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

6212A Manual Version 14.53

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

Operations and Specification Manual for the

Lasercheck 6212A System

Manual Revision 14.53

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

Limited Use License Agreement

CAREFULLY READ THE FOLLOWING TERMS AND CONDITIONS BEFORE OPENING THE PACKAGE CONTAINING THE PRODUCT AND THE COMPUTER SOFTWARE LICENSED HEREUNDER. CONNECTING POWER TO THE MICROPROCESSOR CONTROL UNIT INDICATES YOUR ACCEPTANCE OF THESE TERMS AND CONDITIONS. IF YOU DO NOT AGREE WITH THE TERMS AND CONDITIONS, PROMPTLY RETURN THE UNIT TO THE DEALER FROM WHOM YOU PURCHASED THE PRODUCT WITHIN FIFTEEN DAYS FROM DATE OF PURCHASE AND YOUR PURCHASE PRICE WILL BE REFUNDED BY THE DEALER. IF THE DEALER FAILS TO REFUND YOUR PURCHASE PRICE, CONTACT OPTICAL DIMENSIONS IMMEDIATELY AT THE ADDRESS FOLLOWING CONCERNING RETURN ARRANGEMENTS.

Optical Dimensions provides the hardware and computer software program contained in the microprocessor control unit. Optical Dimensions has a valuable proprietary interest in such software and related documentation ("Software"), and licenses the use of the Software to you pursuant to the following terms and conditions. You assume responsibility for the selection of the product suited to achieve your intended results, and for the installation, use and results obtained.

License Terms And Conditions

a. You are granted a non-exclusive, perpetual license to use the Software solely on and in conjunction with the product. You agree that the Software title remains with Optical Dimensions at all times.

b. You and your employees and agents agree to protect the confidentiality of the Software. You may not distribute, disclose, or otherwise make the Software available to any third party, except for a transferee who agrees to be bound by these license terms and conditions. In the event of termination or expiration of this license for any reason whatsoever, the obligation of confidentiality shall survive.

c. You may not disassemble, decode, translate, copy, reproduce, or modify the Software, except only that a copy may be made for archival or back-up purposes as necessary for use with the product.

d. You agree to maintain all proprietary notices and marks on the Software.

e. You may transfer this license if also transferring the product, provided the transferee agrees to comply with all terms and conditions of this license. Upon such transfer, your license will terminate and you agree to destroy all copies of the Software in your possession.

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

Contents

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

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

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

PERFORMANCE SPECIFICATIONS

Measurement / Detection Method	Angle resolved laser scattering
Measurement speed	Single measurement in < 0.5 seconds
Measurement range	0.5 µinch to 40 µinch / 0.0125 µm to 1.0 µm
Repeatability	± 3.0% of measured value
Spot size (area-measured)	5 mm X 1 mm
Environmental considerations (temperature / humidity):	
Operating	-10º C to +55º C / 10% to 90% RH
Storage	-40º C to +80º C / 1% to 99% RH
Power requirements	110 / 220 VAC, 50 / 60 Hz

Other Features

Factory Calibrated to Ra Ground Surface Standards
Works on any material/color (rubber, glass, steel, etc.)
RS232 Interface Option
Stored items:
All Roughness Values
Date and Time
Average Ra Roughness and Standard Deviation
Minimum / Maximum Ra Roughness
CSV text Formatted File

SAFETY

Electrical

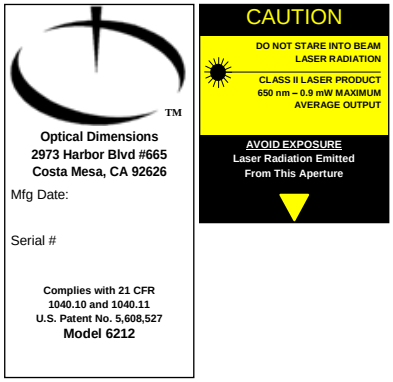
Lasercheck has been designed as a sealed and enclosed system. Voltages to operate the measurement sensor are low (0 to +5 Volts) to minimize shock hazard.

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:

OPTICAL DIMENSIONS
2973 Harbor Blvd, #665
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 diode emits a laser beam from the bottom of the gage illuminating the surface beneath it. After striking the surface, the laser light is reflected and scattered back into the Lasercheck detection system. The overall intensity and distribution of the reflected and scattered light is measured, digitized by Lasercheck electronics, and then Ra roughness is calculated for the illuminated area. This Ra value is then displayed on the LCD screen of the Lasercheck control unit. The Lasercheck Windows display and control software can be used to display the real time Ra values in graphical and numeric format along with statistical parameters.

Lasercheck has been designed for a nominal height standoff of 1.055 inch $\pm$ 0.01 inches from the measurement surface. Motions and vibrations within that tolerance range are monitored continuously and reflectance and scatter distribution are normalized and corrected during every measurement cycle to ensure accurate results. Surfaces are positioned 1.055 inches below the gage allowing non-contact measurements of the surface to be made.

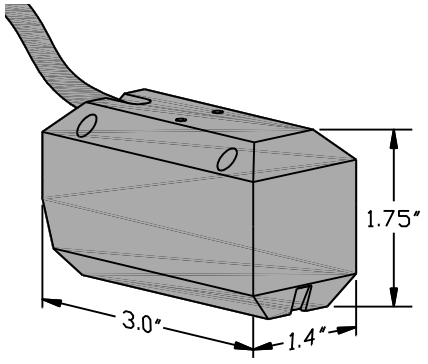
Measurements can be performed by manual pushbutton operation, or continuous high-speed measurements controlled by Windows software, or fully automated high speed on-line measurements triggered by external signals and the Windows software. At the end of a measurement sequence, the user is provided options for performing additional measurements, saving the current measurements or exiting the measurement sequence. When measurements are saved an ASCII file format can be created for reading into a variety of spreadsheet and analysis software packages.

Setting up the Instrument

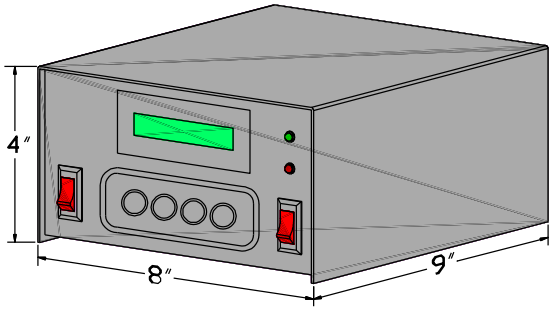
Unpacking Lasercheck

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:

1) Lasercheck measurement head.
2) Standoff (0.100”) plate (typically attached to measurement head)
3) Lasercheck control unit
4) 110 Volt Power Device Cable
5) RS232 serial null modem computer cable.
6) CD or 3.5 inch floppy disk with Lasercheck Calibration & Setup Files, Plus Manual
7) Alignment feet for cylindrical surface measurement (optional).

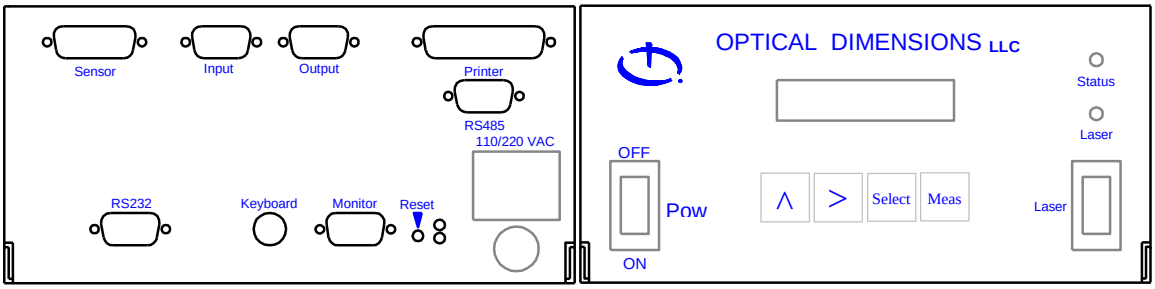


Measurement Head



Control Unit

Basic Connections Control Box



Rear Panel of Box *Front Panel of Box*

Attach the power cable to the "110/220VAC" plug and then connect to ***110/220 Volt Power Source***.

The control unit has a DB15 connector labeled "Sensor" which mates to the connector end of the measurement head cable. The cable should be secured with the thumbscrews on the cable.

The computer cable provided is a serial *null modem* variety. Standard serial connector adapters (25 to 9 pins, male to female etc.) can be used with these cables as necessary without affecting the null modem capability. The Lasercheck control unit has a 9-pin serial connector port for attaching one end of the cable (labeled RS232.) The connector should be screwed on to ensure strength and integrity during operation. The other end should be attached to an available serial port on your host computer. Be sure that port has been set up as COM1 to COM4 in your computer.

Note: During manual pushbutton measurement operation this computer connection is not required or used. This connection is used for transferring saved measurement files to a host computer for storage or input into SPC, spreadsheet, or other data analysis software or for automated measurements taken with Optical Dimensions Windows software.

The start and stop inputs must have a female DB9 connector. They should be connected to the connector on the control box labeled "Input". These would only be used during "automatic operation".

Analog (0-10 Volt or 4-20 mA Current Loop) or indicators for "out of spec" surfaces must have a DB9 connector. They should be connected to the connector on the control box labeled "Output". These would typically be used during "automatic operation".

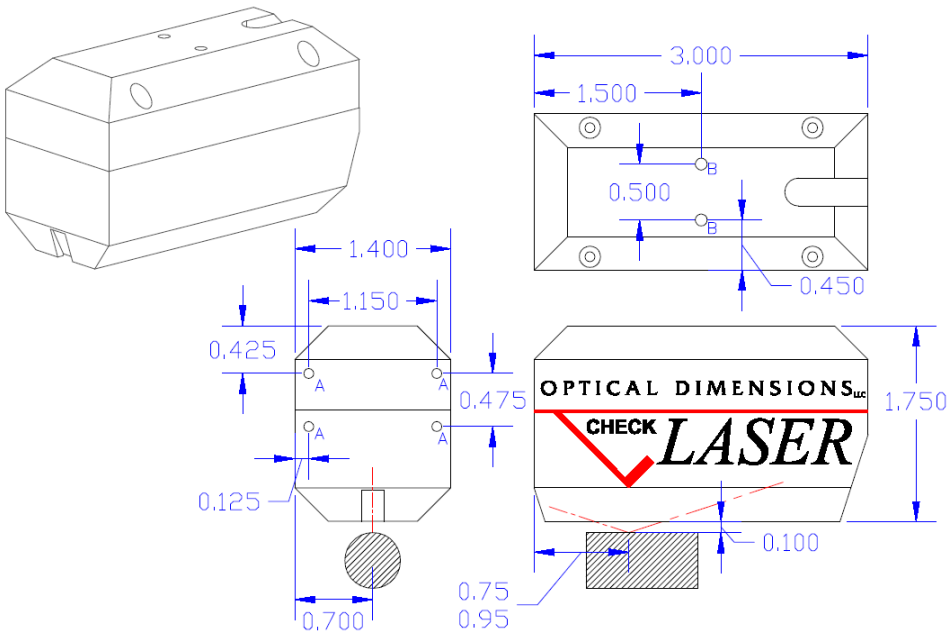
Physical Mounting

The hand held version of the Lasercheck head is supplied with a 1/10-inch thick footplate on the bottom. This will align the head within specification on flat surfaces. If surfaces are cylindrical, then optional alignment feet should be used. For surfaces with different geometry, alignment fixturing should be used. An understanding of alignment principals of Lasercheck is required for development of fixturing. Please read the section "LASERCHECK ALIGNMENT PRINCIPALS AND PRECEDURES" later in this manual to understand principals of alignment.

