OPTICAL DIMENSIONS™
2973 Harbor Blvd, #665, Costa Mesa, CA 92626
Phone: (831) 287-0495
info@optica-ldimensions.com
www.optical-dimensions.com

LASER CHECK®

Surface Roughness Measurement Gages

6212Auto Manual Version 1.25

Operations and Specification Manual for the

Lasercheck® 6212Auto System

Revision 1.25

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PERFORMANCE SPECIFICATIONS

Measurement / Detection Method	Angle resolved laser scattering
Measurement speed	Up to 8 measurements per second
Measurement range	1.00 µinch to 40 µinch / 0.012 µm to 1.0 µm (Ra)
Repeatability	± 3.0% of measured value
Spot size (area-measured)	6 mm X 1 mm
Environmental considerations (temperature / humidity):	
Operating	-10° C to +55° C / 10% to 90% RH
Storage	-40° C to +80° C / 1% to 99% RH
Power requirements	110/220 VAC 5. Wall Power Supply, 50 / 60 HZ, 2.0 Amps max.

Other Features

Factory Calibrated to Ra Ground Surface Standards
Works on any material/color (rubber, glass, steel, etc.)
RS422 Interface
Ethernet Interface
USB Interface
Input Triggering: Start, Stop, and Save Measurements
User Configurable Failed Part Trigger Output
Stored items:
All Roughness Values
Date and Time
Average Ra Roughness and Standard Deviation
Minimum / Maximum Ra Roughness
CSV text Formatted File

SAFETY

Electrical

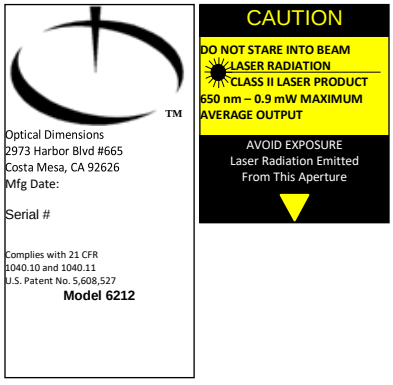
Lasercheck has been designed as a sealed and enclosed system. Voltages to operate the measurement sensor are low (0 to +5 Volts) to minimize shock hazard.

Laser

The laser used in Lasercheck is a class II laser device. Class II lasers are not considered hazardous to the skin but are considered a “chronic viewing hazard”. Users should not stare directly into the beam or directly into the beam reflected off a smooth specular surface. The ends of the Lasercheck measurement sensor have “Caution” and “Avoid Exposure” labels to remind the operator to avoid exposure to the radiation. The sensor also has “Identification” and “Certification” labels. The Lasercheck control unit also has "Identification” and “Certification” labels. Reproductions of these labels are shown below.

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

The measurement sensor emits a red visible (650-nm) laser beam pulsing at a 10 to 50 Hz. Each “pulse” contains as much as 90 microjoules of energy. Pulses can be as short as a 5 millisecond interval, with 20 microsecond rise and fall times. Maximum “peak” power can be as high as 2.0 milliwatts. Average maximum power being emitted from the laser can be as high as 900 microwatts. Once the beam strikes the measurement surface, the laser energy is reflected back into the Lasercheck detection system. However, multiple reflections and stray light may exit from between the sensor and measurement surface and care should be taken to avoid direct eye exposure to the radiation.



Typical Laser Identification and Warning Labels

WARRANTY OVERVIEW

Optical Dimensions certifies that the Lasercheck surface roughness measurement system meets specifications. The Lasercheck system has a warranty period of one (1) year from date of first usage. This warranty is against defects in material and workmanship. During the warranty period, Optical Dimensions will, at its option, either repair or replace products, which prove to be defective. For detailed warranty information, refer to second page of this manual.

LIMITATION OF WARRANTY

This warranty will not apply to defects resulting from improper or inadequate maintenance by Buyer (please refer to Maintenance section), unauthorized modification or misuse, operation outside the environmental specifications, improper site preparation or site maintenance, fire, flood earth movement or collapse. Optical Dimensions shall not be liable for any direct, indirect, special, incidental or consequential damages, whether based on contract, tort, or any other legal theory.

For warranty service or repair, the Lasercheck system must be returned to Optical Dimensions, after prior Return Material Authorization Number (RMA #) has been obtained. Buyer shall prepay shipping charges to Optical Dimensions. The return shipment should be labeled with the RMA #.

Contact Optical Dimensions customer service for shipping instructions:

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Costa Mesa, CA 92626

Phone: 831-287-0495

Email: info@optical-dimensions.com

MAINTENANCE

Lasercheck has been designed and assembled by skilled and experienced engineers and technicians. All components used in the system operate well within their rated specifications to ensure long life and reliability of the Lasercheck system. Electronics, lasers, and detectors are all solid-state devices and should not need to be serviced or maintained by the user.

The controller housing is made from impact-resistant ABS and is colored black. The housing is not waterproof, but it can be subjected to moderate rain or splash without harm.

The laser head is made of machined aluminum and plastic and all electronics and optics are secured and sealed within the head. The head is rugged enough to withstand handling that might be normally encountered in manufacturing shop floor gage operation. The head is also water resistant and can be subjected to moderate rain or splash without harm.

Boards and electronics used in the system are static sensitive and easily damaged by mishandling. The Lasercheck housing and electronics are well grounded. The head is sealed at all seams and holes to protect components from external contaminants. The user should not open the measurement head. *If opened by non-authorized personnel, the warranty provided by Optical Dimensions will be void.*

Cleaning the Windows

The internal optics and electronics are cleaned during assembly and kept within the sealed sensor. The internal windows at the bottom of the Lasercheck sensor cover and protect the internal sensors and laser source. They will be exposed to outside contaminants and in very dirty environments should be cleaned at least weekly.

The windows are rugged, but care needs to be taken to not scratch them during operation or cleaning. They should only be cleaned with ethanol, methanol, or a glass cleaner and a soft, clean paper towel, tissue, or Q-tip.

Assistance

Contact your nearest Optical Dimensions office.

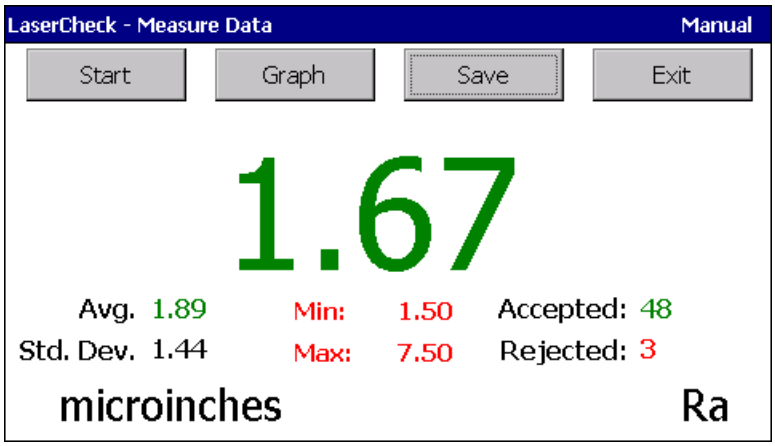
INTRODUCTION TO LASERCHECK

Overview

Lasercheck is designed to perform high speed, accurate, non-contact measurements of surface roughness. A built in visible laser illuminates the surface beneath it. The overall intensity and distribution of the reflected and scattered light is measured, digitized by Lasercheck electronics, and then Ra/Rq roughness is calculated for the illuminated area. This Ra/Rq value is then displayed on the LCD screen of the Lasercheck display unit. The Lasercheck display and control software can be used to display the real time Ra/Rq values in graphical and numeric format along with statistical parameters.

Lasercheck has been designed for a nominal height standoff of 0.1 inch ± 0.01 inches (2.5 mm +/- 0.25 mm) from the measurement surface. Motions and vibrations within that tolerance range are monitored continuously and roughness measurements are corrected for vibrations using patented software algorithms during every measurement cycle to ensure accurate results.

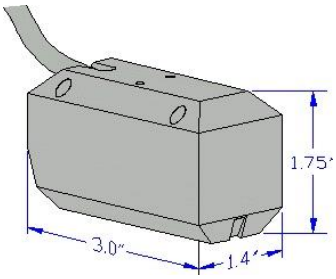
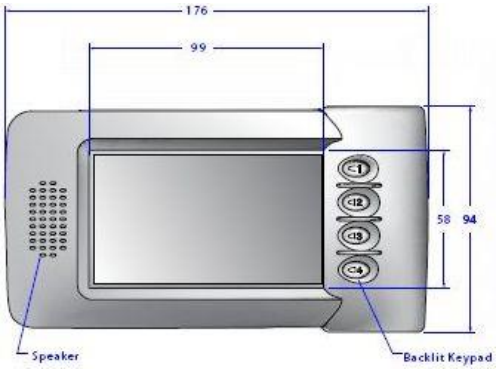
Measurements can be performed by manual operation, or fully automated high speed on-line measurements



triggered by external signals and the software. Measurements are saved in comma separated value text (.csv) file format for reading into a variety of spreadsheet and analysis software packages.

SETTING UP THE INSTRUMENT

Unpacking Lasercheck

1) All components of Lasercheck have been inspected and tested individually and as a system before shipping. You should find the following items with your system:Lasercheck Measurement Sensor	2) 
3) Standoff plate 4) (0.100 inch / 2.5 mm)	5) Attached to measurement sensor for quick set up tests. Remove for non-contact system
6) Lasercheck LCD Display and Control unit	7) 
8) Electronic Interconnect Box 9) (4.6 x 3.6 x 2.3 inches – 117 x 91 x 58 mm)	10) 
11) Wall Power Supply 12) Alignment Fixture for cylindrical surface measurement (optional). 13) Alignment Fixture for ID Bore surface measurement (optional). 14) Lasercheck CD or USB Stick with Installation Program, Manual and Support Files	

Basic Connections

Connect the sensor to female DB15 connector labeled “SENSOR” on interconnect box. The cable should be secured with the thumbscrews on the cable.

Connect the LCD Display and Control Unit to male DB15 connector labeled “DISPLAY” on interconnect box. The cable should be secured with the thumbscrews on the cable.

Connect proximity sensors (triggering inputs) to the female DB9 connector labeled “INPUT/OUTPUT” on interconnect box. These are optional and would only be used during “automatic operation”.

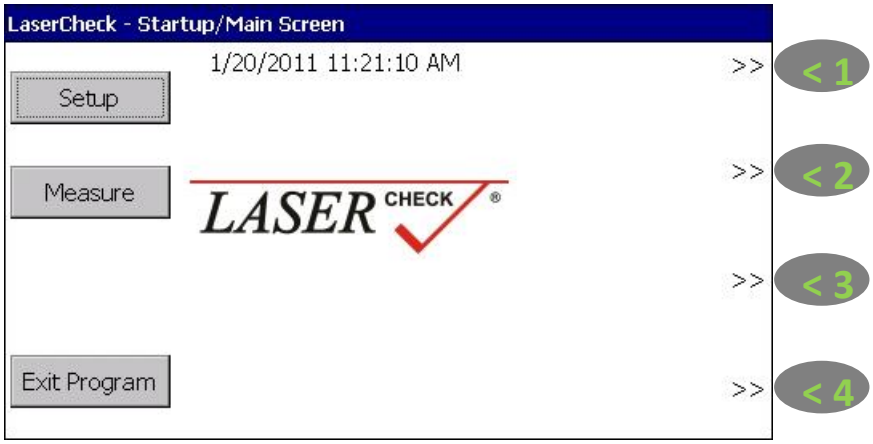
Connect the wall power supply to the circular connector labeled “POWER” on interconnect box.

PERFORMING AUTOMATED ON-LINE MEASUREMENTS

Important: Remove standoff plate for non-contact setup and measurements with the Lasercheck system.

Power ON

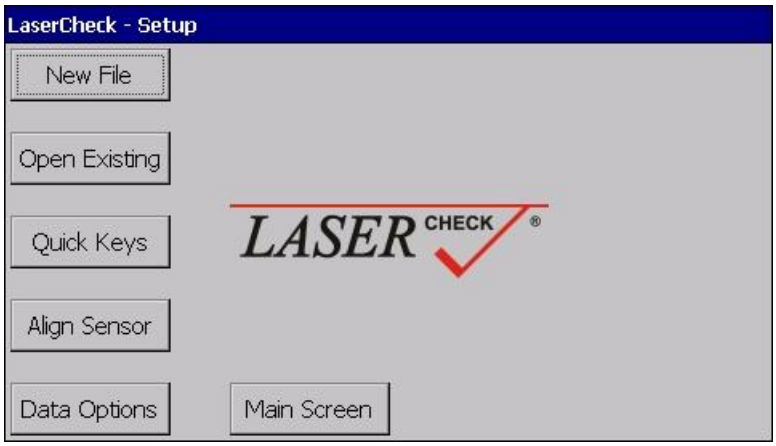
After all connections are made toggle the power switch on the side of the interconnect box to the on position. The following screen will be displayed:



Lasercheck Startup/Main Screen

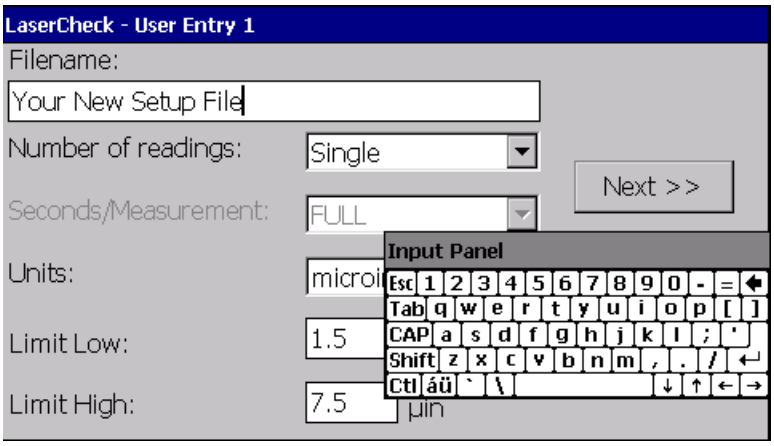
Creating/Modifying a Software Setup File

From the Lasercheck Startup/Main Screen, push the “Setup” button. The following Screen will be displayed:



Main Setup Screen

Push the “New File” button in the Main Lasercheck Setup Screen. The following screen will be displayed:



User Entry Screen #1

Note Above: Windows CE keypad for user entry in fields will be displayed as necessary.

Filename Field

In the Filename field enter the name you wish the setup file saved to. This name will also be the name that measurements will be saved to.

Number of readings Field

Three options can be selected:

Single

One measurement will be made every time the “Measure” button is pushed or the external trigger is active.

Continuous

Continuous measurements at a rate of approximately 8 measurements per second will be made every time the “Measure” button is pushed or the external trigger is active.

2 to 99

Continuous measurements at a rate of approximately 8 measurements per second will be made until the selected number of measurements is reached every time the “Measure” button is pushed or the external trigger is active.

Seconds/Measurement Field

This field will only be active if “Continuous” is selected in the “Number of readings” field. Two options can be selected:

FULL

Continuous measurements at a rate of approximately 8 measurements per second will be made.

1 to 100

Continuous measurements at a rate of exactly 1 measurement per number of seconds selected will be made.

Units Field

This selection determines the roughness units that will be displayed. The options are:

- microinches
- microns
- nanometers

Limit Low Field

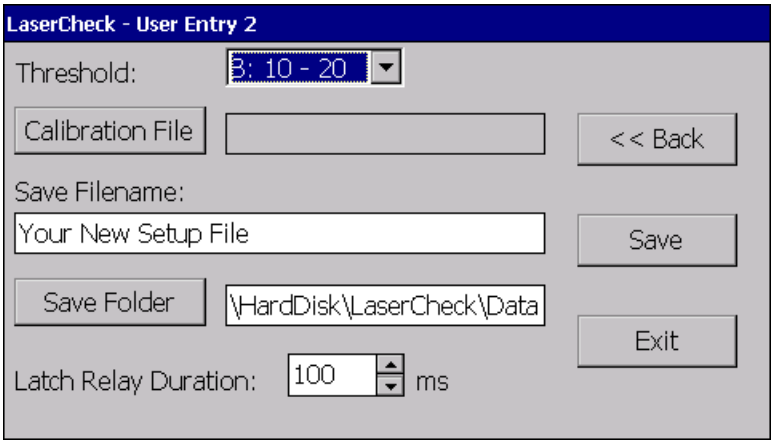
Enter the minimum roughness specification for surface to be measured. This entry is used in data and graphical measurement displays as well as setting failed part output signals.

Limit High Field

Enter the maximum roughness specification for surface to be measured. This entry is used in data and graphical measurement displays as well as setting failed part output signals.

Next Button

Once all selections have been made, push the “Next” button. File” button in the Main Setup Screen. The following screen will be displayed:



User Entry Screen #2

Threshold Field (Roughness Ranges)

Three options can be selected:

A: 0 – 10 microinches

Select if surfaces are less than 10 microinches (0.25 microns) Ra.

B: 10 – 20 microinches

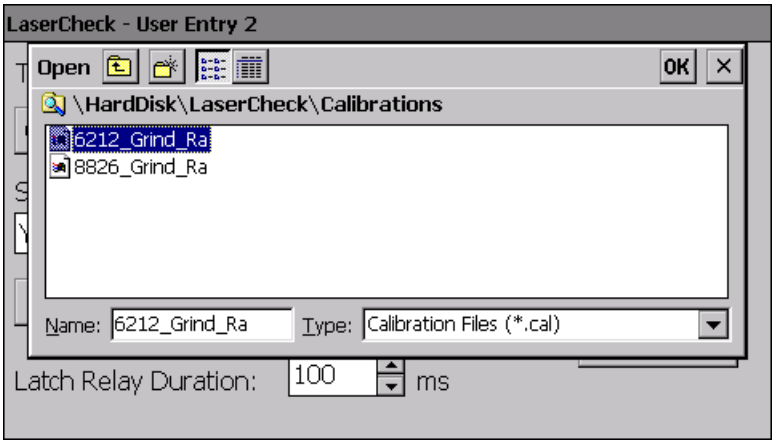
Select if surfaces are greater than 10 and less than 20 microinches (0.25 to 0.50 microns) Ra. This selection is default if surface roughness is unknown or if surfaces cover a wider range than either the “A” or “C” option.

C: 20 + microinches

Select if surfaces are greater than 20 microinches (0.50 microns.

Calibration File Button

A calibration file must be selected for the surface being measured. The following screen will be displayed:



Calibration File Select Screen

Select the calibration file most appropriate for the surfaces to be measured. The "6212_Grind_Ra.cal" is the default calibration for the 6212 AUTO Lasercheck system. Factory file settings provide Ra values on ground surfaces calibrated to known ground surface standards. If your Lasercheck will be used on surfaces other than ground surfaces Schmitt Industries provides custom calibration files for a nominal cost to suit your surfaces and materials.

Save Filename

This field will be defaulted to the same name as you created for the setup file. This name can be edited if desired.

Save Folder

This default local directory that data will be saved to is "HardDisk\Lasercheck\Data. This can be edited by pushing the "Save Folder" button and selecting / creating a new directory to save.

Latch Relay Duration

This field specifies the amount of time that the failed part pins will remain closed after an out of specification roughness reading is encountered. Default is 100 milliseconds. The delay can be adjusted to any value between 10 to 2550 milliseconds. See the Appendix section discussing "Input / Output Connector" for more details.

