ring that shows Z position error, which gets larger as the target gets further from vertically aligned, and closes in on the center as it becomes correct, with the color code red for high, and blue for low. This system is real-time updated, so as the technician pulls on the car he can see exactly which direction and how much he needs to pull on the frame so that the target will line up right on the Bulls-eye.

Another useful feature is the indicator mode, which colors the communication LED light pipes on the targets corresponding to their relative damage as depicted in the Eclipse 3D software. This color is updated real-time, so as the technician pulls on the car he will be able to watch the targets turn from red to orange to yellow to green as they approach the correct as-built spec position. This frees the technician from the computer workstation, so the frame repair can be done with fewer trips back and forth.

There are two indicators that help the technician ensure that he has fully repaired the vehicle. One shows that neither of the manual adjustments (the vector scaler and the damage scaler sliders which adjust the view intensity) has been used to eliminate the display of damage when damage still exists, and another shows that all of the targets in the field are included in the best-fit analysis. This ensures that the technician has fully repaired the car, and that the manipulable interface of the Eclipse 3D repair software has not obscured some important damage information without the technician's knowledge.

### **Report**

Upon completion of the repair process, or at some date after the repair process was completed, the technician will have a need to report the repair to an insurance company or to the customer for billing. The Eclipse 3D software has a robust reporting system, which includes the ability to include any or all of the following: information collected in the data entry screen, snapshot views from the measurement screen, as well as zoom in shots on damaged areas of the frame, annotations by the technician on any of the photos, as well as numerical comparisons of before and after XYZ positional information for the most damaged spec points in the repair. This system gives the technician maximum control over what data goes to the insurance companies.

Additionally, the report system can be used without having actually repaired the frame damaged measured, as an estimating device, or as a way to show a customer the extent of the damage present in a given frame. This level of control over the report system gives the repair technician maximum flexibility to use the tool how he wants.

### **Repair Data Screen**

The Repair Data screen is the location where all of the information about your repair is stored. That information is stored in a database for easy searching, and later retrieval.

The Repair Data Screen is comprised of four sections of controls:

- File Management
- File Information
- Data Entry
- Data Management

### **File Management**

The three buttons on the upper left give easy access to basic file functions. New Repair creates a new, blank data entry in the database. Open Repair brings up a file dialogue where you can open previous repairs by name. Search Repairs allows you to search all previous repairs by name, date, work order #, car type, and several other distinguishing details.

### **File Information**

This readout shows the work order # of the currently displayed database entry, and the date that the entry was created.

### **Data Entry**

These fields are all information that will be stored along with your dimensional repair information to facilitate building a professional report, along with properly tracking project progress. Several of the fields have automatic pull downs to allow you to pick from the list of available options by clicking on the grey down arrow. The Automobile Information entry will pre-populate the car that is loaded in the measurement screen, so insure that the data you enter there is correct.

### **Data Management**

There are several data manipulation controls located near the bottom of the screen. The Delete key will delete the currently viewed database entry. The record locator allows you to scan the records by entry order, with one at a time, and five at a time speed controls. The Edit Record key at the top of the screen allows you to edit old records; this behavior is disabled by default to protect your existing data from accidental damage. The Discard Changes key will eliminate any changes you've made to the viewed record and revert it to the most recently saved state. The save key insures that the data as it exists now is written to the database.

## **Measurement Screen**

The Measurement screen is the heart of the Eclipse 3D software suite. It allows you to quickly observe damage, and manipulate that observation to make clear what exactly the state of the car is.

### **2D View Screen**

The 2D View screen allows you to see information from the Mitchell database that isn't stored in the 3D format supported by the measurement view. The screen supports pan and zoom, to insure that you get a clear view of what you're working on.

The 2D View screen is comprised of two sections of controls:

- View Controls
- 2D View Area

### **View Controls**

These two check boxes control what is displayed in the view area.

**2D View Area**

This area shows what is selected in the view control box. To pan around the screen, click and drag with the left mouse key. To zoom in or out, roll the mouse wheel.



## Troubleshooting

<b>Laser Scanner</b>	Blue LED	CPU Functioning
	Red LED	Operating RPM/Laser Functioning
	Green LED	Power-On Status
	Yellow LED	Fault Condition Indicator
<b>Targets</b>	Flashing Red	Lack of Laser signal received
	Flashing Purple	Lack of IR signal received
	Flashing Green	Communicating but not assigned to Spec
	Solid Green	Communicating and within Spec
	Solid Yellow	Communicating and close to Spec
	Solid Red	Communicating and out of Spec
	Solid Blue	Rapid Charging

## Support Contacts

Research Technologies 425-670-2167