When performing measurements, set the rotational orientation so that the long axis of the head is perpendicular to the dominant "lay" of the surface that you wish to measure. The long axis of the head determines the direction of measurement in the same way that the direction of motion of a stylus on a stylus gage determines the direction of measurement.

Mounting/Fixturing Lasercheck

There are ten drilled and tapped holes on the Lasercheck sensor head that can be used for mounting and installing the Lasercheck in an automated inspection application. The head should be positioned at a location where surface will be at the correct vertical and horizontal position relative to the gage head (see appendix section on Lasercheck Alignment Principles and Procedures). Either the surface will move under the gage or the gage will be moved over the surface. In either case, alignment must be maintained during relative motion. An air knife can be used prior to the gage to clean coolant etc. from surfaces to be inspected if necessary. A "Start" sensor or input should be positioned to be activated when the gage or surface is positioned to measure at the beginning of the surface or process. A "Stop" sensor or input should be positioned to be activated when the gage or surface is positioned to measure at the end of the surface or process. Both of these sensors should be wired to the "Input" connector on the back of the control box as described in the Appendix – Input and Output Pinouts section.


3.000
1.500
B
0.500
B
0.450
1.400
1.150
0.425
A
A
0.475
A
A
OPTICAL DIMENSIONS LLC
CHECK LASER
1.750
0.125
0.100
0.75
0.95
0.700

Software Setup

Lasercheck uses two different software packages. The control unit has software that initializes electronics, controls the LCD screen, monitors the laser, reads detector signals, and calculates the alignment and surface roughness. It also saves measurements in ASCII format files. This software comes *pre-installed* inside the control unit. It is designed to auto load and auto execute whenever the "on / off" switch is turned on.

A CD or floppy disk with calibration & setup files plus the manual is provided. This software is installed on a separate computer.

An optional Windows file transfer software program is provided on a separate CD. This software is installed on a separate computer and uses the optional 110V or 220V Adaptor & RJ12 / Serial Interface Connecting Cable to communicate with the control unit.

To Install Lasercheck Software

1) Insert Lasercheck CD or disk into the appropriate drive.
2) Click on the **Start** button. From the **Start** menu, choose **Run**.
3) Click on **Browse** button.
4) Select "a**ppropriate drive letter:**"
5) Double click on **Lasercheck Model 6212A setup.exe.**
6) Finally, click on **Finish** button.

Basic Operation Using Control Box Pushbuttons

Once the cables are attached and measurement head is mounted and aligned, you are ready to perform a measurement. Lasercheck is run from the control unit keypad and LCD screen or optionally the Windows software on the host computer. *Detailed* instructions on specific setups and operations can be found in the software users' manual. Following is an abbreviated description for setup and performance of a measurement sequence.

Turning the System On

The control unit has a main on/off power switch. The control box provides regulated DC power to the Lasercheck head. The control unit also powers the internal electronics, and automatically loads and executes software internal to the controller.

Main Screen

When the main power switch is turned to the "on" position the internal electronics will turn on and software will

```
Lasercheck
Please Wait
```

begin executing. During this startup period you will see will see the words displayed on the LCD screen:
Once the electronics and software are fully executed, you will see the LCD screen display:

```
Lasercheck
Version 14.52
```

Or the current version of the software will be displayed. After 2 seconds, the LCD screen display will change to the Main Screen:

```
SELECT:>GRIND_ST
^System:
```

The system is now ready to perform measurements. The control unit also has a second non-backlit on/off switch. This must be turned to the on position to provide power to the internal laser. A red LED above the switch is illuminated when the laser is operational.

Control Unit and Displays

LCD Screen

The Lasercheck Sensor Control Box has a 2 row, 16-column LCD screen. There are also 4 push button inputs to control measurements, data storage, and data transfer.

LCD Push Buttons

The four push buttons are labeled as following (in the following order left to right) and are for:

^ Switch highlight between options

> Scroll through options

Select Select highlighted option

Meas Take measurement at any time from main or measure windows

Highlighting

The "^", ">", and "Select" buttons on the front panel of the Lasercheck are used to highlight and select desired options. Pushing the "^" push button on the front panel switches which main menu is ACTIVE and highlighted in CAPITAL letters. Options in that highlighted menu can be scrolled through are with a ">" on the LCD screen. To choose an option, the "Select" button is pushed. The option that appears in to the right of the menu in CAPITAL letters on the LCD screen is then selected. For example the main screen looks like:

```
SELECT>GRIND_ST
^System:
```

Pushing the "^" button will highlight the System menu instead of the Select menu that is currently highlighted to change the screen to:

```
^Select
SYSTEM:   >files
```

Pressing the "Select" button will select the files option from the System menu.

```
Manage files:
FILES:  >Send
```

Changing options in the highlighted Files menu is done by pressing the ">" button. Pushing the ">" button once shows:

```
Manage files:
FILES:  >Receive
```

If Controller Does Not Respond to Pushbuttons

The automated Lasercheck controller is designed to work under external computer control or under control of the front panel pushbuttons. This is determined by configuration of an internal (user selectable) setup file inside the control box. When a setup file configured to respond to an external computer through the serial RS232 connector on the back of the control box is active, the system will not respond to the front panel pushbuttons.

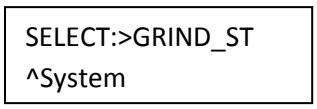
It takes about one second for the serial port to take control away from the pushbuttons when a “serial” based setup file is active. In fact, sometimes the controller may just come up with a “serial” based setup file displayed when you start the system making it difficult to ever get control of the pushbuttons. The solution is to fairly rapidly push either of the scroll (> or ^) pushbuttons as the “serial” based setup file appears. You can get the unit to briefly respond and scroll past a “serial” based setup file if you do it quickly and this will allow you control of the unit through the pushbuttons so that you can do routine measures, file maintenance, transfers and so on.

Performing Measurements

The following section covers the minimum basics required to perform measurements. Additional features built into the Lasercheck Windows software are discussed in detail further in the Lasercheck Windows software manual.

Choose a Setup File

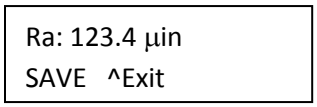
From the Main Screen use the “>” button to select the proper setup file. The controller is delivered with 4 factory provided setup files loaded – grind_st.set, uncal_r.set, uncal_s.set, and serial.set. For a detailed discussion of creation and installation of setup files please see the section labeled “SETUP FILES” and the “Appendix - Calibration Procedures” later in this manual.



This shows the GRIND_ST.SET file as the active setup file.

Measure Window with Results

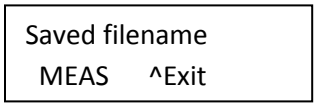
Pushing the Meas button will perform a measurement and the following screen is displayed:



The Ra roughness of the surface that the measurement head is placed on is displayed in microinches (µin) or microns (um) of roughness.

Saving a Measurement

Pushing the Select button saves last measurement in the control box. The following screen will be presented after the file is saved:



Pressing the Meas button without first pushing the Select button will perform another measurement without saving the last measurement in the control box.

File Management

File System Window

- From the Main Window, push the switch (^) push button to highlight the word SYSTEM.
- Scroll to the word “files” with the scroll (>) push button
- Push the Select push button. The following screen will be displayed:

Manage files: FILES: >Send

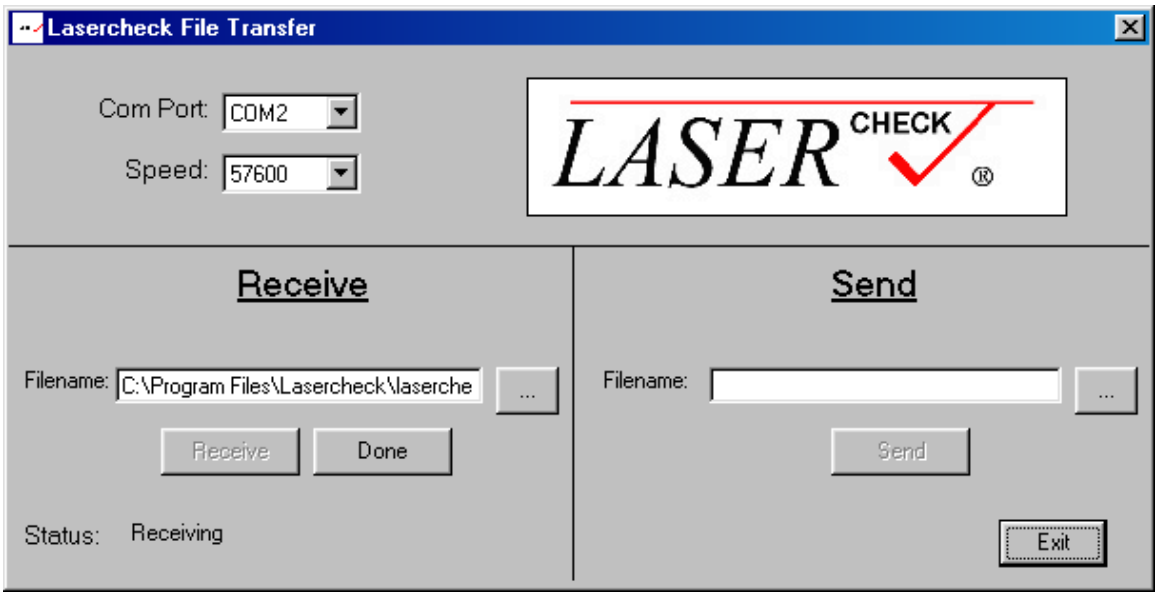
The file management options available by scrolling are:
Send, Receive, New Cal, Delete, Reset, Exit

Send Command

This selection transfers data files to a PC via the serial null modem cable. Before selecting this in the control box, you must first prepare the PC to receive the data.