Exit

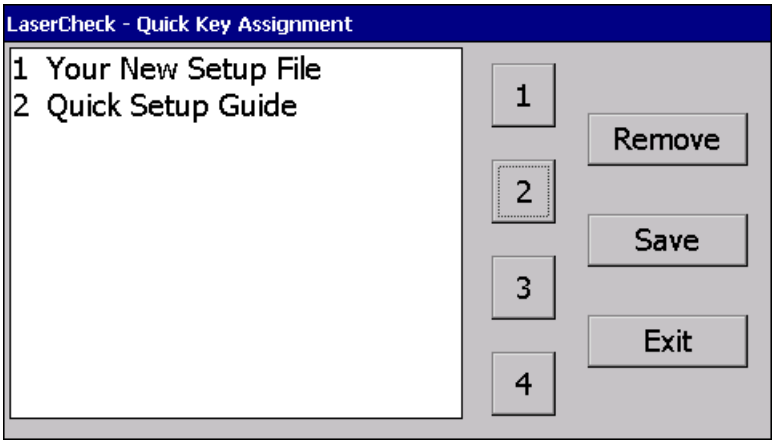
Pushing the Exit Button will prompt you to save the setup file. Selecting "No" will return to the Main Setup Screen. Push "Main Screen" to return to the Lasercheck Startup/Main Screen.

Save

Pushing the Save Button will save the setup file to the name entered in the Filename Field and return to the Main Setup Screen. Push "Main Screen" to return to the Lasercheck Startup/Main Screen.

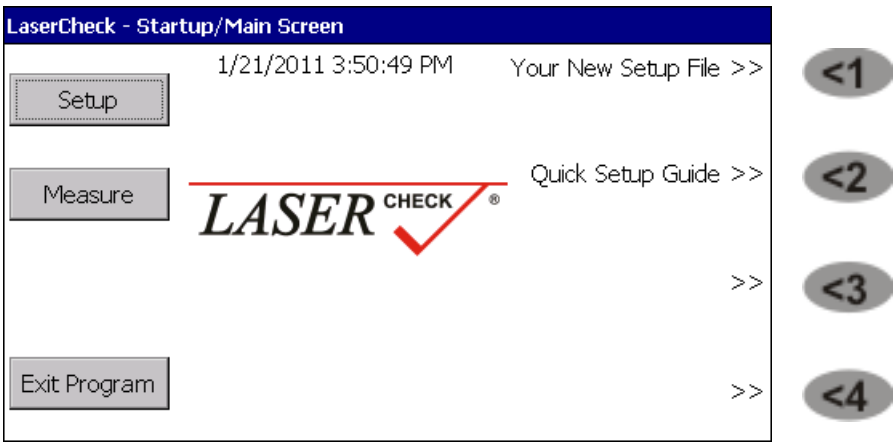
Quick Key Assignment

For convenient operation, up to 4 commonly performed measurements can be assigned to the 4 numbered buttons to the side of the LCD display. To assign measurement setup files to quick keys, push the "Setup" button in the Lasercheck Startup/Main Screen. Then push the "Quick Keys" button. The following screen will be displayed:



Quick Key Assignment Screen

Highlight the setup file you wish to assign a "Quick Key". Than push button 1, 2, 3, or 4 depending on which "Quick Key" you want the setup file assigned to. Assign as many as you wish up to a total of 4. Then push the "Save" Button. You will be returned to the Main Setup Screen. Pushing Exit will return you to the Lasercheck Startup/Main Screen with assigned Quick Keys identified to the right of the screen beside their specific "Quick Key Number".



Lasercheck Startup/Main Screen with Quick Keys Assigned

Aligning Lasercheck Using Mechanical and Software Aids

For detailed information on Lasercheck alignment see appendix “Lasercheck Alignment Principles and Procedures”

Pre-Position Sensor

For surfaces with different geometry or for on-line automated applications, alignment fixturing must be used. The 706200 Adjustable XZ Mount is a robust and flexible adjustable mounting system for Lasercheck that provides improved repeatability, accuracy, and reliability of Lasercheck measurements in your plant installation. An understanding of alignment procedures for Lasercheck is required for development of fixturing. Please read the section on Mounting/Fixturing Lasercheck in the appendix of this manual.

Important! *If the measurement surface is relatively rough (greater than 10 microinches / 0.25 microns Ra) then a piece of shiny clear tape should be applied to the surface at the measurement location. This aids in alignment and must be removed after the alignment procedure.*

Pre-Position Lasercheck Sensor

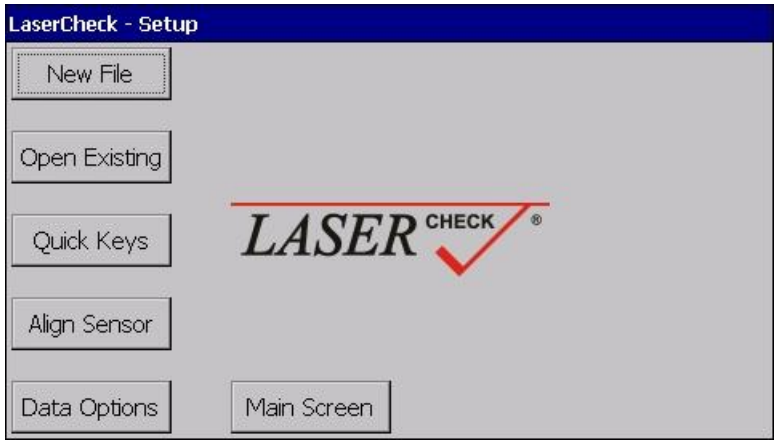
Once the Lasercheck is mounted in a fixture the typical surface being measured should be positioned directly over the surface to be measured. Set the stand-off plate supplied with your Lasercheck on the surface and lower the sensor head until it contacts the stand-off plate. This will pre-position the measurement head approximately 0.1 inch (2.5 mm) from the surface.

Lasercheck Sensor Lowered to pre-set 0.1 inch gap using stand-off plate

The installation is now ready for final fine adjustment of alignment using the Lasercheck Alignment Software Module.

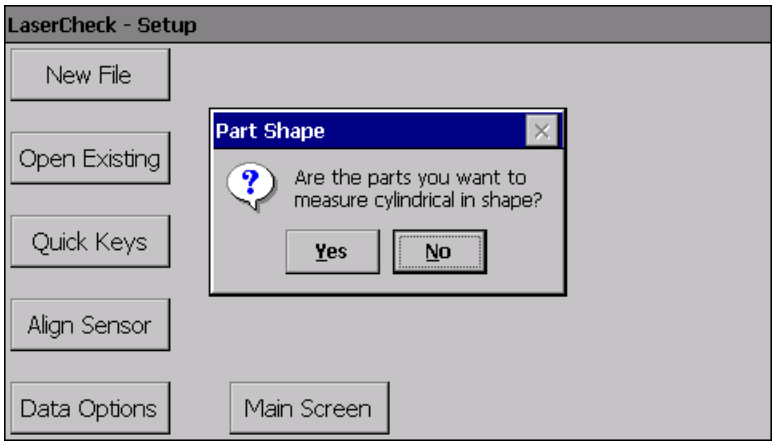
Enter Setup /Alignment Software Module

From the Lasercheck Startup/Main Screen, push the “Setup” button. The following Screen will be displayed:



Main Setup Screen

Push the “Align Sensor” button. The following screen will be displayed:

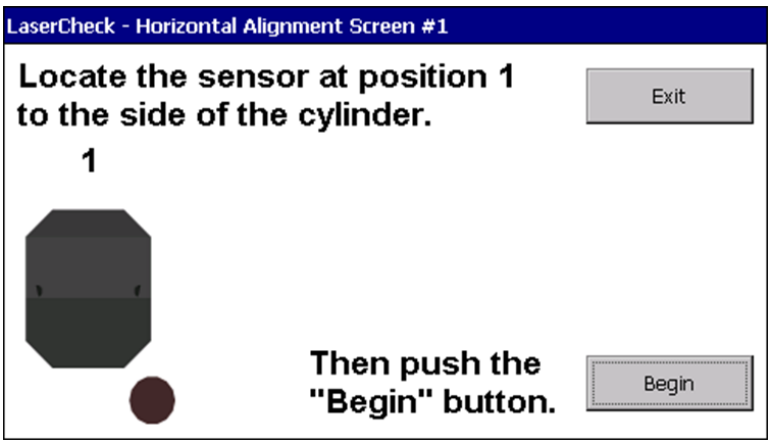


Cylindrical in Shape

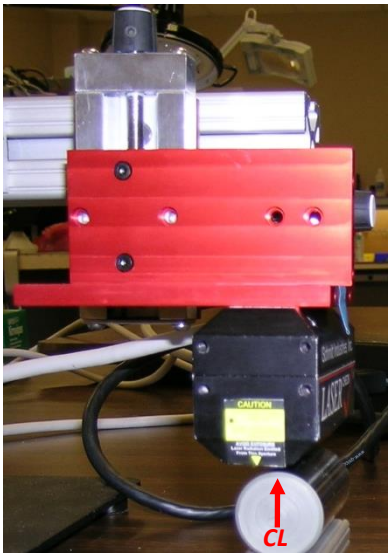
If your surfaces are flat, select no. The software will open Vertical Alignment Screen #1 discussed later in this section. Select yes for cylindrical parts or for material passing over a cylindrical roll where Lasercheck will be positioned over the material passing over the crown of that roll.

Horizontal Alignment of Sensor

If your parts are cylindrical in shape and you select yes, the following screen will be displayed:



Horizontal Alignment Screen #1

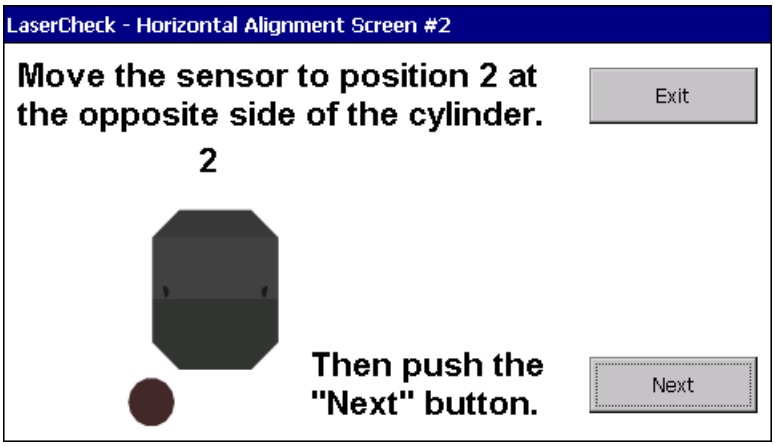


Lasercheck Sensor Positioned over Cylindrical Part

Using horizontal fine adjustment positioners provided on model 706200 Adjustable XZ Mount move the measurement sensor to one side of the centerline of your cylindrical surface as prompted in the software display screen.

Once complete, push the “Begin” button at the bottom right corner of the software screen.

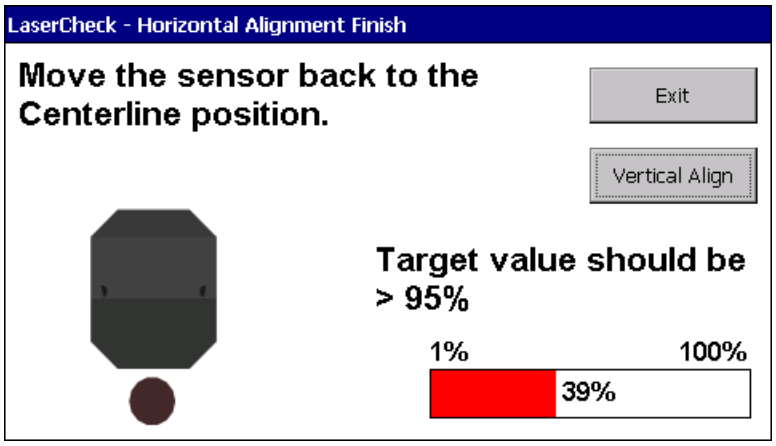
The following screen will be displayed:



Horizontal Alignment Screen #2

The measurement sensor in the software screen will move horizontally from one side of the cylindrical part to the other side. Perform the same operation with the measurement sensor using the horizontal fine adjustment positioners provided on model 706200 Adjustable XZ Mount. When completed, push “Next”.

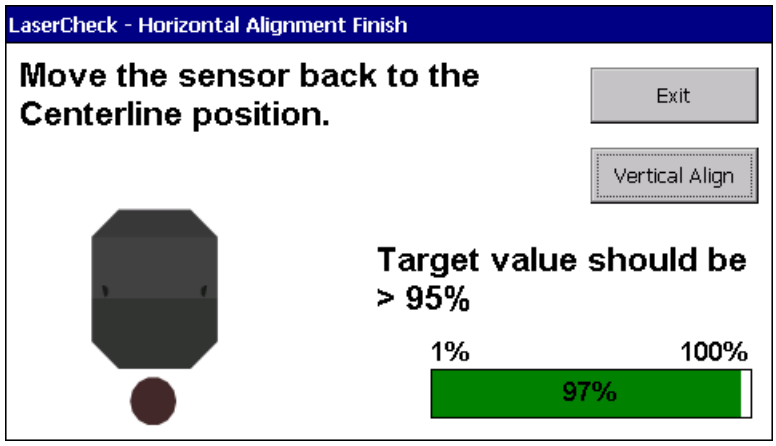
The following screen will be displayed:



Horizontal Alignment Screen #3

The measurement sensor in the software screen will move horizontally back to the center line of the cylindrical part. Perform the same operation with the measurement sensor using the horizontal fine adjustment positioners provided on model 706200 Adjustable XZ Mount. Observe the bar graph while performing this operation.

When the sensor is well aligned the bar graph will change from red to green as shown in the screen below:



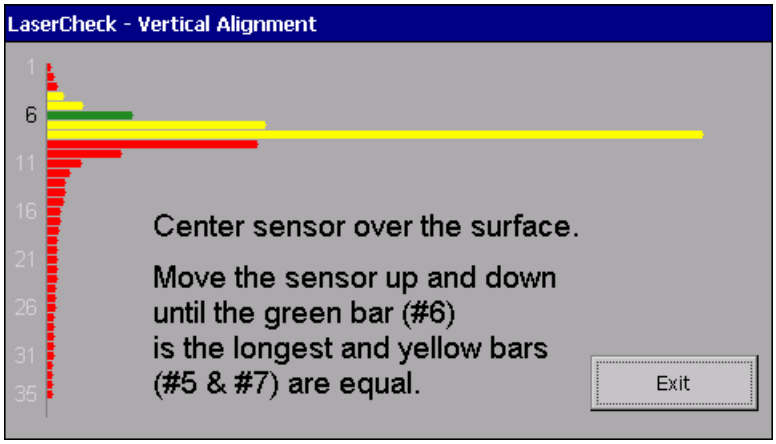
Horizontal Alignment Screen #4

Fine adjust horizontal position until the bar graph is as close to 100% as possible.

When completed, push “Vertical Align”.

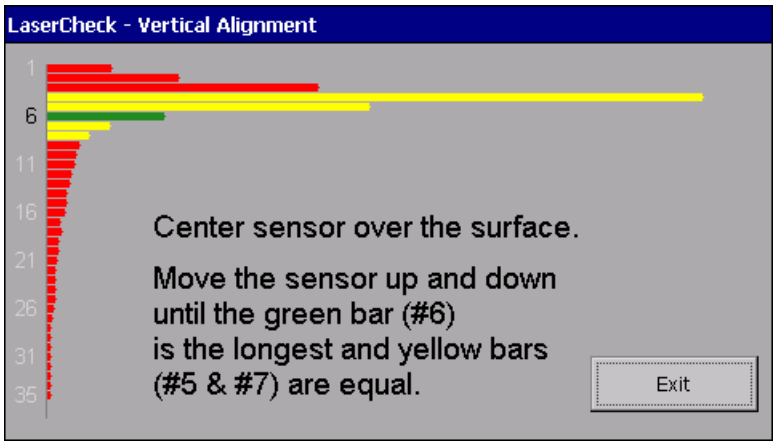
Vertical Alignment of Sensor

The following screen will be displayed:



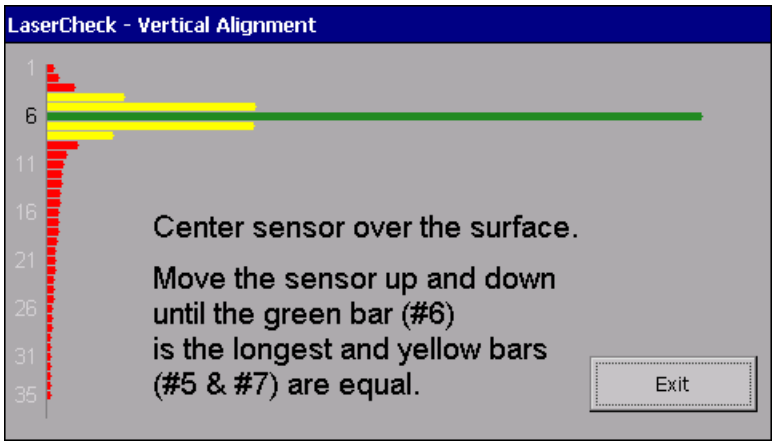
Vertical Alignment Screen #1

If the sensor is too close to the surface, the vertical alignment screen may appear like Vertical Alignment Screen #1 above.



Vertical Alignment Screen #2

If the sensor is too far from the surface, the vertical alignment screen may appear like Vertical Alignment Screen #2 above.



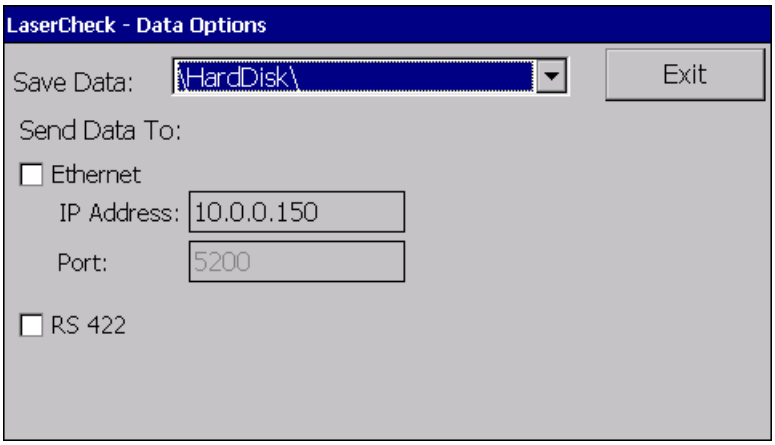
Vertical Alignment Screen #3

Use the vertical fine adjustment positioners provided on model 706200 Adjustable XZ Mount to carefully move the sensor up or down until the vertical alignment screen looks like Vertical Alignment Screen #3 above.

Set the vertical position of the sensor so that the green bar becomes the longest and that the yellow bars on either side of the green bar are as equal in length as possible. When completed, push “Exit”. The software will return to the Main Setup Screen.

Lasercheck Data Collection Monitoring Options

Lasercheck measurements can be saved to any location on the “hard disk” of the LCD controller or to a memory stick inserted in the back of the LCD controller. Additionally data can be collected remotely from either the Ethernet or Com2 connector on the Interconnect Box in RS422 format. To assign output options, push the “Setup” button in the Lasercheck Startup/Main Screen. Then push the “Data Options” button. The following screen will be displayed:



Lasercheck Options Screen

USB or Lasercheck Controller Hard Disk

In the “Save Data” field use the drop down box to select the Lasercheck local hard disk or USB location you wish to have measurements saved to.

Ethernet or RS422

Refer to appendix on Lasercheck AUTO Data Receive Software for detailed information on these settings and software and setup for capturing measured data.