Preparing Windows Software to receive files

- Start the Lasercheck 6212B Data Download Software by clicking on icon in the Start Menu under “Programs / Lasercheck / 6212B Data Download”.
- Select the following options if they are not already selected:
  - Com Port: Select the serial port the Lasercheck cable is attached to on your computer
  - Speed: 57600
  - Filename: C:\Program Files\Lasercheck\Lasercheck.txt
- Leave the filename as “Lasercheck.txt”.
- Click the “Receive” button. Click "OK" if prompted regarding overwriting the file. Follow the directions below for sending the data from the Lasercheck Controller.



Lasercheck File Transfer Software Configured to Receive Saved Measurements

Sending Measurement Data from the Lasercheck Controller

Scroll to “FILES: >Send” on the control box with the scroll (>) push button and push the Select push button. The LCD displays the following screen:

Sending all data files now.

All data files are being transferred to the computer while this is displayed.

The receive operation in the windows software should finish automatically when all of the data is received from the controller. The status message in the windows software will show this by displaying “Finished Receiving”. If it does not, click the “Done” button in the windows software to finish and close the data text file.

When all files have been transferred, the control box will return to the File System Window. The files received in the PC are by default in the C:\Program Files\Lasercheck directory created on your computer, and these data files end in “.txt”.

Receive Command

This selection transfers setup files from a PC via the serial null modem cable.

File Naming

The Lasercheck installation software creates a directory with factory setup and calibration files. The default directory location is C:\Program Files\Lasercheck\ Control Box\Setup Files.

Each setup file must include a line similar the following:

RECEIVE_NAME= filename.set

This line determines what the name of the file will be displayed on the controller LCD screen. Examples are in the C:\Program Files\Lasercheck\ Control Box\Setup Files directory. For a detailed discussion of creation of setup files please see the “Appendix - Calibration Procedures” later in this manual.

Preparing Control Box to receive files

Scroll to “FILES: >Receive” on the control box with the scroll (>) push button and push the Select push button. The LCD displays the following screen:

Receiving setup files now

The control box is waiting to receive data files being transferred from the computer while this is displayed.

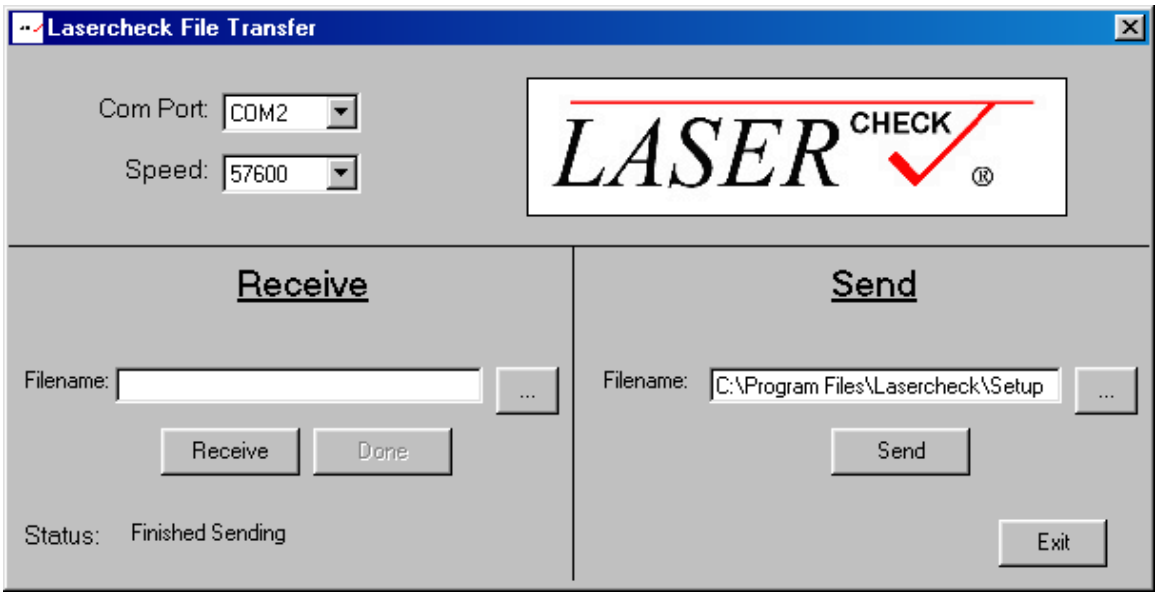
Sending Calibration / Setup Data with the Windows Software

- Start the Lasercheck Data Download Software by clicking on icon in the Start Menu under “Programs / Lasercheck / Data Download”.
- Select the following options if they are not already selected:

  Com Port: Select the serial port the Lasercheck cable is attached to on your computer

  Speed: 57600

  Filename:
- In the Send “Filename:” input box enter the filename of the calibration you want to download into the control box. The small button next to the input box can be used to browse for files on the computer. The file extension will be “.set”.
- Click the “Send” button. The “Status” indication in the windows software will indicate “Finished Sending”. The control box will display:



Lasercheck File Transfer Software Configured to Send Calibration / Setup File

When all files have been transferred, the control box will return to the File System Window.

New Cal Command

This selection is a step-by-step procedure to collect uncalibrated measurements on new surfaces for use in the calibration spreadsheet.

Smooth and Rough Surface Calibration

Lasercheck uses software calculations that are optimized for measurements on either “smooth” or “rough” surfaces. Smooth mode gives most accurate readings on surfaces approximately 10 microinches and smoother, and rough mode gives most accurate readings on surfaces 10 microinches and rougher.

Lasercheck calibration readings are automatically taken in the smooth mode (for surfaces smoother than approximately 10 microinches). If surfaces are too rough for the smooth mode, Lasercheck will sense this and

automatically revert to rough mode when taking calibration readings (for surfaces rougher than approximately 10 microinches).

Performing Calibration Measurements

Statistics and Accuracy

It is important to remember that more calibration surfaces and measurements provide better statistics and better calibration, especially if a wide range of roughness is used in the calibration.

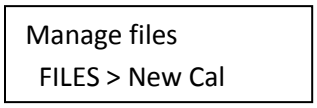
It is also important to remember that stylus gage measurements often lack repeatability. It is a good idea, therefore, to take a few stylus gage measurements for each sample and enter the average of those values into the spreadsheet. Stylus gage measurements can show significant variability depending on surface uniformity, the environment the measurement is taken in, condition of the instrument and condition of the actual stylus tip.

Actual Surface Values

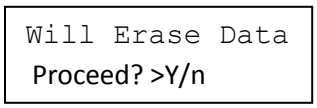
First, if the actual surface roughness of the set of test surfaces is not known, then measure with a calibrated stylus gage.

Perform Lasercheck New Calibration Data Measurements

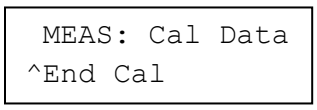
Scroll to the “New Cal” option in the files menu. The LCD will display the following window:



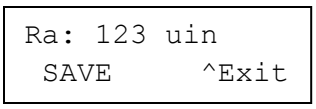
When the “Select” key is pushed, you will see the LCD screen display:



When the “Y” is selected, you will see the LCD screen display:

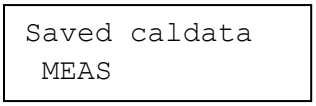


The system is now ready to begin providing raw roughness values on surfaces for creating a new calibration. Place test surfaces under the measurement head. Pushing the “MEAS” button will perform a measurement and you will see the LCD screen display:



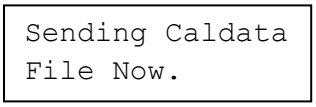
The raw roughness of the surface is displayed in relative roughness units. Pressing the “MEAS” button will perform another measurement without saving this value.

Pushing the “Select” button saves the value and you will see the LCD screen display:

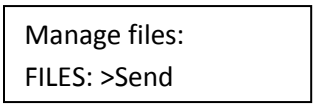


Continue measurements on calibration surfaces repeating measurements and saving as described above. When surfaces have all been tested, scroll to highlight “EXIT”. Push the “Select” button. The following screen will be displayed:

The procedure for sending data is discussed earlier in the manual in the section titled “Transferring Saved Measurements from the Lasercheck”. When “Receive” is selected in the Lasercheck Data Download File Transfer software and then the “Select” button is pushed on the controller (note: this must be done in this specified order) you will see the LCD screen display:



When all of the calibration measurement data has been sent, you will see the LCD screen return to the main File System Window and display:



The calibration measurement data will be available on the host computer for input to the Lasercheck “Setup File and Calibration Template.xls” calibration spreadsheet. See the section “Appendix - Calibration Procedures” for directions on using this spreadsheet.

Delete Command

This selection will delete all data measurement files from the control box. This would typically be done after the "Send Data Files" has been executed. Scroll to FILES: >Delete on the control box with the scroll (>) push button and push the Select push button. The LCD displays the following screen:

Delete all data files? >n/Y

Scrolling to highlight "Y" and pushing the Select push button, will delete all data files, then the system will return to the File System Window. Scrolling to highlight "N" and pushing the Select push button will return to the File System Window without deleting files.

Reset Command

This selection should only be used if the user experiences difficulties with files and software in the controller. Scroll to FILES: >Delete on the control box with the scroll (>) push button and push the Select push button. The LCD displays the following screen.

Reset to factory files? >y/N

Scrolling to highlight "Y" and pushing the Select push button will present the following display:

ALL data will be deleted! >y/N

Scrolling to highlight "Y" and pushing the Select push button will delete data, configuration, and setup files that have been added to the control box and return it to factory setups and configurations.

Exit Command

This selection exits the file management section of the system and returns to the Main Screen.

Setup Files

Every Lasercheck comes with setup files, GRIND_ST.SET, UNCAL_R.SET, UNCAL_S.SET, and SERIAL.SET. GRIND_ST is used to measure surfaces that have been ground. UNCAL_R and UNCAL_S are setup files that are used to collect data from rough and smooth surfaces when creating a new setup file. SERIAL.SET is used with Lasercheck Windows software control and disables the front panel pushbuttons.

Creating Setup Files

Included with the software is an Excel spreadsheet program titled "Setup File and Calibration Template.xls". This program is found in the C:\Program Files\Lasercheck\Calibration directory created by the installation program. It

is designed to calibrate the Lasercheck for specific processes. The spreadsheet program also integrates the calibration in Lasercheck setup files.

Detailed instructions on how to perform calibrations and use this Excel program are in the appendix of this manual under the section titled “Appendix - Calibration Procedures”. The three setup files that the spreadsheet creates can be renamed as long as the name is not longer than eight characters and its three-character extension, “.SET”, remains. These setup files need to be transferred to the control box; see the Receive Command in the section on File Management.

Data Files:

The data files stored in the control box have up to 8 letter file names as prescribed in the setup file. The filename extension is “TXT”. The data files contain measurements and headers. The data fields are separated from the header fields by tab characters so that SPC programs and spreadsheet programs like Excel can read the text files easily.

Sample Data File

Filename	grind001.txt
Date	02/15/2005
Time	22:45:12
Setupfile	GRIND_ST.SET
Average	16.131527
Standard Dev.	17.050699
Maximum	49.570293
Minimum	2.193076
# Measurements	5

1	7.252161
2	9.095555
3	2.193076
4	49.570293
5	12.546545

EOF

Advanced Operations

Operation Using Windows Software

The Lasercheck can also be used and controlled through the Lasercheck windows software. For a detailed explanation of using the Lasercheck windows software see the included software manual. A PDF version of the software manual can be found under the C:\Program Files\Lasercheck directory created by the installation program. The following is just a simple example of using the basic features of the windows software.

Control Box Setup

Make sure the Lasercheck control box is connected to the computer with the serial null modem cable. For more detail on doing this refer to the "Setting Up the Instrument" section in the beginning of the manual.

The Control Box must be loaded with a proper setup file so that it is ready to communicate with the windows software. This setup file tells it to take all its commands from the windows software on the host computer through the serial port.

Use the Setup File and Calibration Template.xls to create a setup file with the line in the file:

"START_INPUT= SERIAL"

For instructions about how to create or edit a setup file see the section in this manual under "Appendix - Calibration Procedures". For instructions about how to load a setup file into the control box see the section in this manual under "File Management / Receive Command".

NOTE: When a serial file with this command line is in use by the control box, it will not respond to the front panel push buttons.

Starting Windows Software

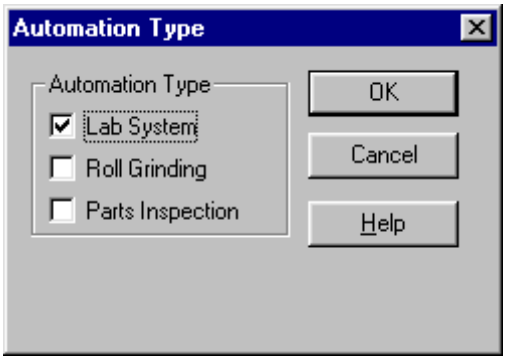
Next start the Lasercheck Windows Software Program. Click on the **Start** button, choose **Programs**, and then **Lasercheck**. Then choose **Lasercheck Windows Program**.

Entering the Setup Module

From the main window of the Lasercheck software select the "Setup" push-button. This invokes the "Password Entry" dialog box. Enter the password "4956", and click OK.

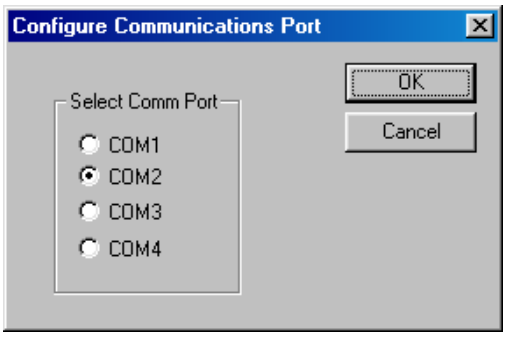
Setup for Lab System

Under the Setup menu, select "Setup" and "Automation Type". Select Lab System so that the software can be used to control the measurement process. Then select "OK"



Select the Communications Port

Under the Setup menu, select “Setup” and “COM Port”. Select the COM port that the RS232 null modem cable is connected to on your computer. Then select “OK”



Selecting “Main: from the top menu selection of the Setup Module will return you to Lasercheck software main menu.

Manual Operation

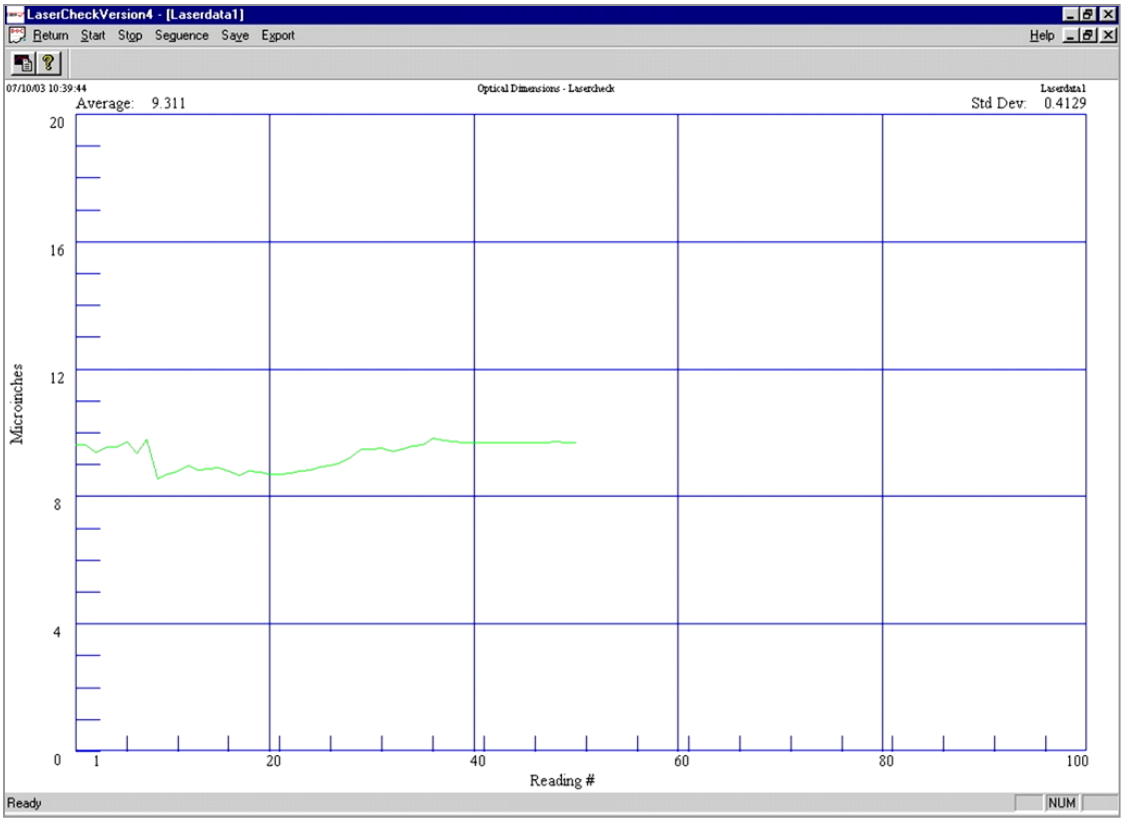
Perform Measurements Module

From the main window of the Lasercheck software select the “Perform Measurements” push-button. This invokes the “setup/open” dialog box.

When Lasercheck software is first installed on your computer, sample setup files (*.STP) are loaded on your computer in the C:\Program Files\Lasercheck directory. Select the “manual.stp” setup file.

Measure Menu

Under the menu item “Measure”, select the option “Measure”. This creates an empty graph screen with a run menu.



Start

Selecting “Start” from the Run Menu starts the Lasercheck and the graph begins displaying roughness information. A graph of roughness vs. reading number will begin appearing in real time on the screen. In addition, statistics of all measurements will be displayed digitally in real time at the top left and right corners of the graph, and the current measurement in the top center of the graph.

Stop

While the roughness display is running, the Stop menu selection can be used to stop the data acquisition. Selecting Start will restart the display. The “Stop / Start” cycle can be repeated as many times as is necessary for the measurement set.

Sequence

While the roughness display is running, the Sequence menu selection can be used to restart the data acquisition. All previous values on the screen will be discarded and an empty graph will be presented as the measurements resume.

Save

The Save menu selection will provide a Windows “Save As” dialog box prompting the user to enter a filename to save the data. Lasercheck software automatically attaches a Lasercheck “.LSC” data file extension to the file name that is typed in. This data file can be opened for review in the Review Data module from the main screen of the software.

Export

The Export menu selection will save an ASCII text file of all measurements in the current measurement cycle. This text file will be automatically named “Lasrdata.txt” and it will be saved in the “C:\Program Files\Lasercheck” directory on your computer. The file will contain all saved values, statistics on the values, filename, date, time, and information on the specific windows software setup file.

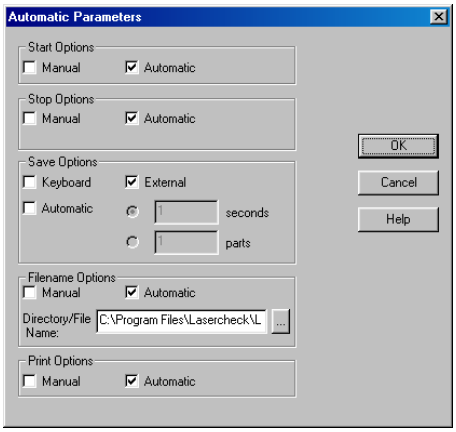
Return

The Return menu selection will return you to an empty Measure Menu window.

Automated Operation

The Lasercheck can be used with external inputs to start and stop the measurements in an automated installation. The inputs on the back of the Lasercheck control box are read by the Lasercheck Windows software, so the Lasercheck must be connected to a host computer for this option to work.

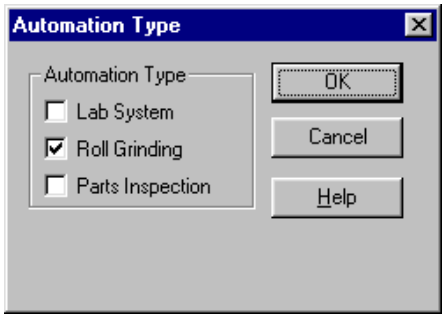
The windows software is designed to work with external inputs in two modes for automated applications. One is for continuous surface applications in which numerous measurements are taken between one start input and one stop input. This mode of operation is typically used to rapidly provide numerous roughness measurements on large surfaces such as mill rolls or sheet surfaces. All data points are displayed on the graph as they are being taken at a rate of approximately 10 readings per second. The second mode of operation is for measuring individual parts being presented to the gage, such as parts on a conveyor. In this mode the few measurements made between a start input and a stop are averaged and only the single average of that part is plotted on the graph; one average point for each start and stop input received.