Ethernet

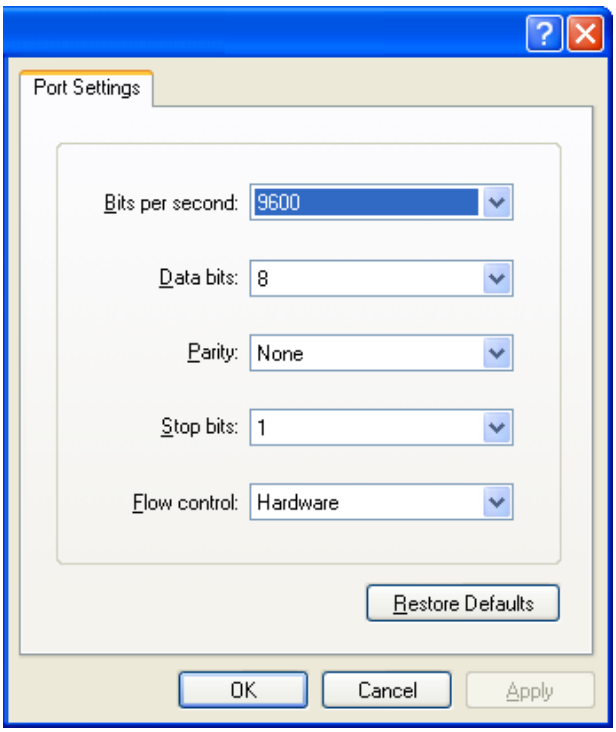
Select the check box beside Ethernet and data will stream out the Ethernet port as measurements occur. The receiving computer requires software to receive the csv formatted text values and save to a location on the computer or network.

Connect the host computer and Lasercheck AUTO Control using either a crossover Ethernet cable or standard Ethernet cables with a router or switch in-between the devices to accomplish the communication crossover. A standard Ethernet cable will also work directly on computers that have an auto-sensing network interface card (NIC).

RS422

Select the check box beside RS422 and data will stream out the COM 2 port as measurements occur. The receiving computer requires software to receive the csv formatted text values and save to a location on the

computer or network. Lasercheck AUTO Data Receive Software discussed in the Appendix of this manual can be used to capture measurements on the receiving computer. Other commercial SPC and Quality management software programs can also be used. HyperTerminal provided in Windows XP based computers or secondary market suppliers can also be used. Computer com port settings should be 9600, 8, N, 1 as shown below:

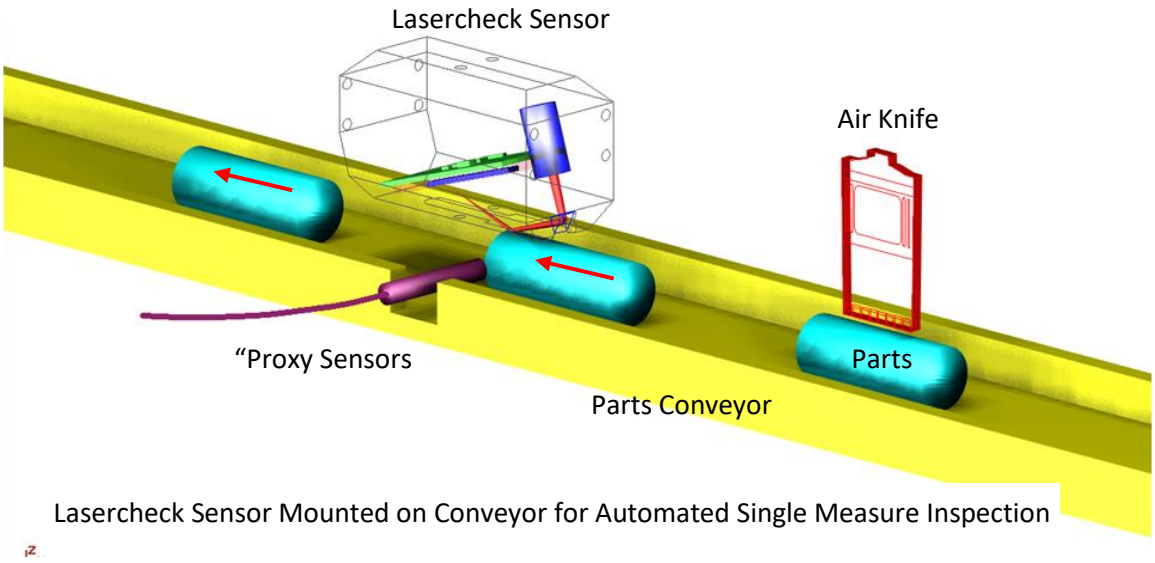


A serial null modem crossover cable that is made for computer to computer connections is required to establish communications and data transfer.

Input Trigger Setup

Single Measurements per Surface

Lasercheck measures moving parts after a finishing operation. Parts should be transported under the Lasercheck sensor on a stable conveyor or brought to the Lasercheck sensor with automated robotic positioning machinery. Input trigger devices must be positioned and timed so that the trigger becomes active when the surface is in correct measurement position. Once the input goes "active" a single measurement will occur. The surface roughness measurement will begin a few milliseconds after the trigger is received. Measurement time is approximately 10 milliseconds. The surface can be moving at any speed under the measurement sensor while the measurement takes place.



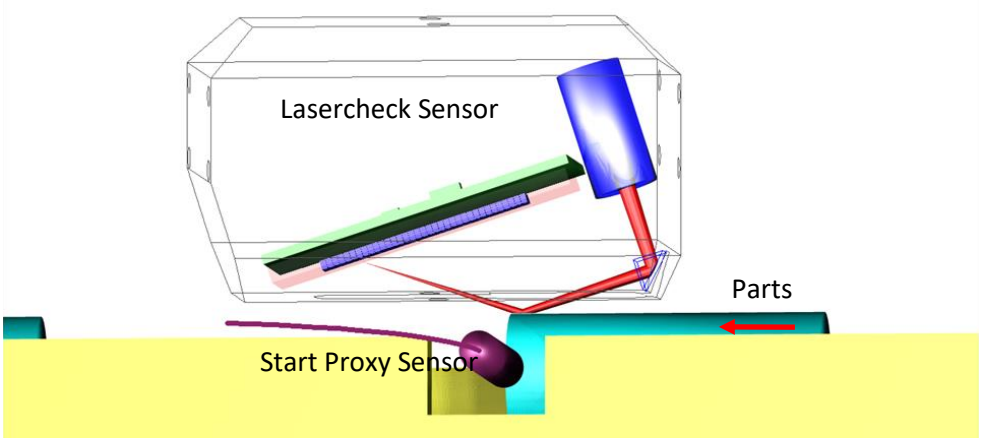
Lasercheck Sensor Mounted on Conveyor for Automated Single Measure Inspection

If parts are not clean, an air knife should be installed and mounted prior to the laser sensor to blow-dry excess coolant off of the surface to be measured. Ideally the parts would pass a few millimeters under the air knife, which would operate with a pressure of approximately 20 psi blowing on the surface to clean off coolant and debris.

Setting Input Triggers for Automated Single Measurement Inspection

A "start" input should be set so the trigger activates as soon as the surface to be measured is in a measurement position. From the Lasercheck Startup/Main Screen push the "Setup" button, then the "Align Sensor" button. When prompted about cylindrical parts, select "No". The laser will now start pulsing. Move a surface under the Lasercheck sensor until the pulsing laser spot is visible on the measurement area as shown in the image below.

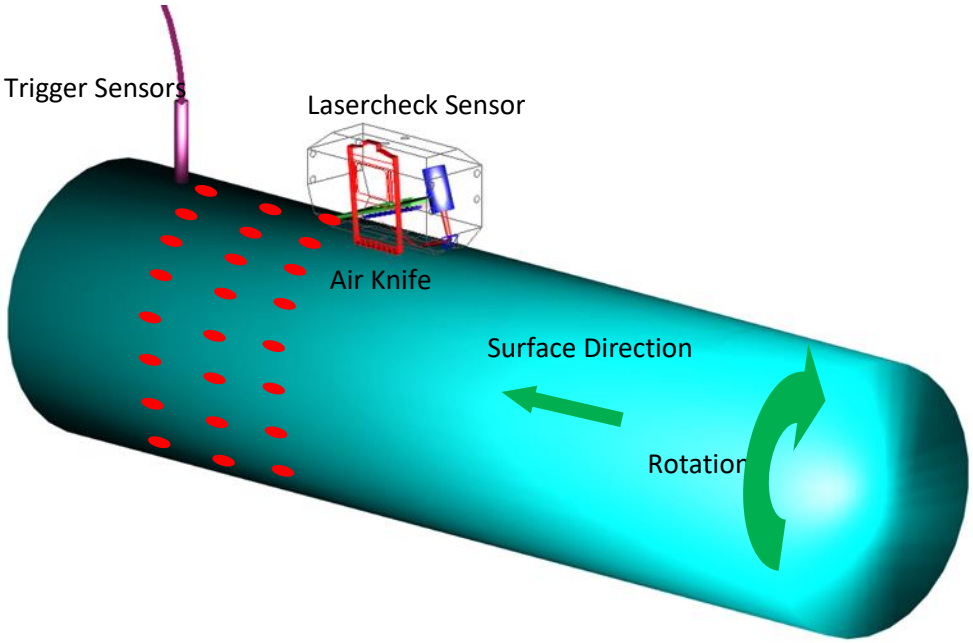
Then set or position the trigger mechanism so that it activates at exactly this point.



Proximity Sensor Trigger positioned to activate as surface reaches Measurement Position

Continuous Measurements on a Surface

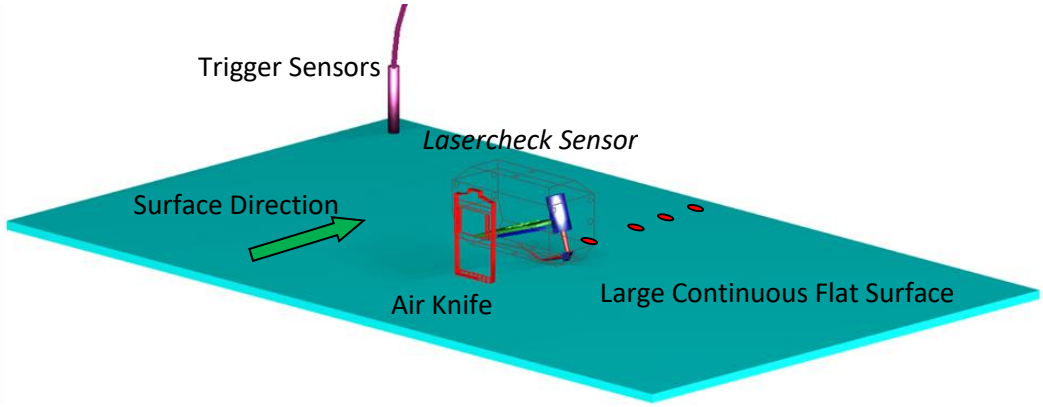
Lasercheck measures large moving surfaces during or after a finishing operation. The Lasercheck sensor is positioned over the surface and the surface is transported under the measurement sensor. Input trigger devices must be positioned and timed so that the trigger becomes active when the surface is in correct measurement position. Once the input goes "active" multiple continuous measurements will occur at a rate of approximately 8 complete measurements per second. The surface roughness measurements will begin a few milliseconds after the trigger is received. Measurement time for each measurement is approximately 10 milliseconds. The surface can be moving at any speed under the measurement sensor while the measurement takes place. Measurements will stop as soon as the trigger becomes inactive. This procedure is the same for either large flat or curved surfaces passing under the Lasercheck sensor.



Lasercheck Sensor Mounted on Large Rotating Roll for Automated Continuous Inspection

If the surface is not clean, an air knife should be installed and mounted prior to the laser sensor to blow-dry excess coolant and debris off of the surface to be measured. Ideally the parts would pass a few millimeters under the air knife, which would operate with a pressure of approximately 20 psi blowing on the surface.

Setting Input Triggers for Automated Continuous Measurement Inspection



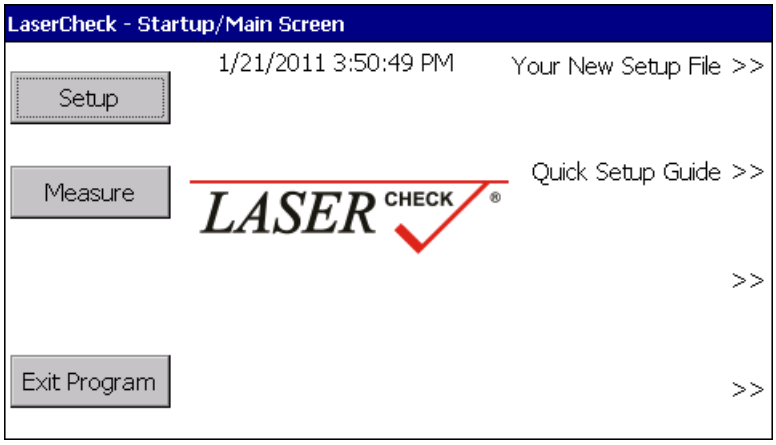
Lasercheck Sensor Mounted on Large Flat Sheet for Automated Continuous Inspection

A “start” input should be set so the trigger activates as soon as the surface to be measured is in a measurement position. From the Lasercheck Startup/Main Screen push the “Setup” button, then the “Align Sensor” button. When prompted about cylindrical parts, select “No”. The laser will now start pulsing. Move the Lasercheck sensor or surface under the Lasercheck sensor until the pulsing laser spot is visible on the measurement area.

Then set or position the trigger mechanism so that it activates at exactly this point.

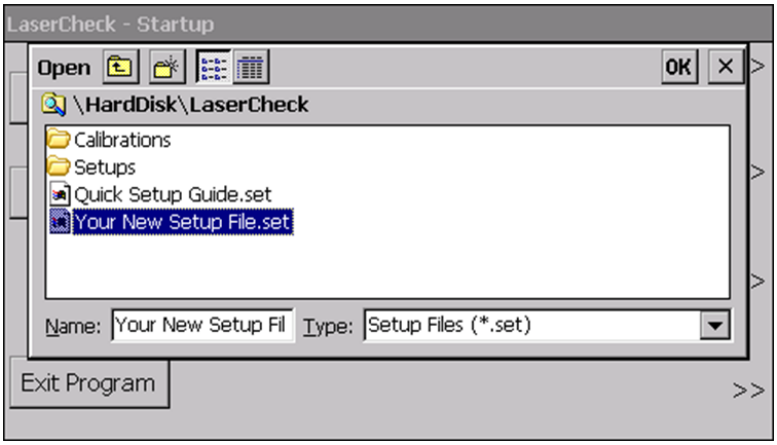
Begin Automated Measurements

Exit back to the Lasercheck Startup/Main Screen.



Lasercheck Startup/Main Screen

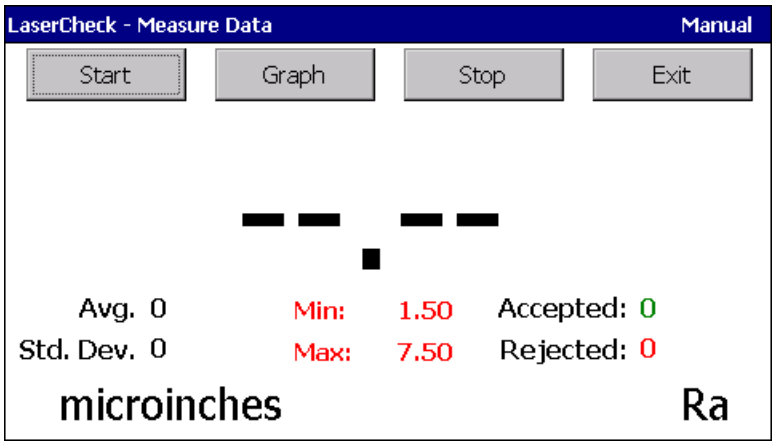
Push the Measure button, the following screen will be displayed:



Measure Open Setup

Select the “Setup” file for the surface measurements you will be performing.

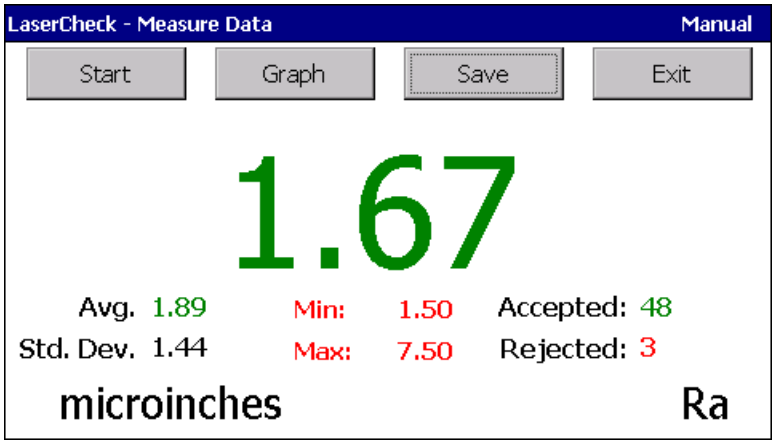
The following screen will be displayed:



Measure Data Screen Prior to Trigger

The selected filename appears in the upper right banner section. The minimum and maximum Ra specification values appear in the center of the screen. Measurements will be performed upon activation of the input trigger or pushing the “Start” button.

When measurements begin, the following screen will be displayed:

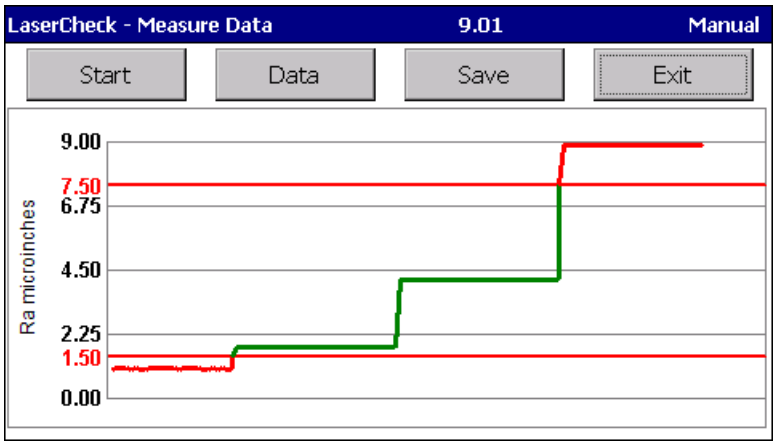


Measure Data Screen after Trigger

Note that the values will be displayed in **GREEN** if results are within the minimum and maximum Roughness values specified in your setup file. Values will be displayed in **RED** if results are outside the minimum and maximum Roughness values specified in your setup file.

Average of all measurements will be displayed in **GREEN** if the average is in specification and in **RED** if the average falls outside your specification. Real time counters appear in the bottom right corner indicating how many measurements are in specification / Accepted in **GREEN** and out of specification / Rejected in RED.

Push the “Graph” button and the following screen will be displayed

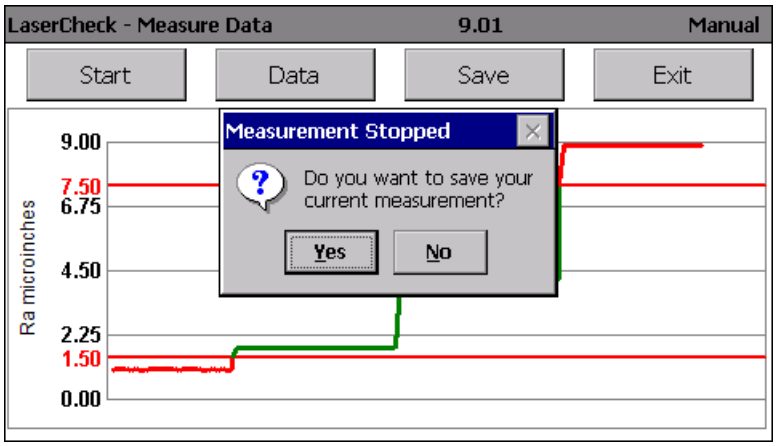


Measure Graph Screen Scanning 1, 2, 4, and 8 Microinch Surfaces

The same measurement results will be displayed in real time in a graphical display. Note that horizontal **RED** lines designating the minimum and maximum Roughness values specified in your setup file. The graph of measurement values will be displayed in **GREEN** if results are within the minimum and maximum Roughness values specified in your setup file. The graph of measurement values will be displayed in **RED** if results are outside the minimum and maximum Roughness values specified in your setup file.