Numerous Continuous Measurements / Roll Grinding

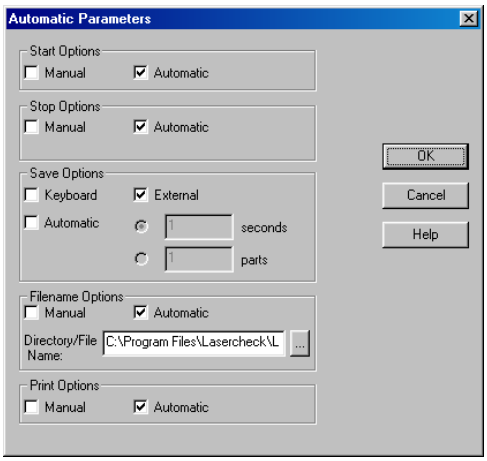
Setting up Windows Software for External Inputs

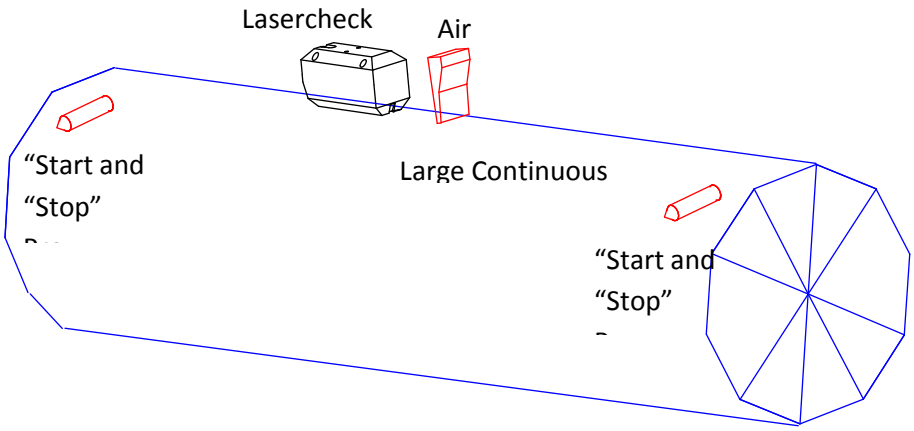
Under the Setup menu, select “Setup” and “Automation Type”. Select “Roll Grinding” so that the software can be used to perform automated measurements on large continuous surfaces.



Automatic Parameters for Automatic Start, Stop and Save Options

Under the Setup Module, select Open, and open the setup file named “automatic.stp” to modify and use. Next select the “Automatic” button and select “Automatic” for the Start and Stop options. Select “External” for Save Options. The name of the data file can also be generated and printed automatically or manually each time a new data file is saved. For details of doing this refer to the Lasercheck Windows Software Manual.





Lasercheck Head Mounted over Large Surface for Continuous Automated Inspection

There are ten drilled and tapped holes on the Lasercheck sensor head that can be used for mounting and installing the Lasercheck in a continuous automated inspection application. The head should be positioned at a location where surface will be at the correct vertical and horizontal position relative to the gage head (see appendix section on Lasercheck Alignment Principles and Procedures). Either the surface will move under the gage or the gage will be moved over the surface. In either case, alignment must be maintained during relative motion. An air knife can be used prior to the gage to clean coolant etc. from surfaces to be inspected if necessary. “Start” and “Stop” sensors or inputs should be positioned to be activated when the gage is positioned to measure at the start of the process and at the stop of the process. Both of these sensors should be wired to the “Input” connector on the back of the control box as described in the Appendix – Input and Output Pinouts section. Measurements will proceed at a rate of approximately 10 per second between the “Start” and “Stop” activation.

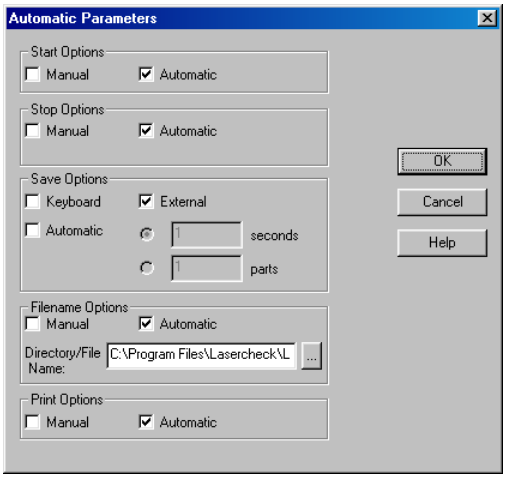
Individual Parts / Parts Inspection

Setting up Windows Software for External Inputs

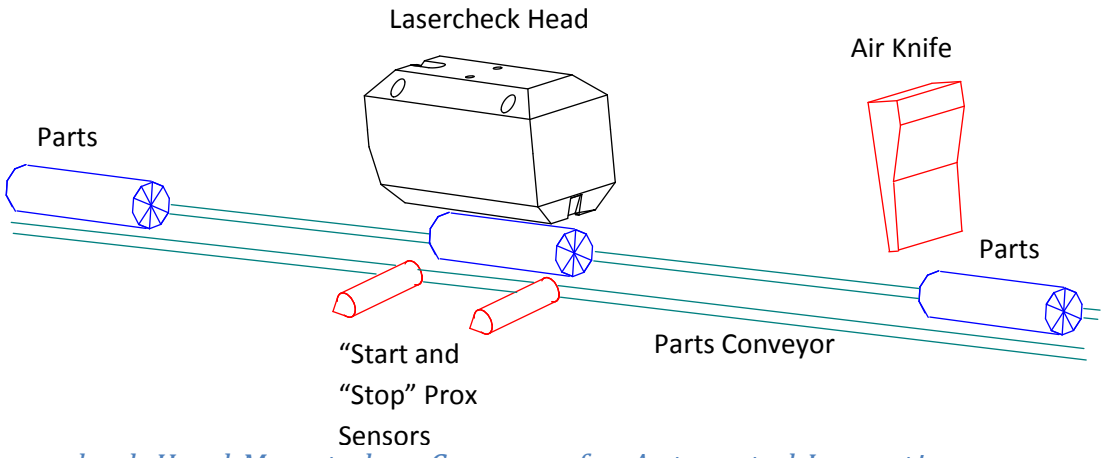
Under the Setup menu, select “Setup” and “Automation Type”. Select “Parts Inspection” so that the software can be used to perform automated measurements on individual parts.

Automatic Parameters for Automatic Start, Stop and Save Options

Under the Setup Module, select Open, and open the setup file named “automatic.stp” to modify and use. Next select the “Automatic” button and select “Automatic” for the Start and Stop options. Select “External” for Save Options. The name of the data file can also be generated and printed automatically or manually each time a new data file is saved. For details of doing this refer to the Lasercheck Windows Software Manual.

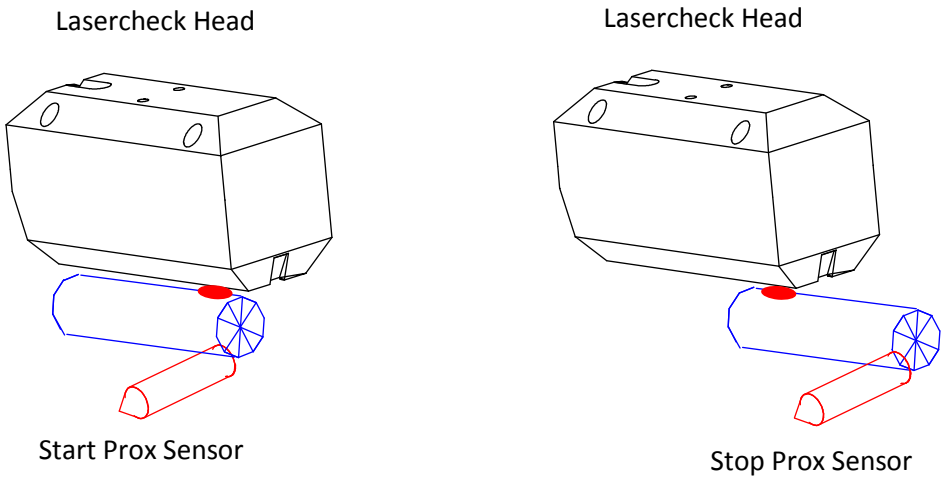


Optionally data files can be saved automatically at time intervals or after a set number of parts. The name of the data file can also be generated automatically and printed automatically each time a new data file is saved. For details of doing this refer to the Lasercheck Windows Software Manual.



Lasercheck Head Mounted on Conveyor for Automated Inspection

There are ten drilled and tapped holes on the Lasercheck sensor head that can be used for mounting and installing the Lasercheck in an automated inspection application. The head should be positioned at a location where parts will pass beneath the gage at the correct vertical and horizontal position relative to the gage head (see appendix section on Lasercheck Alignment Principles and Procedures). If parts are not clean, an air knife should be installed and mounted prior to the laser head 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.



Positioning Prox Sensors on Conveyor for Automated Inspection

A "start" sensor should be mounted in a location that activates as soon as the surface to be measured is entering a position for the Lasercheck head to measure (indicated by laser beam being fully positioned at the front edge of the measurement area of the part). A "Stop" sensor should be mounted in a location that activates as soon as the surface to be measured is leaving a position for the Lasercheck head to measure (indicated by laser beam being fully positioned at the front edge of the measurement area of the part). Both of these sensors should be wired to the "Input" connector on the back of the control box as described in the Appendix – Input and Output Pinouts section.

"Start" and "Stop" Sensor Wiring Inputs

External inputs to trigger the starting and stopping of measurements can be push buttons, proximity sensors, or any type of input that momentarily closes contacts.

For individual parts in Parts Inspection mode use input 1 for start and input 2 for stop. For a continuous surface in Roll Grinding mode use input 3 for start and input 2 for end/save.

See the Appendix – Input and Output Pinouts for the details of wiring the inputs.

External Trigger or Pushbutton Operation

An external push button or foot pedal can be hooked to the 6212A controller to control the measurement.

Control Box Input

Wire up the push button or foot pedal to external input 1 as indicated in the Lasercheck Manual Appendix for inputs and outputs.