You can toggle back and forth between graph and data display of roughness values. Pushing “Stop” from the data or graph screen or activating input 2 (Stop) stops the measurement.

Pushing “Save” will save the measurements. Pushing “Exit” without first initiating a Save will display the following screen:



Measure/Save Screen

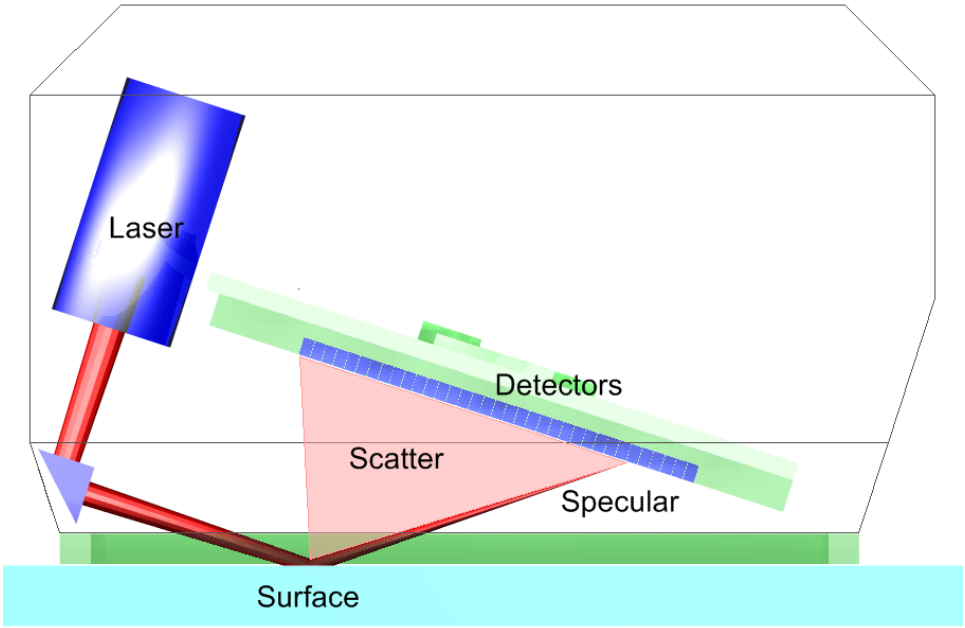
If “Yes” is selected, the measurement results will be saved to a predetermined location then you will be returned to an empty Measure Data Screen. If “No” is selected, you will be returned to an empty Measure Data Screen without saving any values.

Appendix A – Lasercheck Alignment Principles and Procedures

This section contains information on principals and procedures to install and align Lasercheck heads. The keys to getting accurate and repeatable data are controlling alignment and cleaning the surface.

How Does Lasercheck Work?

The visible (650-nm.) laser illuminates the surface with a shallow incident angle to measure surface roughness features. The distribution of reflected and scattered light from the surface is detected by a photodiode array with 35 small closely packed detectors. This relative distribution of reflected and scattered light is used to calculate the surface roughness of the area illuminated by the laser beam. The array is also scanned by software to find the specular beam (when there is one) and its position is used to determine height of the measurement head from the surface.



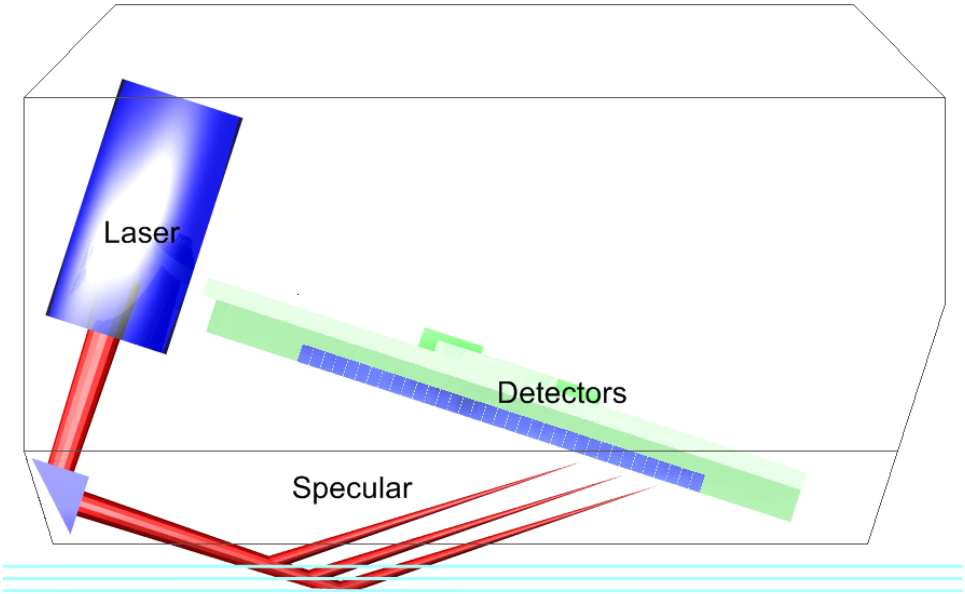
Schematic Diagram of Lasercheck Instrument

The image shows a schematic of the layout of the laser, the beam path and the detectors in Lasercheck. The “Photodiode Array” has 35 discrete detector elements.

Alignment

Vertical

The specular laser beam must fall on one of detectors 3 to 9 n the 35-element photodiode array. If Lasercheck is too close to the surface, the specular reflection falls on detector number 10 or greater. If Lasercheck is too far from a surface, the specular laser beam falls on detector 2 or smaller, or misses the photodiode array entirely.



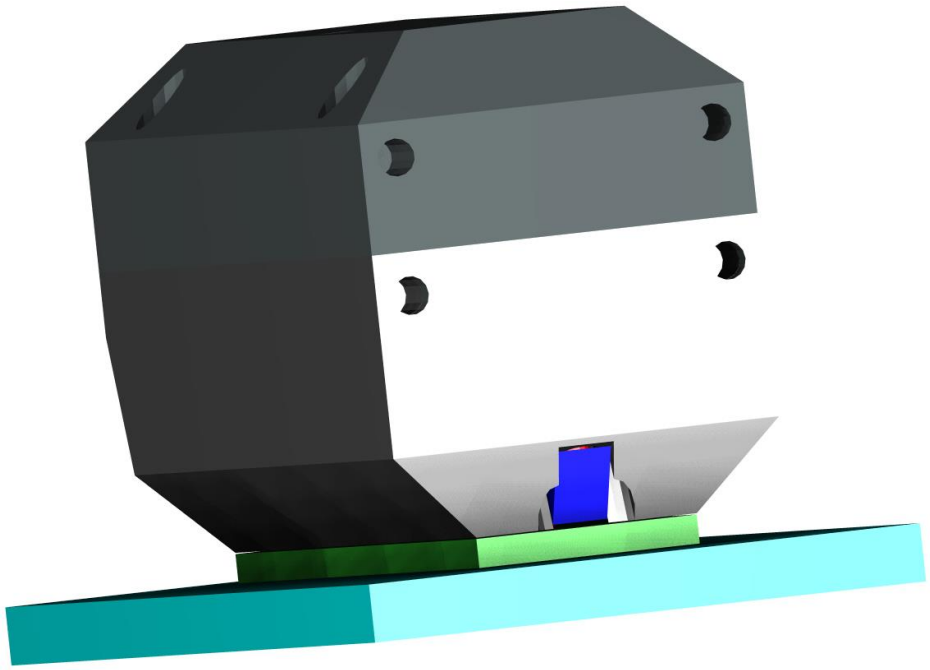
Three Surface Locations – Too Close, Correct, Too Far

The image depicts the laser path and specular reflection from surfaces at three different distances from the head. The bottom surface, the farthest from the head, shows the specular reflection about to strike detector 2. This is misaligned – the head is too far from the surface. The top surface is also misaligned because the specular beam is hitting higher than detector 9 on the detector array – the head is too close to the surface.

A good guideline is to try to maintain alignment so that specular falls on detector 6 with a tolerance of no more than +/- 1 detector elements. As a reference, the head movement is approximately 0.010 inches for every shift of the specular beam of one detector element.

Vertical Alignment Base plate

Lasercheck is shipped with base plate that is pre-aligned to set correct vertical positioning on flat parts. This base will set vertical position of the head so that the specular reflected laser beam will strike close to or on detector 6 in the middle of the detectors 4 to 8.

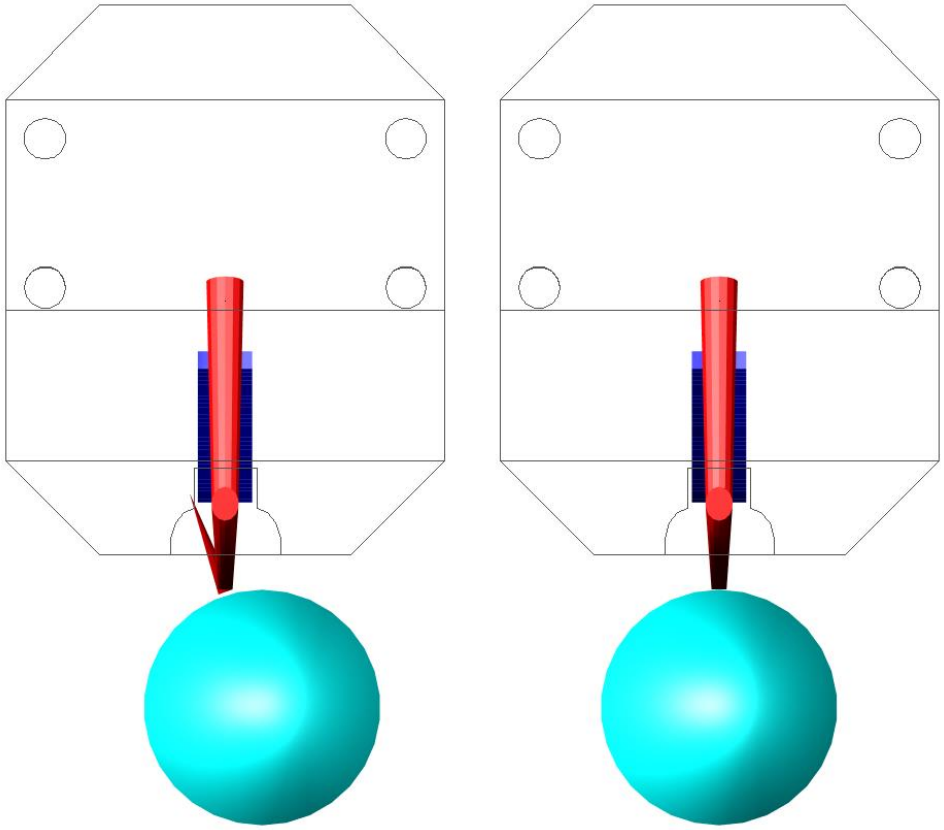


6212 on Flat Surface with 0.10 inch Base Plate to Set Vertical Alignment

Horizontal

The Lasercheck is also sensitive to horizontal misalignment on curved surfaces.

If the Lasercheck Head is correctly aligned, the reflected and scattered laser light reflects back into the center of the detector window. If it is misaligned, the reflected and scattered laser light reflects to one side or the other of the center of the detector window.

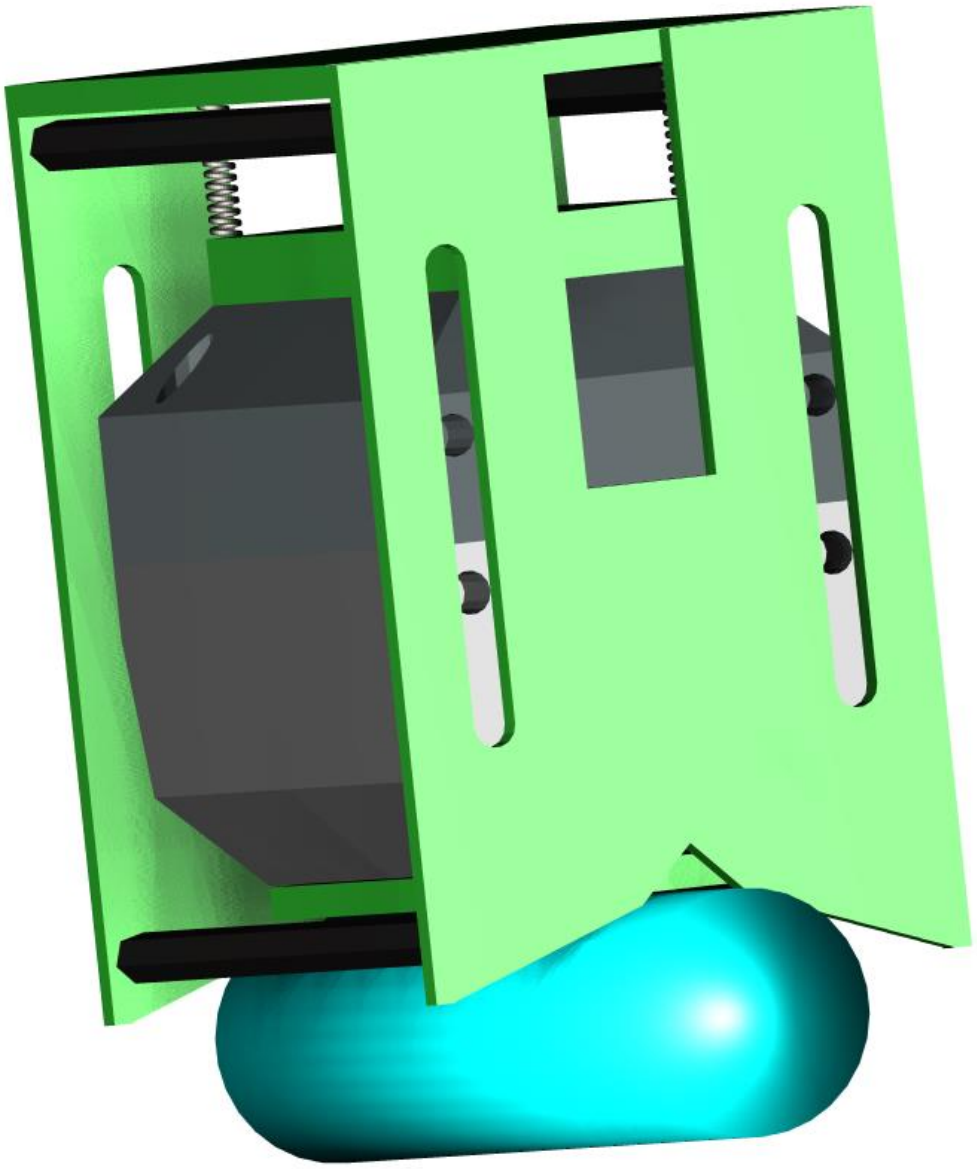


6212 End View showing misaligned and aligned cylindrical surfaces

This figure demonstrates horizontal misalignment because the laser beam and scatter does not reflect back into the center of the head where the sensors are positioned. When a cylindrical surface is perfectly horizontally aligned, all laser reflection is back into the centerline of the Lasercheck head.

Cylindrical Surface Measurement Alignment Fixture

Lasercheck can be equipped with our optional model 6216 spring loaded alignment fixture. This simple to use fixture, when attached to the Lasercheck head will set horizontal position of the head perfectly on cylindrical shaped surfaces ensuring accurate measurements.

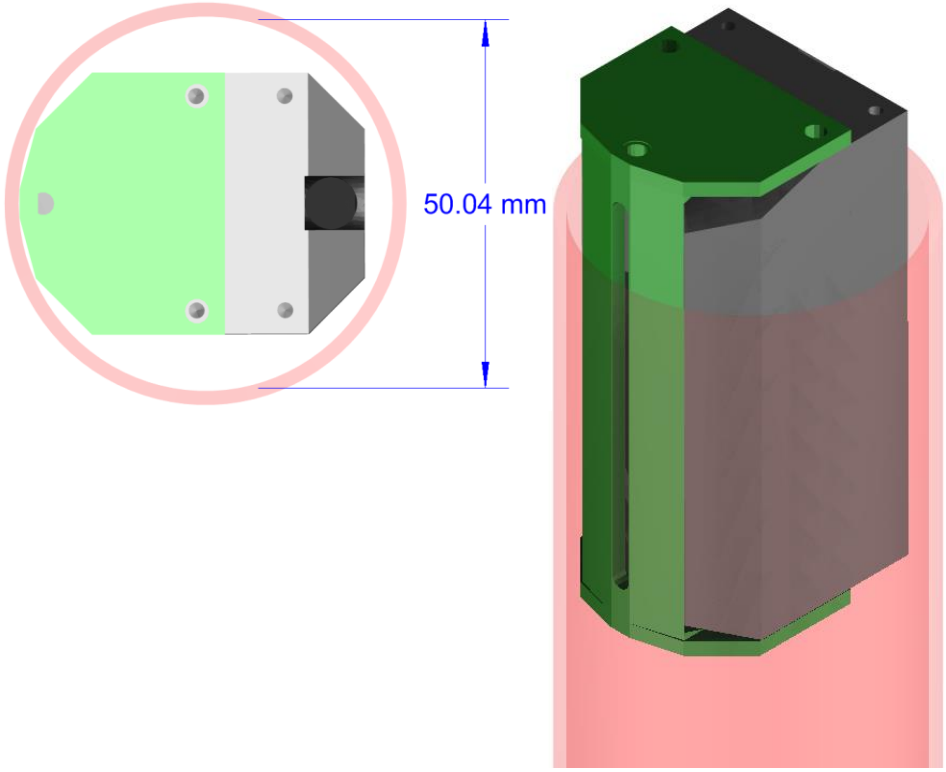


6212 on Cylinder Surface with Alignment Fixture Setting Correct Horizontal Position

Bore ID Surface Measurement Alignment Fixture

Lasercheck can be equipped with our optional model YMC070016 bore ID measurement alignment fixture. This mates and centers with a range of bore curvatures setting correct vertical and horizontal position of the head ensuring accurate measurements.

The YMC070016 fixture on the 6212 measurement head can be used on any ID bore diameter 2 inches (50 mm) or greater. This measurement capability is suited for large high quality bores like engine cylinder bores and hydraulic shafts that have been honed to high surface quality.



6212 in Cylinder Bore with Alignment Fixture End and Perspective View

Directional / Rotational

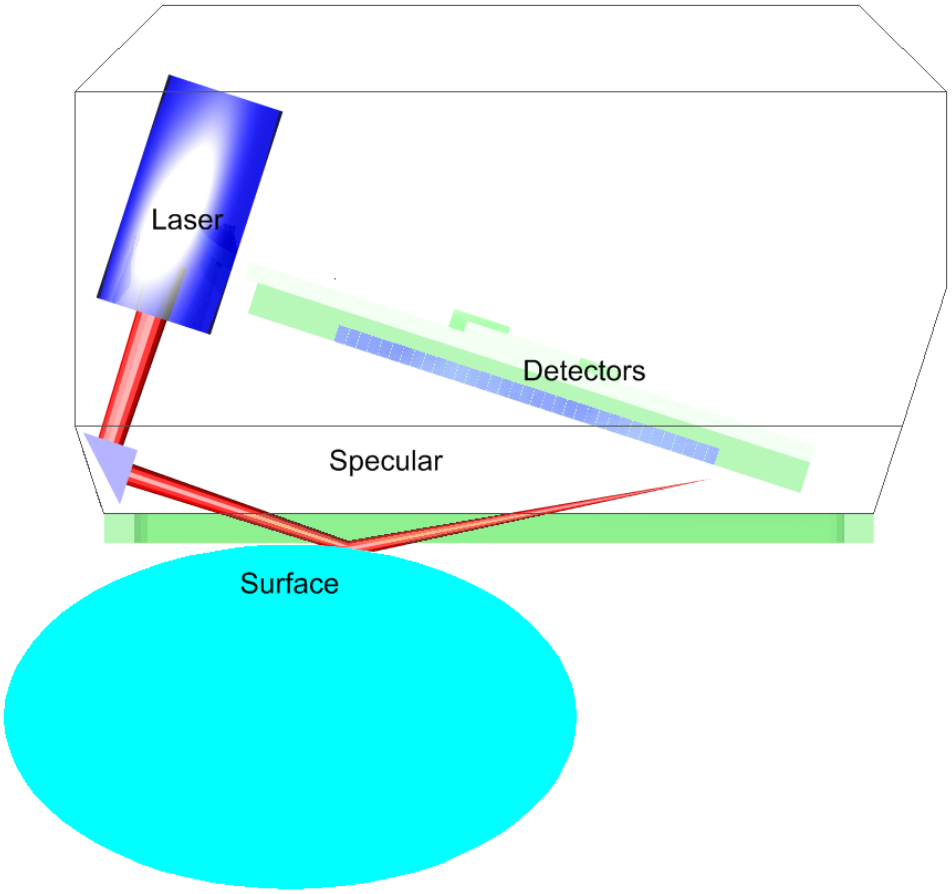
Many machined surfaces have a dominant direction of roughness. The length of the Lasercheck head must be oriented perpendicular to the direction of roughness so that the scatter strikes the detectors, which are oriented in a line down the middle of the head. Well-designed mounting hardware will ensure proper orientation.

If Lasercheck is not aligned at right angles to grinding groves on a directional ground surface for example (or straight along the length of a cylindrical barrel) then the “line” of scattered light will not perfectly fall on the detectors in Lasercheck. Well-designed fixtures will ensure accurate measurements.

Custom Shapes and Fixturing

3-Dimensional Shapes

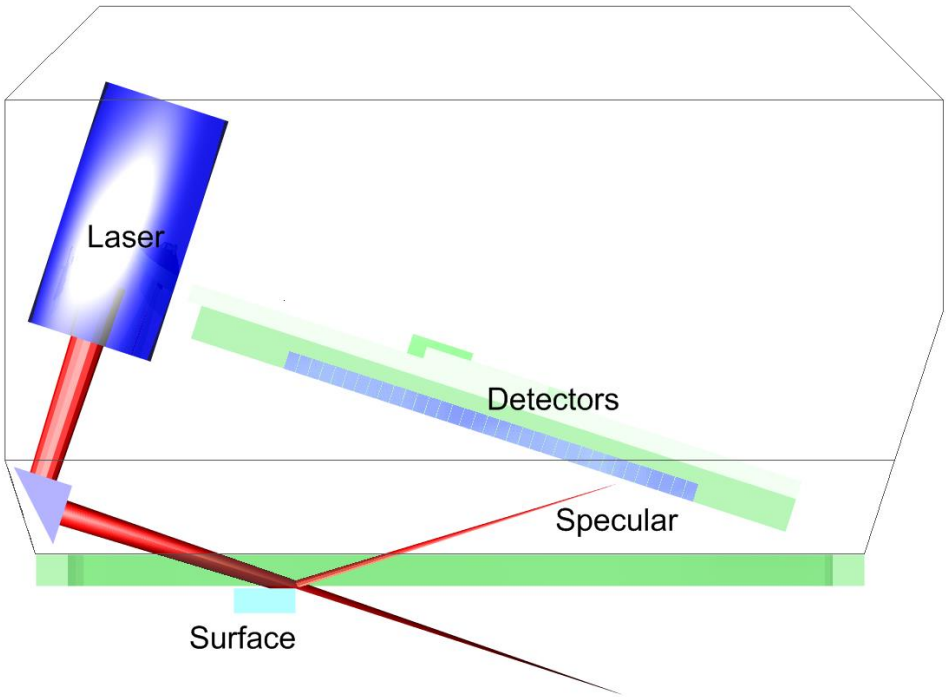
3-Dimensional curvatures and shapes cause Lasercheck to become easily misaligned either in the vertical or horizontal axis. Fixturing must be designed to carefully and repeatably control positioning in both axes so that the specular reflected beam strikes in the middle of the first 11 detectors and the overall reflection falls into the center of the detection window as viewed from the end of the measurement head.



6212 on “3-D” Curved Surfaces showing misalignment

Small Surfaces

Surfaces that are smaller than the actual footprint of the laser spot (approximately 5 to 6 mm long X 1 mm wide) can be measured. The part of the laser beam that “overfills” the surface can be allowed to pass by. It is important to ensure that part of the beam is not allowed to strike a “secondary” surface and reflect back into the sensors. This would affect the reading and the results of the “primary” small surface measurement. Fixturing must be designed to accommodate this requirement.

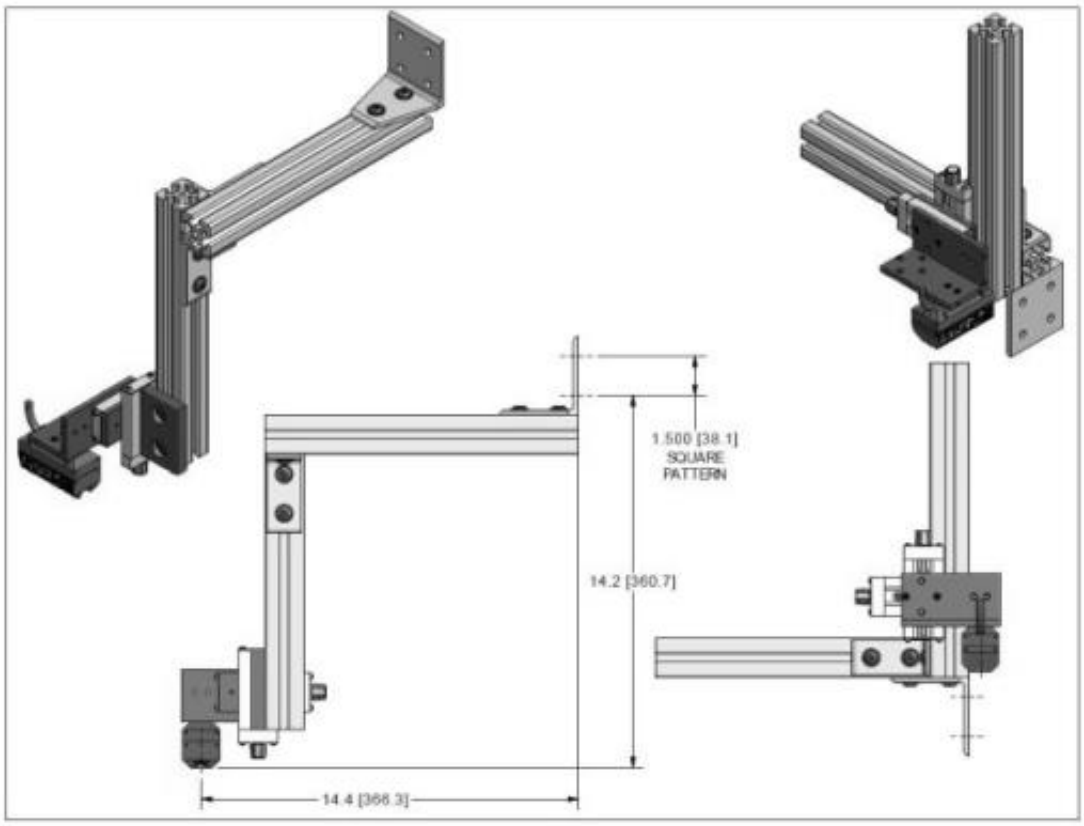


6212 can “over-illuminate” a small surface and measure roughness

Appendix B – Mounting/Fixturing Lasercheck

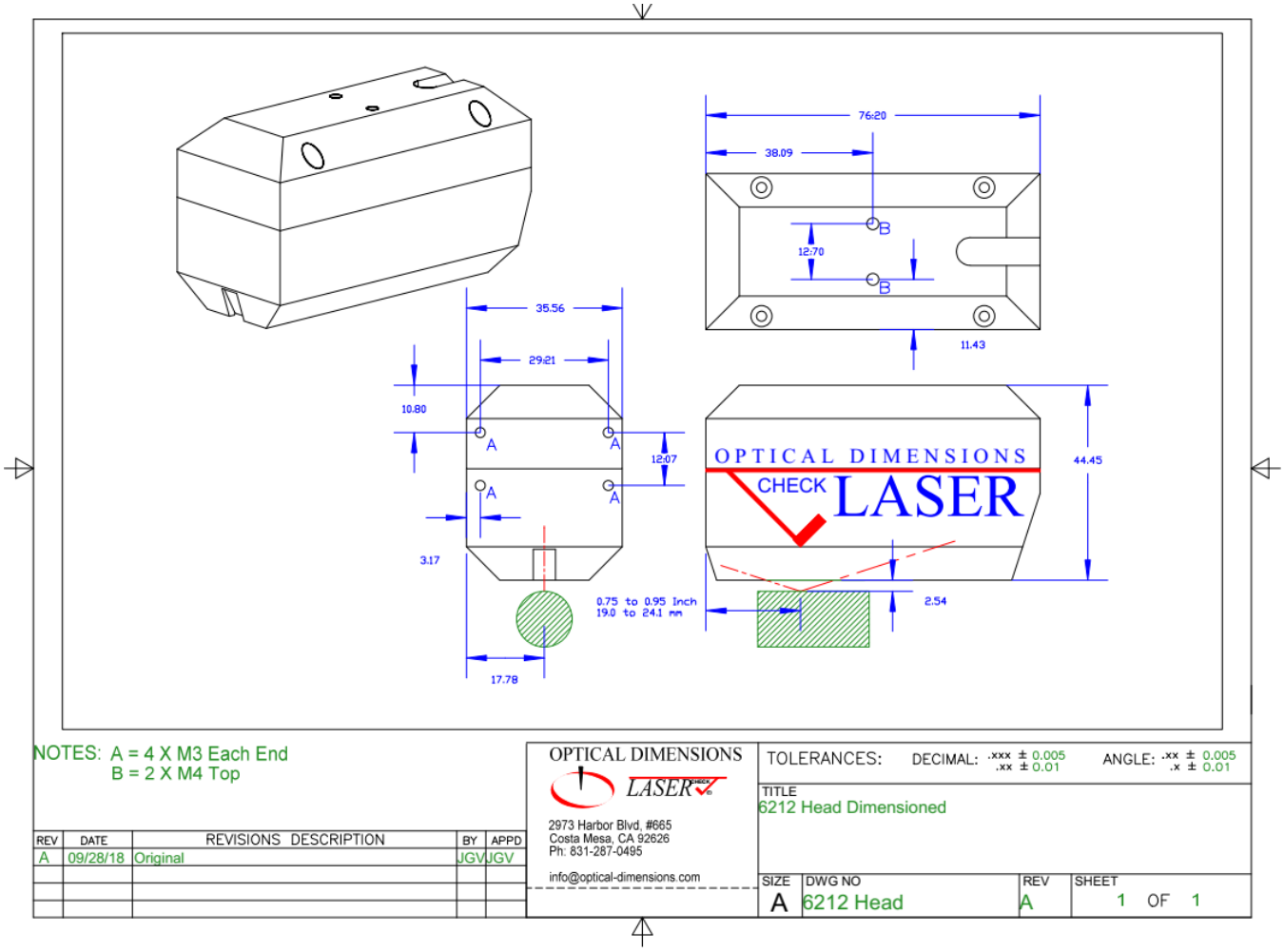
There are drilled and tapped holes on the Lasercheck sensor that can be used for mounting and installing the Lasercheck in an automated inspection application. The sensor should be positioned at a location where surface will be at the correct vertical and horizontal position relative to the gage sensor. The Lasercheck sensor must be precision adjusted over the surface in 2 axes (X and Z position) for optimal mounting / alignment.

Optical Dimensions provides an optional adjustable mounting fixture (model 706200) that provides necessary adjustment of sensor position in an on-line measurement application.



706200 Adjustable XZ Mount

Existing Mounting Holes on Lasercheck Sensor



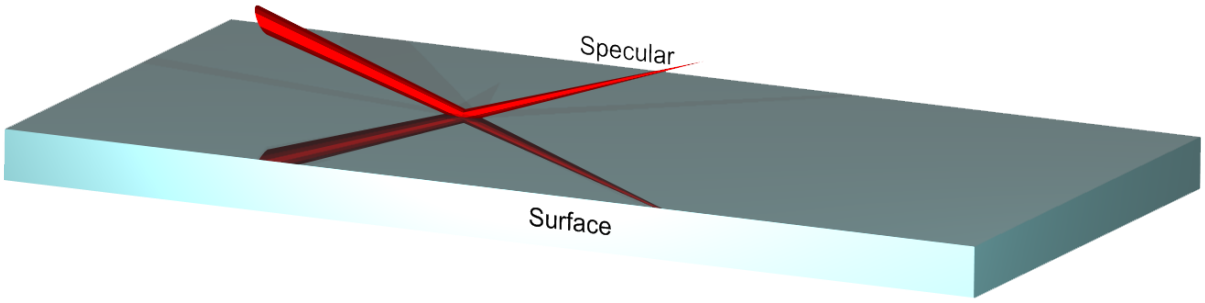
The CAD image above provides dimensional information for mounting of Lasercheck sensor over a cylindrical surface. IMPORTANT: the position of the measurement sensor relative to the surface is an approximate value. All mounting designs must incorporate fine positioning adjustment of the Lasercheck sensor in the X and Z axis to set correct alignment using Lasercheck software aids.

Appendix C – Calibration Process

Theory - Measurement and Calibration

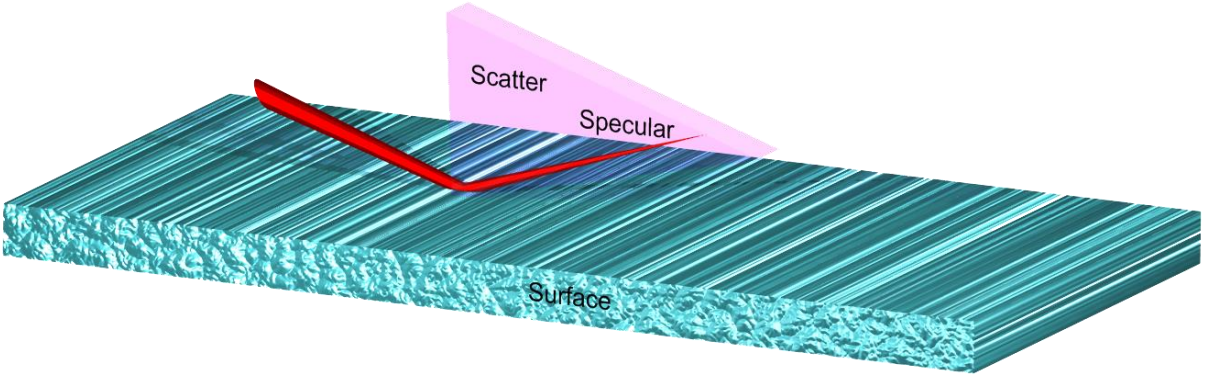
Measurement of Roughness

Lasercheck technology is based on measuring change in properties of a laser beam reflecting from a surface. When a laser is shone on a perfectly smooth mirror like surface there will be a clean “specular” laser reflection off that surface.

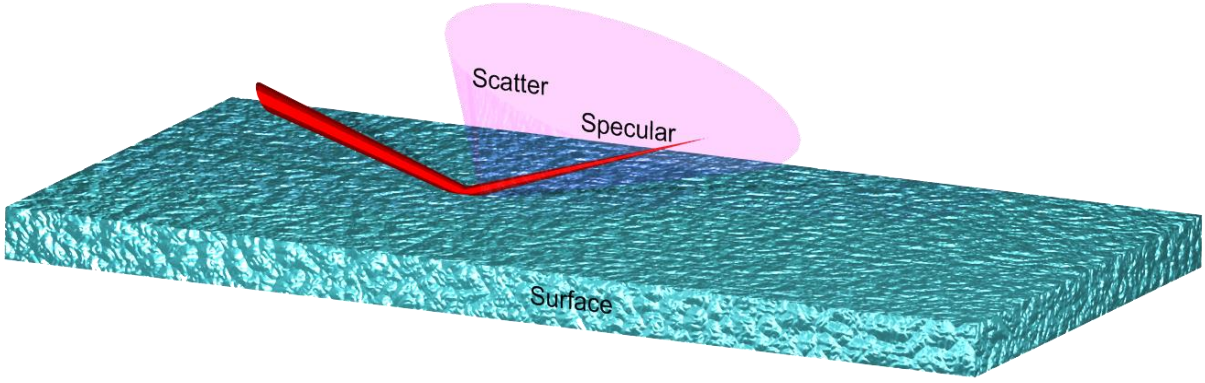


If a surface is not perfectly smooth and has some roughness the laser reflection will contain some diffuse reflection (scatter) in addition to the specular reflection. The “shape” of the pattern of scattered light is affected by the microscopic surface roughness pattern created by the machining operation used on the surface. Two simple examples to illustrate surface pattern affecting roughness pattern:

1) A directional belt sanding operation creates a roughness pattern on a surface that is highly directional. This directional roughness pattern generates a scattered light reflection pattern that is also highly directional, visually appearing like a 2D “stripe” of scattered light.



2) A sand blasting operation creates a roughness pattern on a surface that is non-directional or isotropic. This non-directional roughness pattern generates a scattered light reflection pattern that is also non-directional, visually appearing like a 3D “cone” of scattered light.

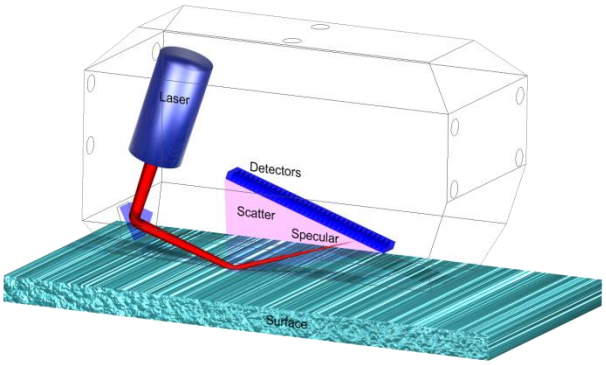


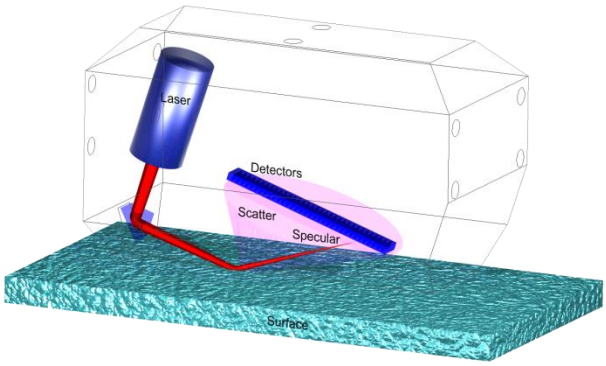
There are other examples of unique surface roughness pattern from various machining operations (swirl pattern, repeating groves, random / fractal, predominant peaks, predominant valleys) that uniquely affect the shape of the scattered light pattern.