Setup File

Use the Setup File and Calibration Template.xls to create a setup file with the line in the file:

"START_INPUT= EXTERNAL1"

For instructions about how to create or edit a setup file see the section in this manual under "Appendix - Calibration Procedures". For instructions about how to load a setup file into the control box see the section in this manual under "File Management / Receive Command".

This will allow first external input on the 9-pin connector to trigger a measurement (the measure button on the LCD display is also still active).

An example setup file would look like:

```
RECEIVE_NAME=          External.set
FILENAME=       External
START_INPUT=  EXTERNAL1
RA_UNITS=       MICROINCHES
RA_LIMITS=      15.00    20.00
LOW_ANALOG=10.00
HIGH_ANALOG=           25.00
RA_THRESHOLD=          12.00
CAL_TYPE=       EXPONENTIAL
CAL1=   -11.90   14.81    0.00     0.46
CAL2=   0.00     3.90     2.50     4.70
CAL3=   1.10     -6.44    26.80    MAX
CAL4=
```

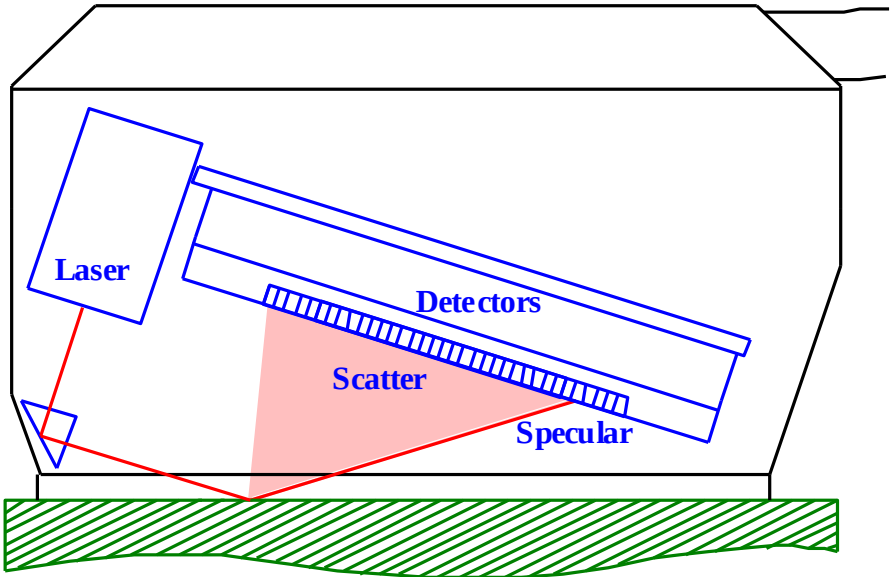
CAL5=
PCAL1= 12.791 0.6404 MAX
EOF

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

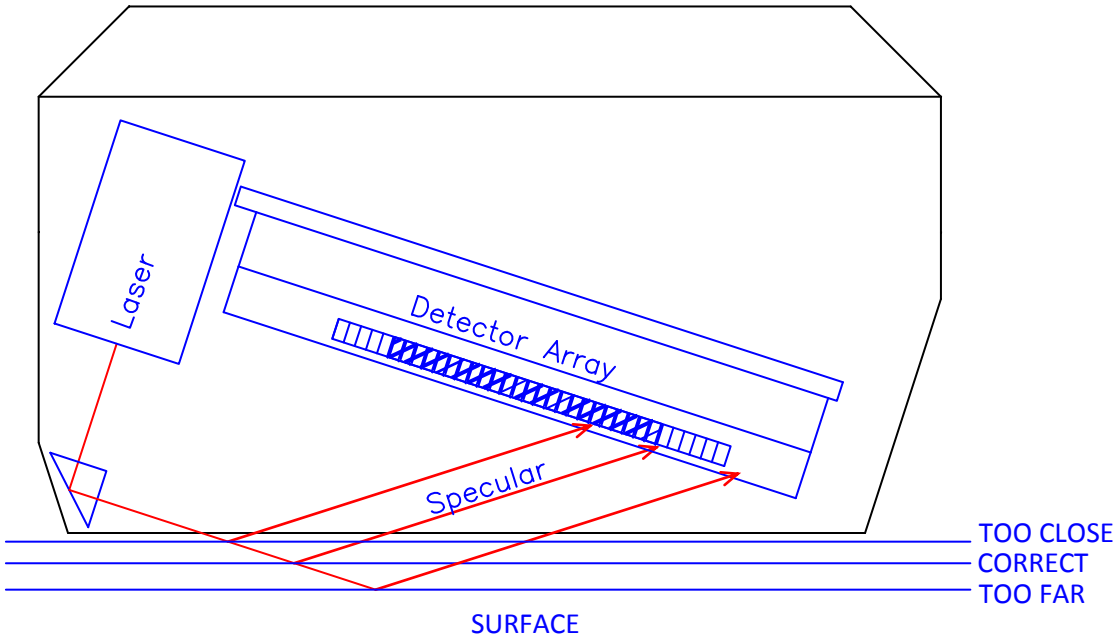
Figure 6 shows a schematic of the layout of the laser, the beam path and the detectors in Lasercheck. The "Photodiode Array" has 35 discrete detector elements. Of the 35 detectors in the array, only the 24 detectors that are positioned to the "inside" of the specular laser beam (toward the direction of the incoming laser beam) are used. This is important to understand in the discussion of alignment.

Alignment

Vertical

The shallow incident angle allows Lasercheck to measure similar roughness features to a stylus gage. It also creates sensitivity to vertical misalignment.

The specular laser beam must fall on one of the first 11 detectors in the 35-element photodiode array; the next 24 (closest to the incoming laser beam) are used to calculate surface roughness. If Lasercheck is too close to the surface, the specular reflection falls on detector number 12 or greater. Since 12 + 24 = 36 and there are only 35 detectors available, there are no longer enough "scatter" detectors available to calculate roughness. If Lasercheck is too far from a surface, the specular laser beam misses the photodiode array; this also results in an invalid measurement and/or and error message.



Positions of the specular reflected laser beam for three different positions of the surface relative to the Lasercheck instrument

Figure 7 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 missing the detector array. This is misaligned – the head is too far from the surface. The specular reflection from the middle surface strikes the array in the first 5 detectors; this is the proper alignment. Ideally, it should strike in the middle of those 5 detectors. The top surface is also misaligned because the specular hitting too high on the detector array – the head is too close to the surface.

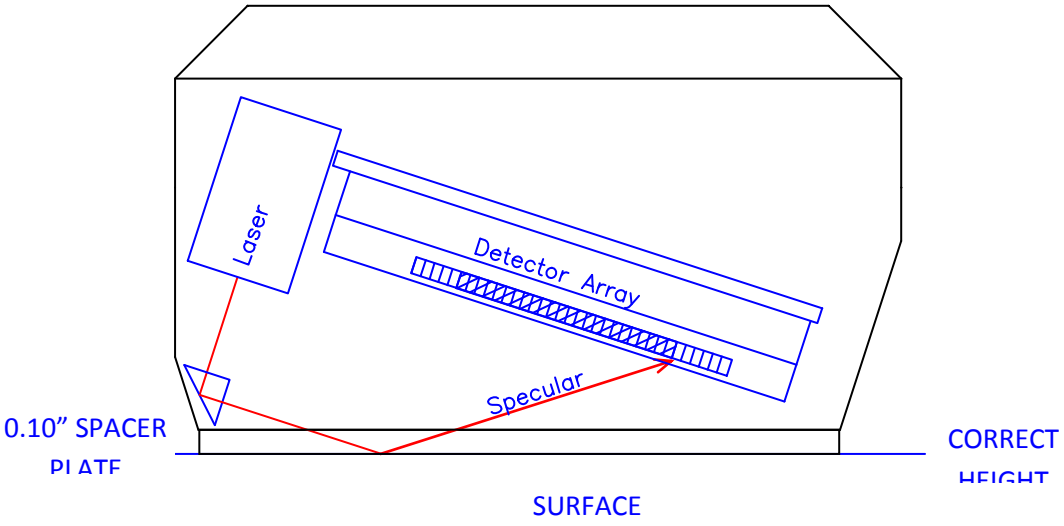
Ideally, Lasercheck is positioned so that the specular laser beam falls on one of the central detectors in the first 11. A good guideline is to try to maintain alignment so that specular falls on detector 6 with a tolerance of no

more than +/- 2 detector elements. As a reference, the head movement is approximately 0.005 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 in the middle of the first 11 detectors.

The important alignment feature to emphasize in design of custom fixtures is that it positions the part so that ultimately the specular reflected beam does strike in the middle of the first 5 detectors.