Within any machining operation, as surface roughness increases, the specular portion of reflection decreases in intensity and the scatter portion of reflection increases in intensity. Lasercheck measures that entire pattern of specular and scatter reflection to determine roughness of a surface.

Requirement for Calibration of Lasercheck to Specific Machining Operation

The images below are basic optical schematics of Lasercheck showing laser source, beam reflecting optics, and layout of detectors. In both cases Lasercheck is on surfaces with the same Ra roughness value, but different surface pattern from different machining operation. Note the detectors are arranged in a line. They measure all of the scattered light from the directional surface. They measure only a portion of the scattered light from the non-directional surface.





Lasercheck will measure different signals and calculate different roughness for these two surfaces with identical Ra. The surface roughness pattern (machining operation) and resulting scatter pattern therefore must be an integral part of any Lasercheck calibration.

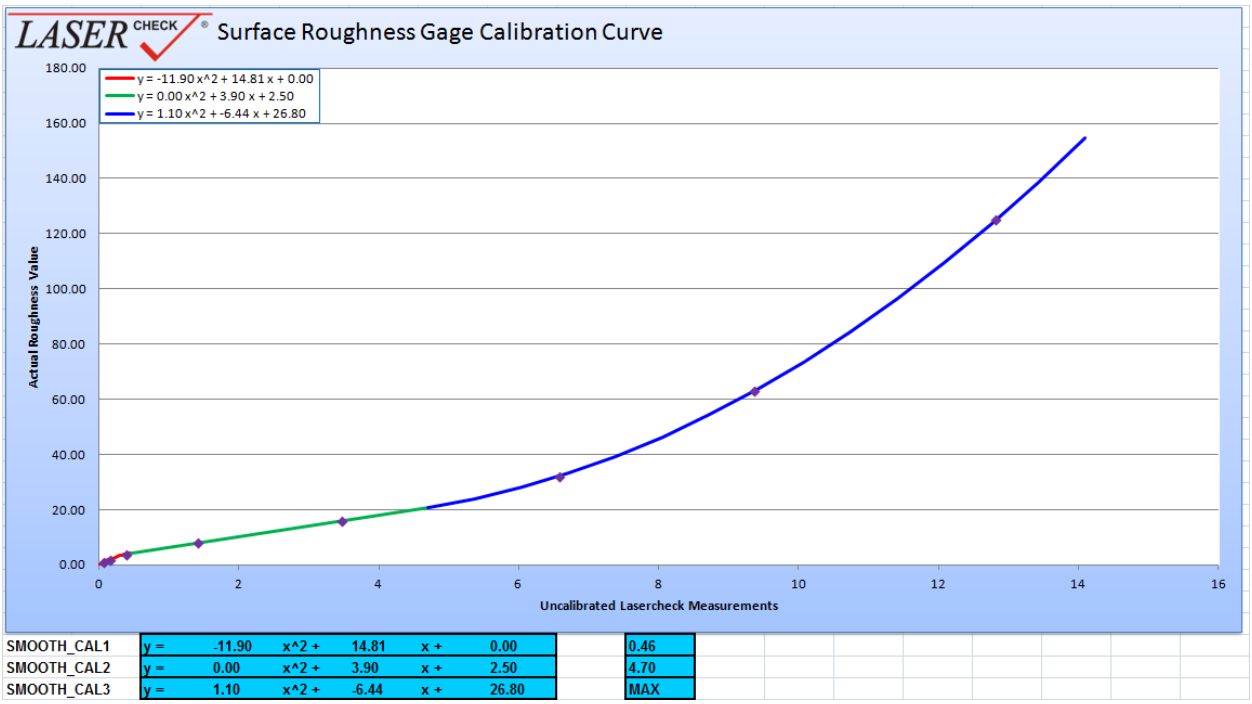
Base Calibration

Lasercheck is shipped calibrated to traceable standards for measurement of directional ground and sanded surfaces. Lasercheck can be calibrated for other surface finishing processes using an Excel spreadsheet calibration tool provided to generate a machining / surface pattern specific calibration file.

Overview of Calibration Process

Calibration of the Lasercheck gage involves customer testing known surfaces with the Lasercheck.

Lasercheck factory engineers use a custom excel spreadsheet tool to create a calibration file using those customer test values. Software in the Lasercheck instrument uses the new calibration file when it performs a measurement to provide users with roughness values calibrated to their finishing process.



SMOOTH_CAL1	y =	-11.90	x^2 +	14.81	x +	0.00	0.46
SMOOTH_CAL2	y =	0.00	x^2 +	3.90	x +	2.50	4.70
SMOOTH_CAL3	y =	1.10	x^2 +	-6.44	x +	26.80	MAX

Graph of directional ground surfaces from Lasercheck Excel Calibration Tool

Once a calibration is performed, Lasercheck never requires re-calibration for a specific surface finishing process; calibration never changes.

Appendix D – Controller Software Upgrade Instructions

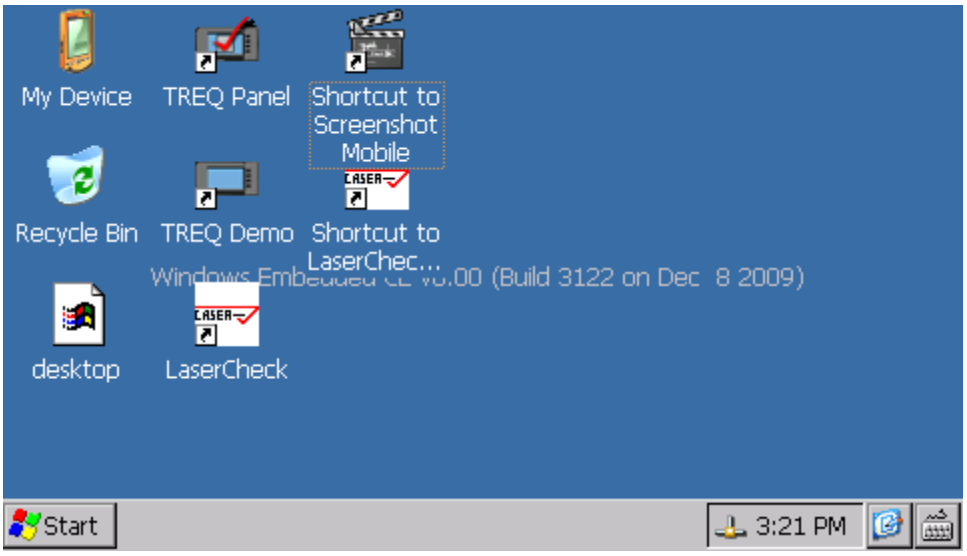
Prepare Upgrade Files

The Lasercheck AUTO setup program creates a “C:\Program Files\Schmitt Industries\Lasercheck\AUTO Software Upgrade” directory on the host computer. Copy all files inside this directory to the root drive of a USB memory stick. Do not add any directories or sub-directories to the USB stick. Files and directories must remain in the USB root directory.

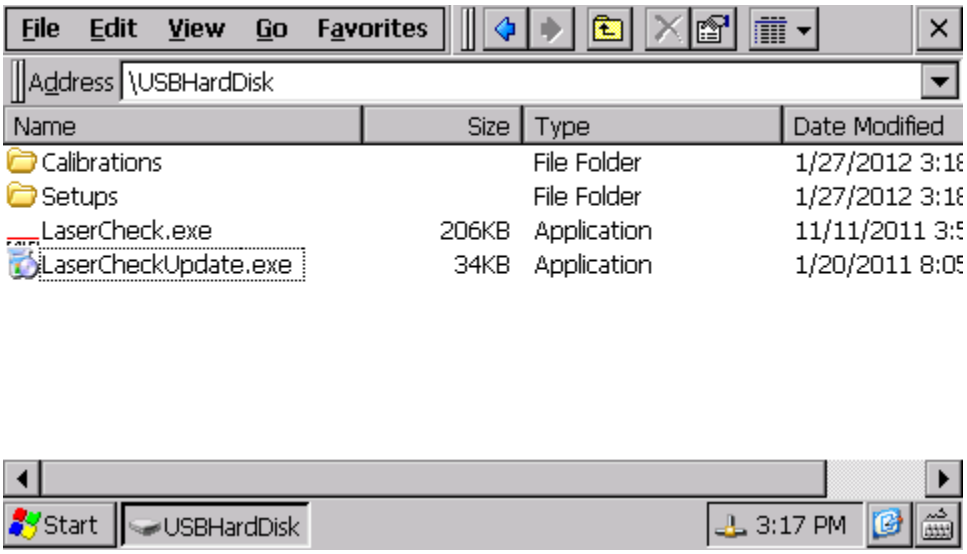
If repairing existing program on AUTO controller these are all the files necessary. If upgrading to a newer version of the Lasercheck AUTO controller copy the new “LaserCheck.exe” program over the existing version on the USB memory stick.

Prepare AUTO Controller and Install Upgrade

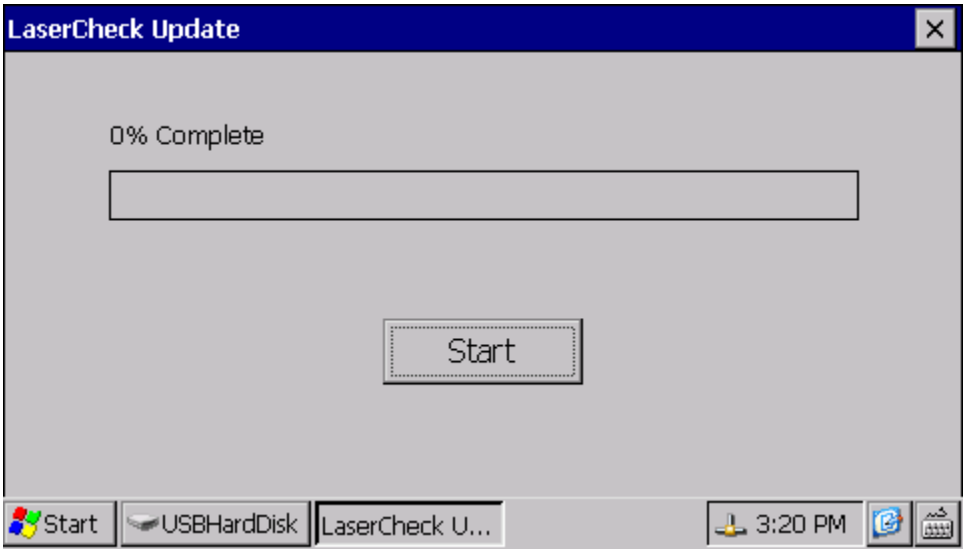
1. Install memory stick in one of the available USB ports on the back of the AUTO controller.
2. Power on the AUTO controller.
3. Once powered, exit the Lasercheck program. The main windows CE screen similar to below will appear:



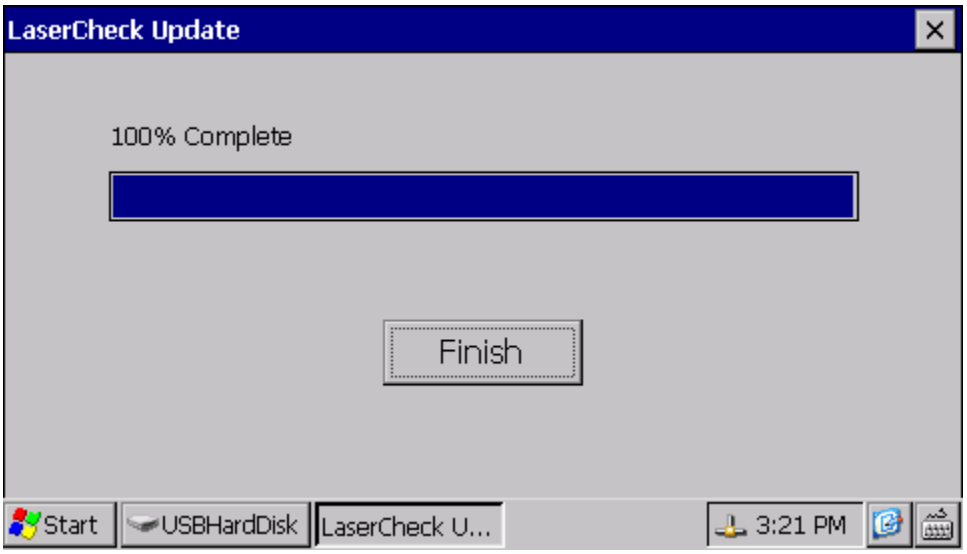
4. From the start menu of the Windows CE screen select “Start\Programs\Windows Explorer”. Navigate to the USBHardDisk location in Windows Explorer. You should see the files on the memory stick displayed



5. Execute the “LaserCheckUpdate.exe” program. Do NOT copy files to the controller and run the program. You MUST leave all files on the USB stick and run from there. You will see the following screen displayed:



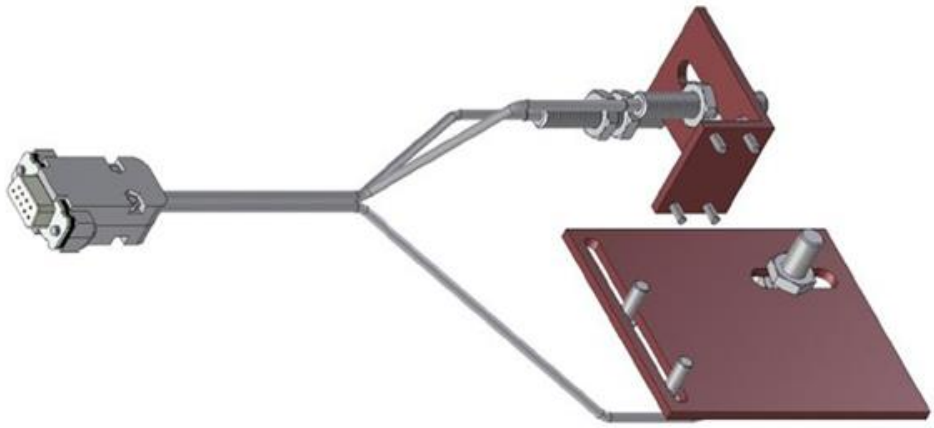
6. Push the “Start” button. Files will be installed on the AUTO controller. When complete the following screen will be displayed:



7. Push the “Finish” button. The update will complete. Turn off the AUTO controller and remove the USB memory stick. The update will be complete.

Appendix E – INPUT/OUTPUT Connector

The model 706202 Input Triggering Sensors provide convenient and easy adjustment and setting of proximity sensor input trigger position.



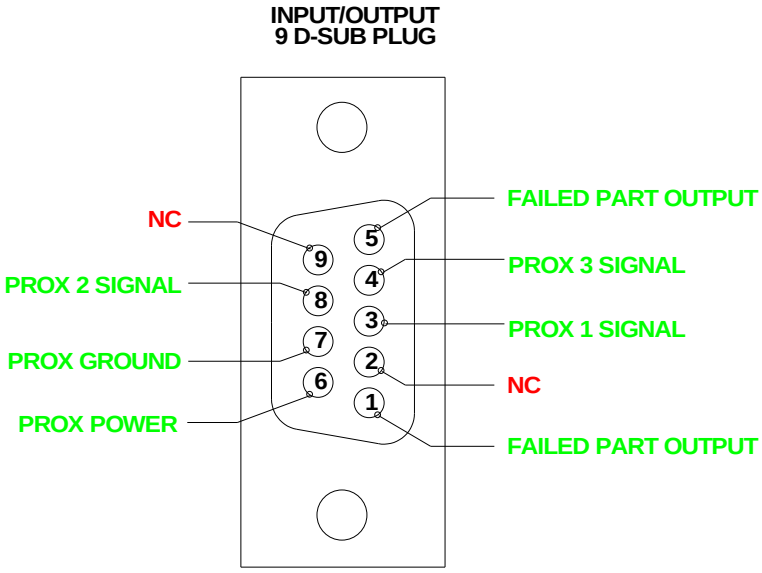
706202 Input Triggering Sensors

These are a convenient option used during “automatic operation”. Three proximity sensors with mounts are prewired for connection to the INPUT/OUTPUT connector. Proxy 1 is the start input and Proxy 2 is the stop input. Bare wires for failed part signal are also provided with the 706202.

INPUT/OUTPUT Port Pin Map

Input triggers should be wired to the "INPUT/OUTPUT" connector on the Electronic Interconnect Box as described in the image and chart below. Power for proximity sensor inputs and other powered devices can be obtained from Pin 6 of the DB9 connector.

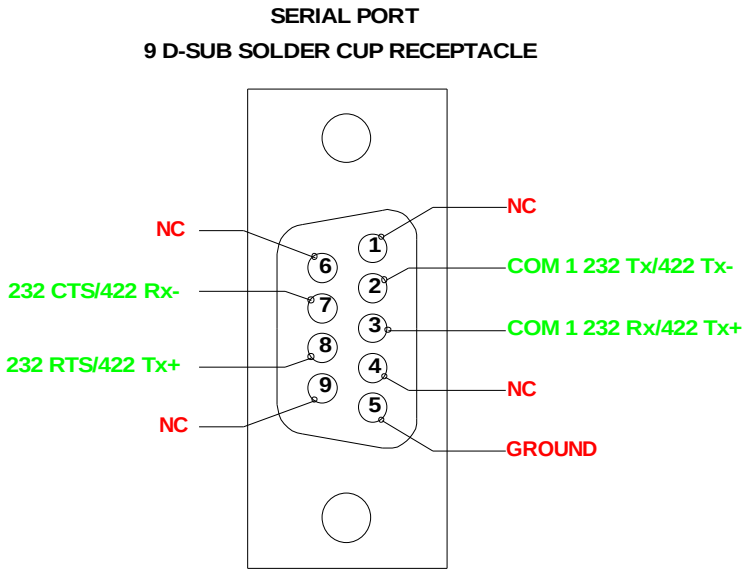
Note connections indicated in **GREEN** are required connections for external control. Connections indicated in **RED** are not to be used.



Pin	FUNCTION	USE
1	FAILED PART OUTPUT	OUT OF SPEC CLOSE CONTACT WITH PIN 5
2	NC	NOT FOR CUSTOMER USE
3	PROXY 1 TRIGGER SIGNAL	SIGNAL TO START A MEASUREMENT
4	PROXY 3 TRIGGER SIGNAL	NC
5	FAILED PART OUTPUT	OUT OF SPEC CLOSE CONTACT WITH PIN 1
6	PROXY POWER (15 VDC MAX)	USE FOR POWERED SENSORS
7	PROXY GROUND	USE FOR POWERED SENSORS
8	PROXY 2 TRIGGER SIGNAL	SIGNAL TO STOP A MEASUREMENT
9	**NC**	**NOT FOR CUSTOMER USE**

Appendix F – Ethernet and Com Port for Remote Monitor

The Ethernet and female DB9 connector may be used to access a com port or Ethernet port on a remote computer containing data capture software. Connections indicated in **RED** are not to be connected or used. The connections in **GREEN** can be wired to the remote computer.



Pin	FUNCTION	
1	NC	NOT FOR CUSTOMER USE
2	COM 1 RS232 TX/RS422 TX- EXTERNAL	REQUIRES NULL MODEM
3	COM 1 RS232 RX/RS422 TX+ EXTERNAL	REQUIRES NULL MODEM
4	NC	NOT FOR CUSTOMER USE
5	GROUND	NOT FOR CUSTOMER USE
6	NC	NOT FOR CUSTOMER USE
7	COM 1 RS232 CTS/RS422 RX- EXTERNAL	REQUIRES NULL MODEM
8	COM 1 RS232 RTS/RS422 TX+ EXTERNAL	REQUIRES NULL MODEM
9	**NC**	**NOT FOR CUSTOMER USE**

Appendix G – Lasercheck AUTO Data Receive Software

The Lasercheck AUTO Receive Software is a PC based program that provides data capture capability from a Lasercheck AUTO Control. Communication can be setup over either Ethernet TCP/IP or over RS232 or RS422 serial. Ethernet setup can be made manually or automatically, as DHCP assignment is supported. If assigned manually, the Lasercheck Control must be assigned Ethernet settings (IP address and Subnet Mask) that are compatible with the receiving "host" computer.

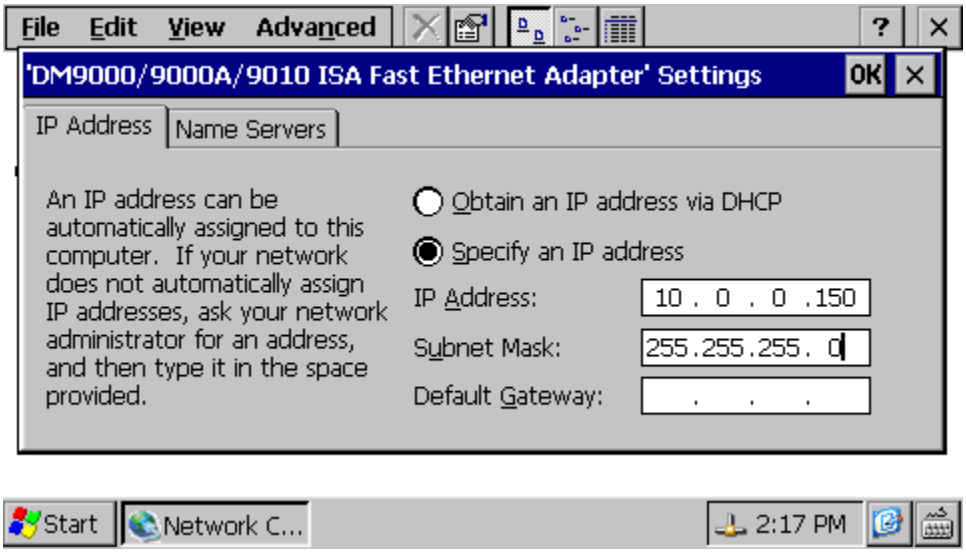
IP settings for Lasercheck AUTO Control

Note: For setup you can insert a USB mouse and USB keyboard into the 2 USB ports on the back of the Lasercheck Control to make setup easier, or you will have to use a stylus to access the Control's touch screen soft keyboard.

To view IP settings, power on the Lasercheck Control and exit the Lasercheck program to access the Windows CE desktop. Select Start/Settings/Network and Dial-Up Connections. Double click the DM9CE1 icon and in the dialog box select the "IP Address" tab.

Click on Specify and IP Address. The factory defaults for the Lasercheck Control are:

IP address: 10.0.0.150, subnet mask: 255.255.255.0

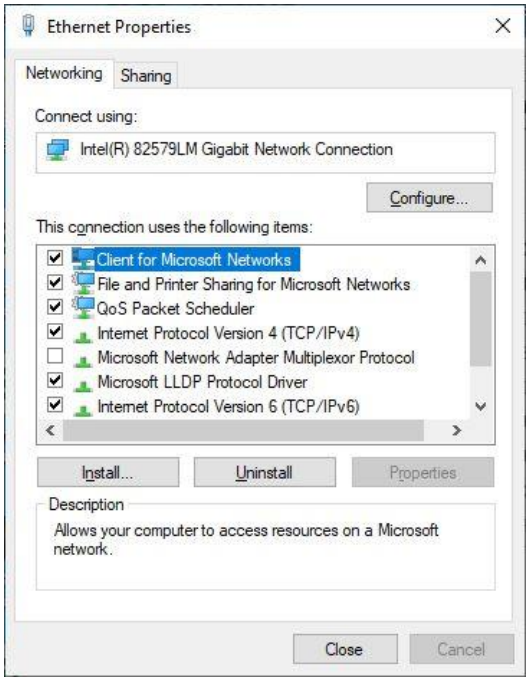


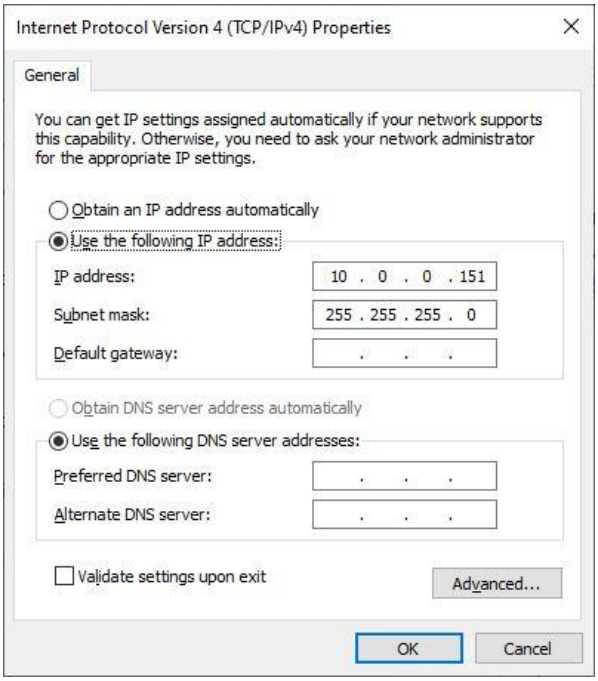
IP Settings for Host Computer.

To view or change IP settings for your computer's Ethernet adapter in Windows, select "Network Connections" in your computer control panel. Under Network Connections, right click on the active "Local Area Connection" and select **Properties** or double click the active "Local Area Connection" and click the **Properties** button on the Status screen. On the "Local Area Connection Properties" screen, highlight the "Internet Protocol (TCP/IP) option and click **Properties** button.

In your Local Area adapter Internet Protocol (TCP/IP) Properties box on your host PC, choose "Use the following IP address". You should assign a value from 10.0.0.1 to 10.0.0.254. Do not duplicate the address of the Lasercheck AUTO Control.

Subnet mask should be set to match the Lasercheck AUTO Control (default IP address: 10.0.0.150, default subnet mask 255.255.255.0).

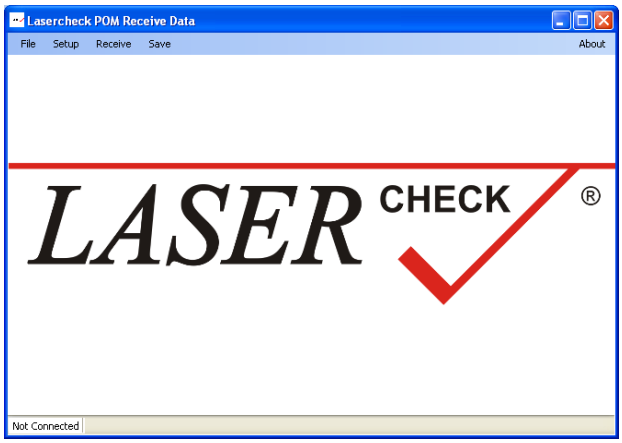




Software Install and Configuration

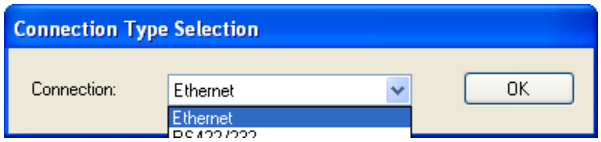
Install the program by running the provided file LasercheckAUTOSetup.msi on the host computer.

Start the Receive Software from the desktop icon or Start menu. You will see the following startup screen on the Receive software on your host computer. Note the “Not Connected” status indicator at the bottom of the screen indicating the software is not yet connected to the Lasercheck Control.



Setup New Connection

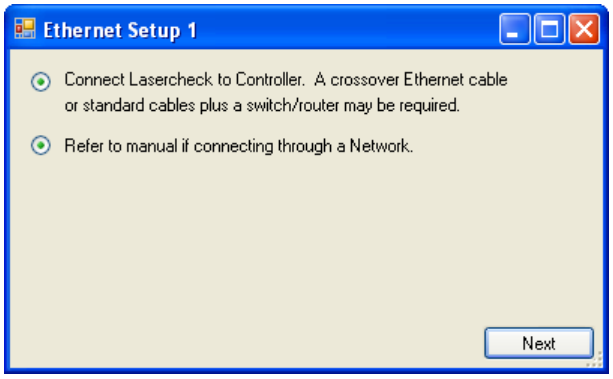
When Setup/New Connection is selected, either Ethernet or RS422/232 options are available.



Ethernet Connection

When “Ethernet” is selected, the following series of setup screens will be presented.

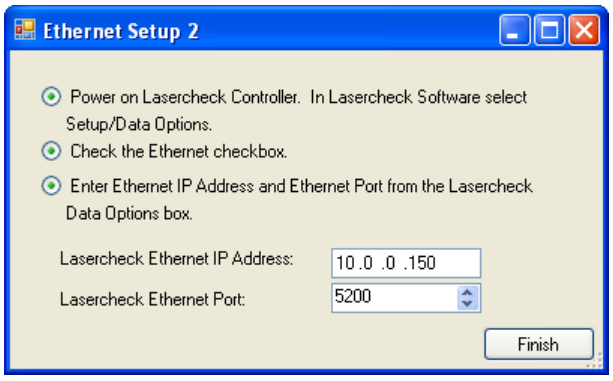
Ethernet Setup 1



This box prompts to connect the host computer and Lasercheck AUTO Control using either a crossover Ethernet cable or standard Ethernet cables with a router or switch in-between the devices to accomplish the communication crossover. A standard Ethernet cable will also work directly on most modern computers which are equipped an auto-sensing network interface card (NIC).

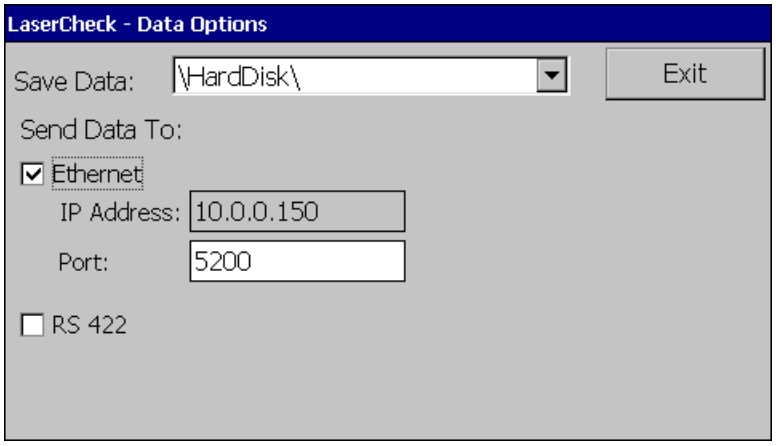
Select Next to proceed to the next dialog box:

Ethernet Setup 2



This box prompts to power on the Lasercheck AUTO Controller. It will automatically execute the Lasercheck Software. When the Lasercheck AUTO software is executed, select the “Setup” button than the “Data Options” button. The following screen will be presented in the Lasercheck AUTO display:

Lasercheck AUTO Data Options Ethernet



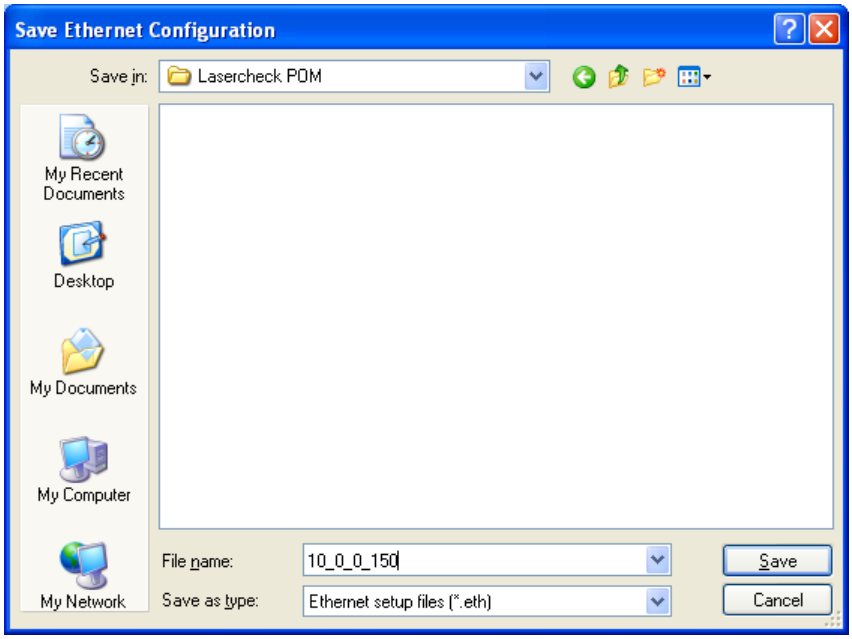
Check the Ethernet Box. You will see the local IP address for the Lasercheck AUTO controller displayed as well as a Listening Port. That port should be defaulted to 5200.

Enter the AUTO Controller IP address into the “Lasercheck Ethernet IP Address” field of the AUTO Receive Software Ethernet Setup 2 box. Set the Listening Port to match the AUTO Controller at 5200.

Exit the AUTO Controller Data Options Box then exit to the main startup screen. Click Finish to complete Ethernet Setup.

Save Ethernet Configuration

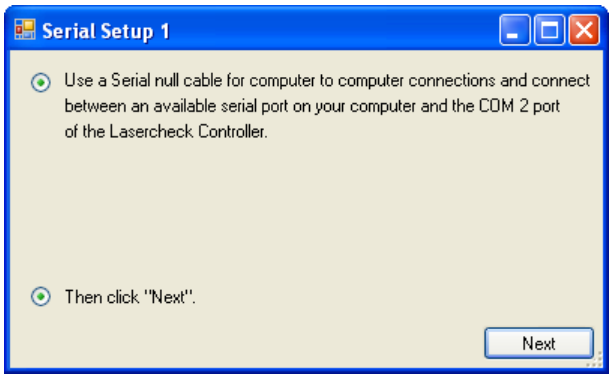
A save as dialog box will appear allowing you to save this Ethernet setting file. The file extension will be *.eth.



RS422/232 Connection

When “RS422/232” is selected, the following series of setup screens will be presented.

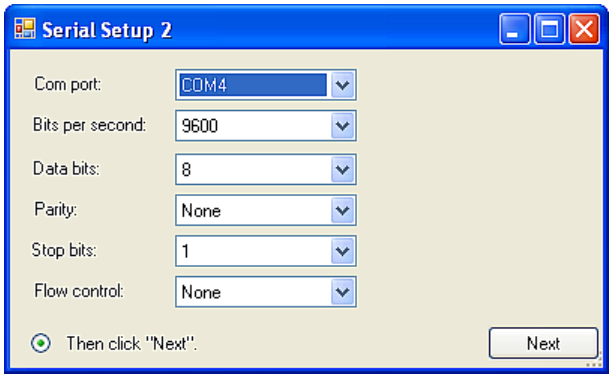
Serial Setup 1



This box prompts to connect the host computer and Lasercheck AUTO Control using a serial null modem cable for 2 way communication.

Select Next to proceed to the next dialog box:

Serial Setup 2

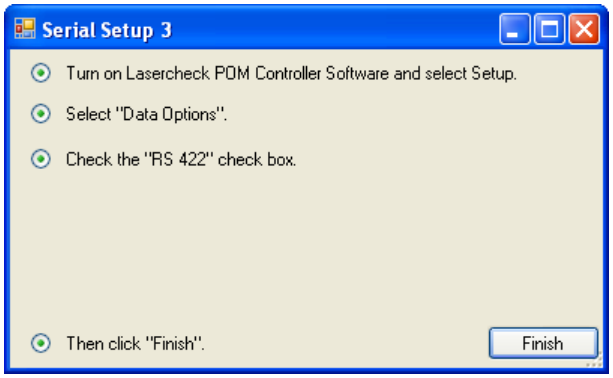


This box prompts to select the appropriate Com port the serial null modem cable is attached on the host computer. Remaining selections should be left at default:

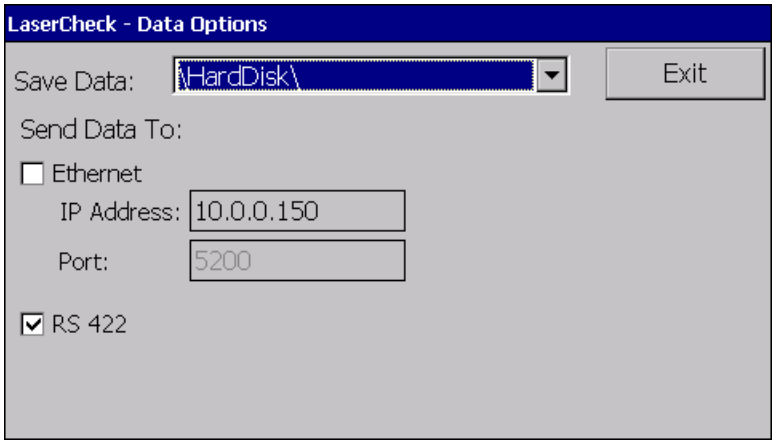
Bits per second:	9600
Data bits:	8
Parity:	None
Stop bits:	1
Flow Control:	None

Select Next to proceed to the next dialog box:

Serial Setup 3



This box prompts to power on the Lasercheck AUTO Controller. It will automatically execute the Lasercheck Software. When the Lasercheck AUTO software is executed, select the “Setup” button than the “Data Options” button. The following screen will be presented in the Lasercheck AUTO display:

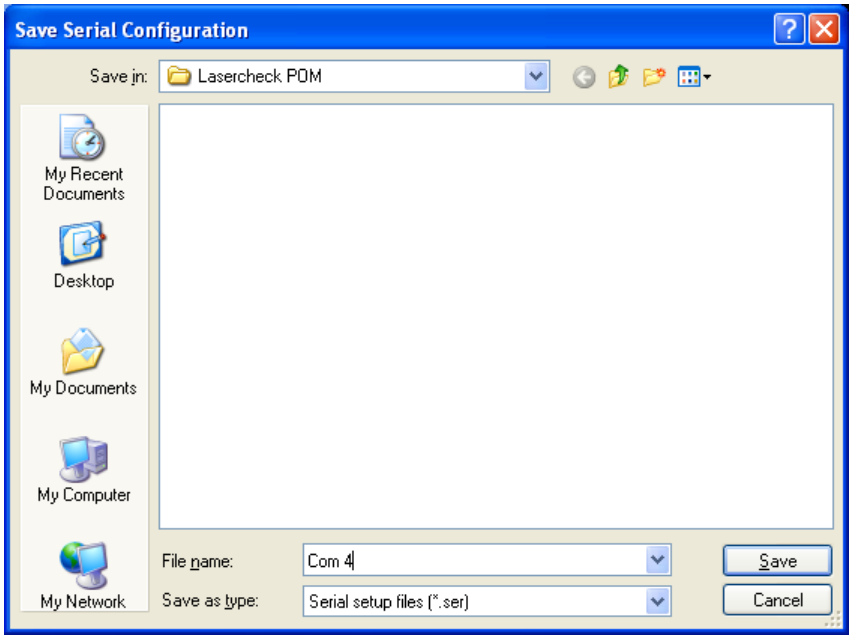


Exit the AUTO Controller Data Options Box then exit to the main startup screen.

Click Finish in the Receive Software Serial Setup 3 to complete RS422 Setup.

Save RS422/232 Configuration

A save as dialog box will appear allowing you to save this RS422/232 setting file. The file extension will be *.ser.