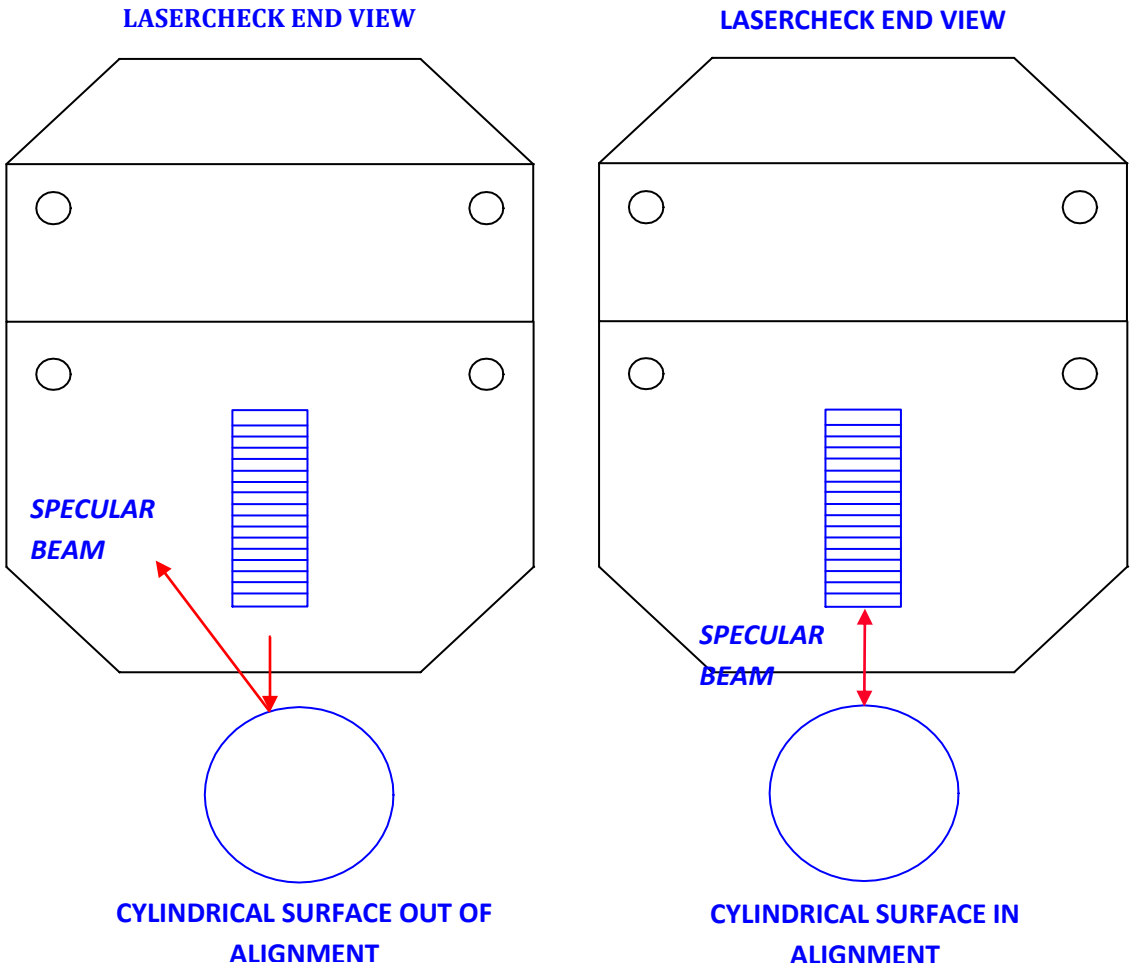


Lasercheck provided with 0.10" thick spacer plate to perfectly set height in manual operations or aid alignment setup in automated applications.

Horizontal

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

When you look under the Lasercheck from the “laser” end of the head, you will be able to see where the light is reflected after hitting the surface. If it is correctly aligned, you will see the reflected and scattered light bouncing back into the center of the detector window. If it is misaligned, you will see the light bouncing to one side or the other of the center of the detector window.



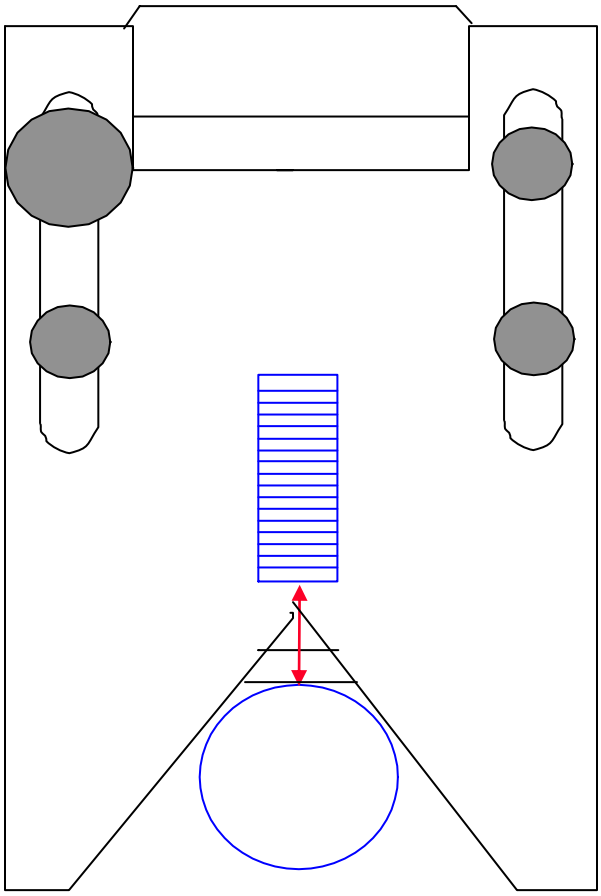
Lateral offset of the specular reflected laser beam on misaligned curved surface

Figure 9 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 Horizontal Alignment Feet

Lasercheck can be equipped with optional alignment feet that set correct horizontal positioning on cylindrical parts. This fixture, when attached to the ends of the Lasercheck head will set horizontal position of the head so that the reflected laser beam will reflect into the center of the detector window. This fixture is held on by four shoulder and thumbscrews and can easily be removed for installation of custom fixtures.

LASERCHECK END VIEW



CYLINDRICAL SURFACE IN ALIGNMENT BY USE OF CYLINDRICAL ALIGNMENT FEET OPTION

Lasercheck with Adjustable Cylindrical Alignment Feet Setting Correct Horizontal Alignment in manual operations

Directional / Rotational

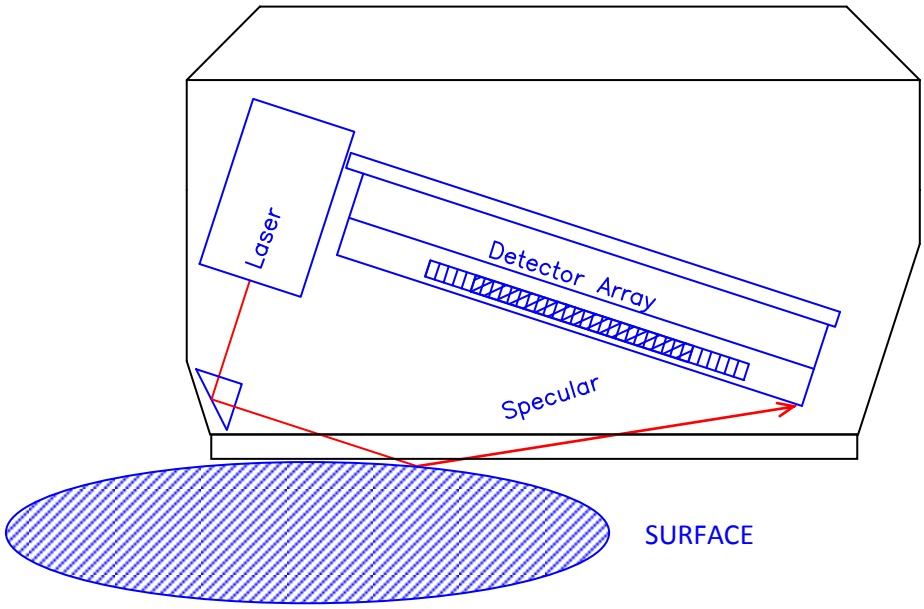
Many man made surfaces have a dominant direction of roughness. Strong directional roughness produces a strong directional scatter pattern or “line” of scatter across the direction of roughness. The length of the Lasercheck head must be oriented perpendicular to the direction of roughness so that the scatter strikes the detectors, which are oriented in a line down the middle of the head.

If Lasercheck is not aligned at right angles to grinding groves on a 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 mounting hardware will eliminate this potential problem.

Custom Shapes and Fixturing

3-Dimensional Shapes

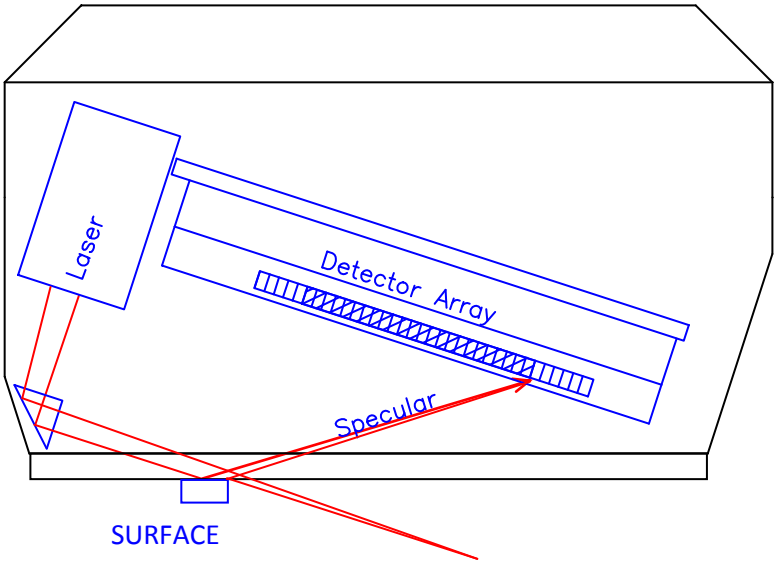
3-Dimensional curvatures and shapes cause Lasercheck to become easily mis-aligned either in the vertical or horizontal axis. Fixturing must be designed to carefully and repeatably control positioning in both axis so that the specular reflected beam strikes in the middle of the first 11 detectors and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



Lasercheck 6212 Sensor Head “3-D” Curved Surfaces. 3-D Curved surfaces cause laser to rapidly become misaligned. Carefully designed fixturing is required.

Small Surfaces

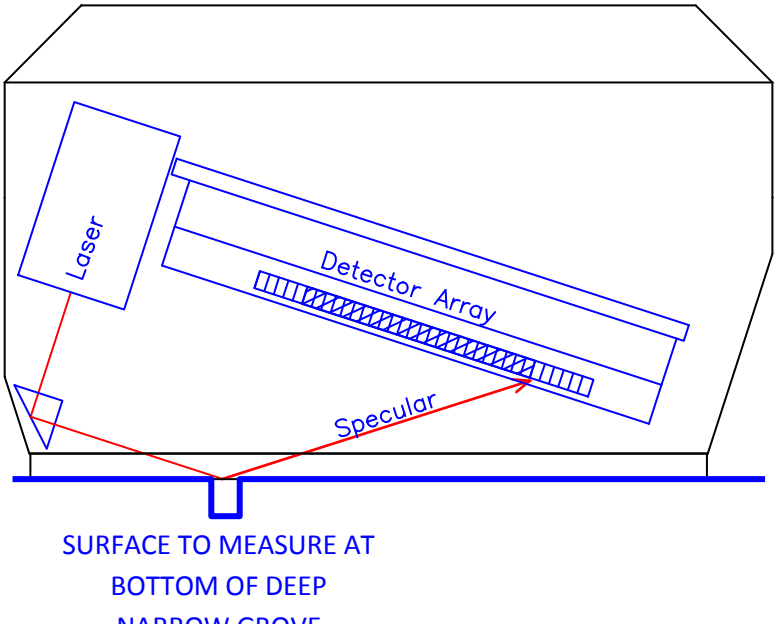
Surfaces that are smaller than the actual footprint of the laser spot (approximately 5 to 6 mm long X 1 mm wide) can be measured. The part of the laser beam that "overfills" the surface can be allowed to pass by. It is important to ensure that part of the beam is not allowed to strike a "secondary" surface 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.