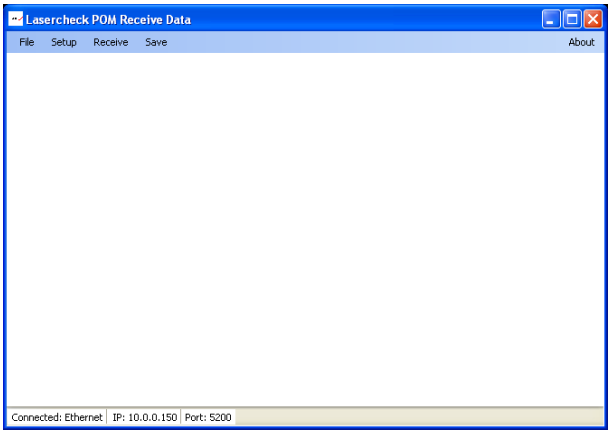
Receiving Data

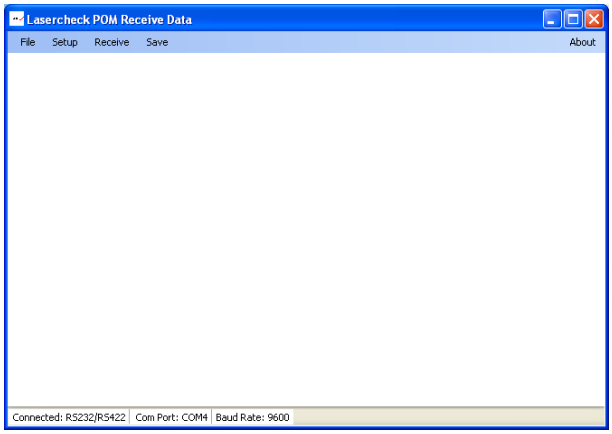
Lasercheck Screen Ready to Receive

After configuring either an Ethernet or RS422/232 connection, the software is able to receive measurements from the Lasercheck system. Note at the bottom of the screen the indicator status is “Connected” and it provides details on your active connection.

Receiving Measurements once Configuration Files have been created

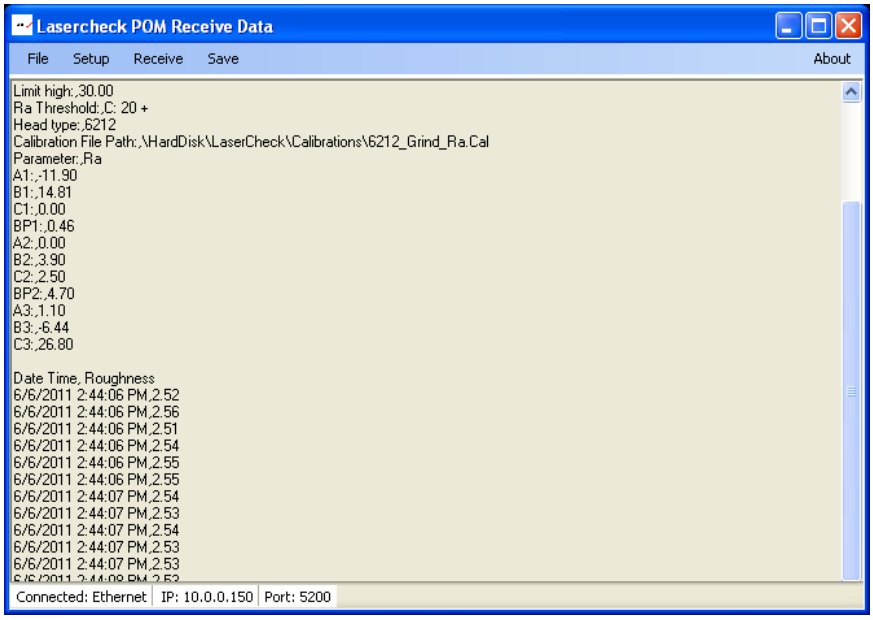
Once Ethernet or serial configuration files have been created, Setup/Open option can be used to select the configuration file anytime the software is turned on.



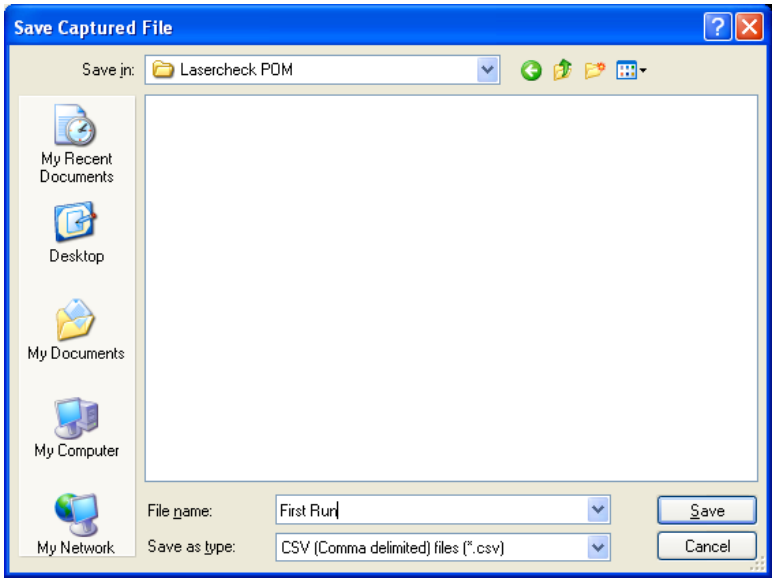


Lasercheck Control Receiving Data

In the Lasercheck controller, select a measurement file and start measurements. Values will begin porting into the Lasercheck Receive Data window.



When Save is selected or you attempt to exit the program a save as dialog box will be presented:



Save Captured Data to CSV File

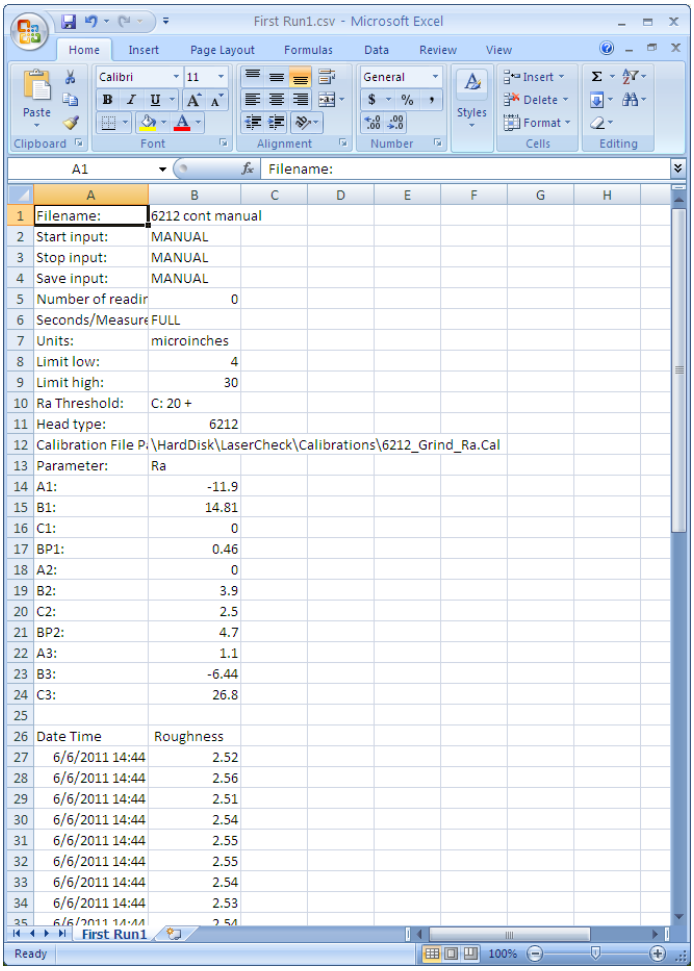
Create a *.csv file name and select Save. This data format is easily imported into numerous programs. Once a file name is selected, the save button can be pushed at any time and the Receive Software will automatically assign a number incremented file name (name, name2, name3, etc.) so long as the Lasercheck measurements continue.

File size is limited to 1048575 lines. If this is exceeded, a new file is started after the filename extension is automatically incremented.

Any time you stop measurement on the Lasercheck Control and initiate a new measurement set, a data file will automatically be saved by the Receive Software before it begins receiving the new measurement set data.

Whenever you exit the Receive Software a data file will be automatically saved. If you have not yet assigned a file name to the series, the program will prompt you for a file name.

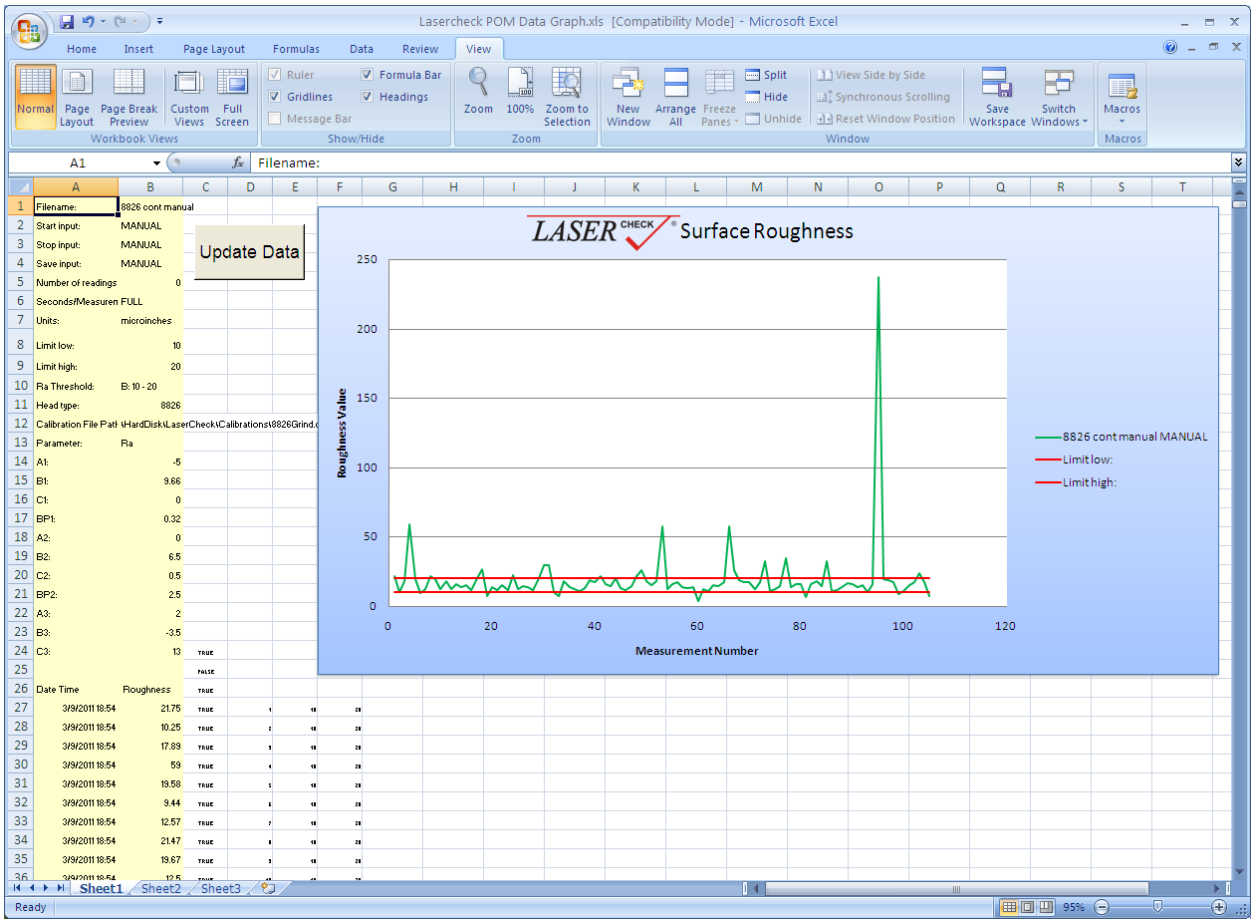
Below is a format of a typical saved file as it appears in Microsoft Excel with header information followed by data (time/date stamp, and roughness values).



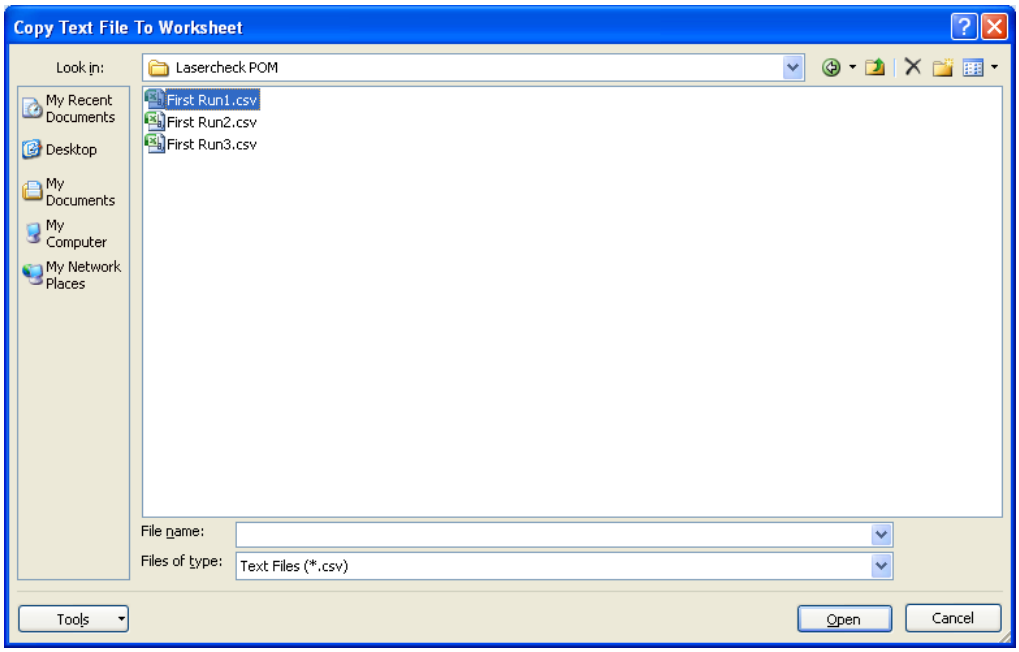
	A	B
1	Filename:	6212 cont manual
2	Start input:	MANUAL
3	Stop input:	MANUAL
4	Save input:	MANUAL
5	Number of readir	0
6	Seconds/Measure	FULL
7	Units:	microinches
8	Limit low:	4
9	Limit high:	30
10	Ra Threshold:	C: 20 +
11	Head type:	6212
12	Calibration File P	\HardDisk\LaserCheck\Calibrations\6212_Grind_Ra.Cal
13	Parameter:	Ra
14	A1:	-11.9
15	B1:	14.81
16	C1:	0
17	BP1:	0.46
18	A2:	0
19	B2:	3.9
20	C2:	2.5
21	BP2:	4.7
22	A3:	1.1
23	B3:	-6.44
24	C3:	26.8
25		
26	Date Time	Roughness
27	6/6/2011 14:44	2.52
28	6/6/2011 14:44	2.56
29	6/6/2011 14:44	2.51
30	6/6/2011 14:44	2.54
31	6/6/2011 14:44	2.55
32	6/6/2011 14:44	2.55
33	6/6/2011 14:44	2.54
34	6/6/2011 14:44	2.53
35	6/6/2011 14:44	2.54

Display Captured Data using Lasercheck AUTO Data Graph.xls

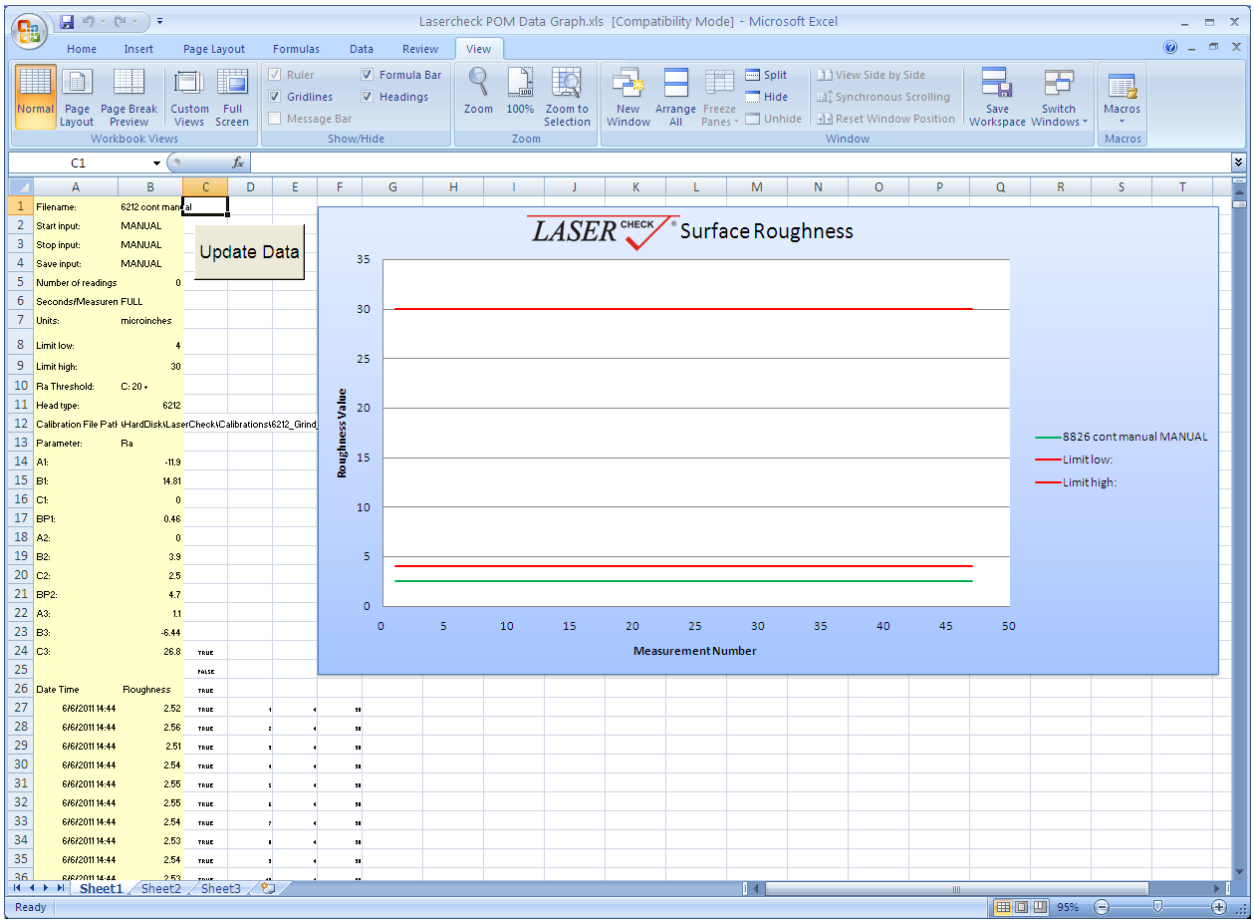
Open the Lasercheck AUTO Data Graph.xls. Enable macros if prompted. A screen similar to the following excel screen will be displayed:



To insert one of your saved csv files, push the “Update Data” button. A dialog box will be presented where you can select the csv file you wish to display. Select the file and push “open”.



Your csv file will be inserted in the excel spreadsheet and data will be displayed in a graph format:



The red bars in the graph specify the control limits (low and high roughness value) in the measurement setup file used to collect the data.

The green graph bar will represent your actual values.

The vertical axis of the graph is roughness value.

The horizontal axis of the graph is measurement number in your saved csv data file.