Lasercheck can "over-illuminate" a small surface. Part of the beam can "pass by". Requires careful fixturing and no "background" surface reflecting portion of beam into sensors.

Recessed Surfaces

Surfaces that are recessed (blind holes, o-ring groves) are difficult and often not possible to measure. The "bottom" of the recess is often too deep and the "walls" effectively shadow the incoming and reflected beam. The effect is much like standing behind a tall building during sunset. The walls of the building shadow the sun when it is low in the sky in the same way that the walls of a recess shadow the shallow incident angle laser beam.

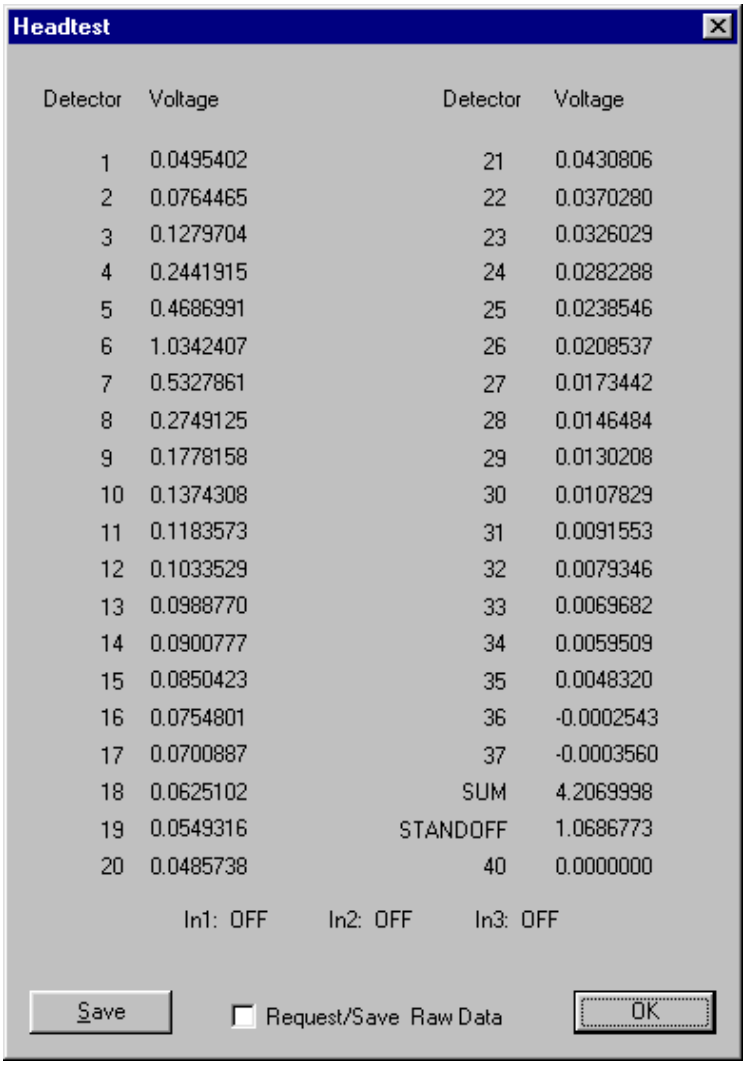


Lasercheck beam cannot access recessed surfaces such as o-ring groves. Beam geometry is not correct, walls of grove "shadow" the beam.

Measure/Headtest Dialog Box

Measure/Headtest Screen A and B are printed out from our Measure/Headtest selection in our windows software. In this screen, you will see Lasercheck values displayed beside numbers 1 to 37. Numbers 1 to 35 are voltage readings from the 35 array detectors. Also displayed is a sum of voltages from all detectors and a "relative" height standoff calculation. Nothing is displayed beside number 40. Measure/Headtest can be used to assist in alignment of the Lasercheck head.

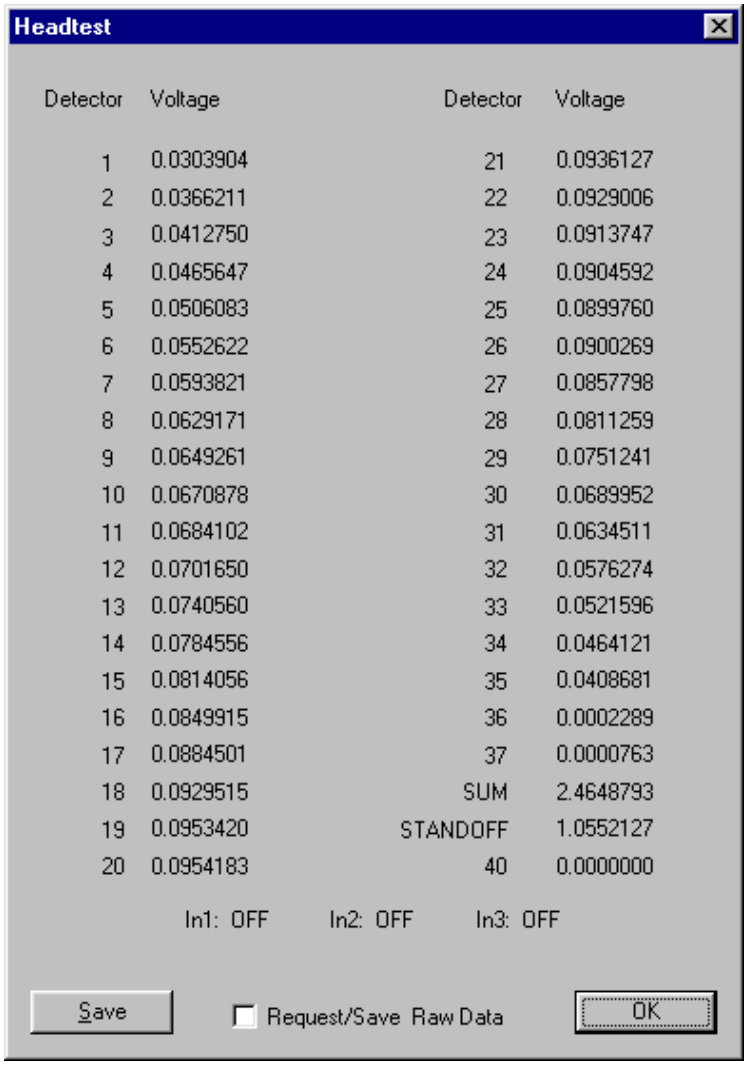
Measure/Headtest Screen A



Measure/Headtest Screen A shows a well-aligned smoother surface, Ra of about 5 microinches. Because the surface is relatively smooth, a well-defined specular beam is maintained as it bounces off the surface into Lasercheck. It displays itself as the largest voltage readings in the array at # 6. A relative indication of the Lasercheck standoff height from the surface is also indicated . *Note: this Standoff Distance calculation is a relative reading only; the absolute values are not correct.* If Lasercheck were moved away from the surface, the specular laser beam would move up to detectors # 5, 4, 3, 2, 1 etc. and the standoff reading indication would

increase. If Lasercheck were moved closer to the surface, the specular laser beam would move down to detectors # 7, 8, 9 etc. and the standoff reading indication would decrease.

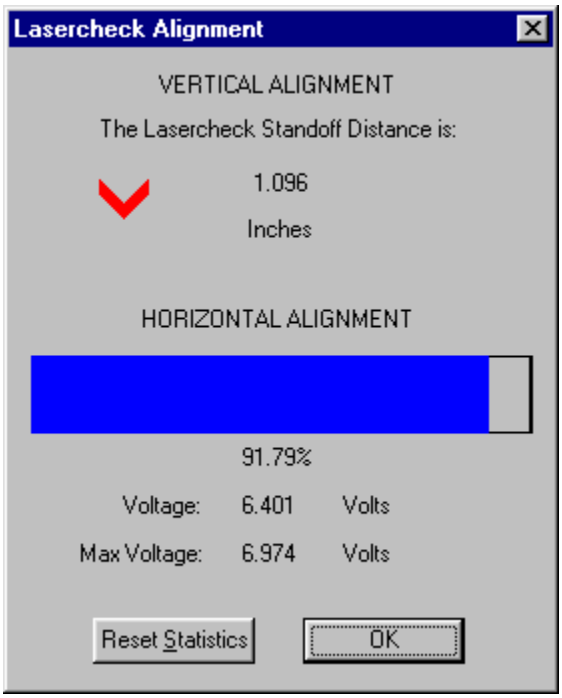
Measure/Headtest Screen B



Measure/Headtest Screen B is a display from a rougher surface, Ra of about 30 microinches. Because the surface is relatively rough, the specular beam is now lost as it bounces off the surface into Lasercheck. There is no obvious large voltage anywhere in the array. The standoff reading indication is no longer reliable. On these rougher surfaces, we cannot do height alignment with Lasercheck's help. What must be done is to either align on a smooth surface in the exact position the rough surface is at or make the rough surface look smooth to Lasercheck for just the alignment. A reliable way to make a rough surface look smooth to Lasercheck is to wipe a thin film of oil on the surface. This makes the surface look "slick" to the human eye and to Lasercheck. Position the oiled portion of the surface under Lasercheck and proceed with the vertical alignment using the Measure/Headtest to position the specular center on detector # 6.

It is important to perform this alignment at least once because the signals from a well-aligned rough surface can be identical to signals from a misaligned smooth or rough surface. You must be certain Lasercheck is aligned to rely on “rough” surface measurements.

Measure/Align Dialog Box



Measure/Align provides the same information as Measure/Headtest but in a different format and display. The relative indication of the Lasercheck standoff height from the surface as indicated in the Measure/Headtest screen is indicated in the top portion of the dialog box. For optimal alignment target a standoff height value of 1.069. *Note: this Standoff Distance calculation is a relative reading only; the absolute values are not correct.* A downward or upward pointing chevron is also provided to indicate to the user to move the head up or down to achieve optimal alignment.

Horizontal Alignment with Measure/Headtest or Measure/Align

Measure/Headtest and Measure/Align in the windows software will help you with horizontal alignment on cylindrical surfaces. Remember SUM is a sum of all of the voltages from the detectors. When horizontally aligned, you will obtain the largest possible value on SUM because more light is reflecting into the center of the detector window and detectors. As you move the head back and forth over a cylindrical surface, you will see this value go up and down. Position Lasercheck for maximum signal on SUM. The lower portion of the “Measure/Align” dialog box provides a display of the reading from SUM, a continuously updating maximum value from SUM, as well as a continually updating bar graph to help with horizontal alignment.

You must be sure to pass the head back and forth over the surface one or two times so that the maximum possible value for SUM can be found. Once it is found, then the head must be positioned to achieve a value as close to that maximum as possible.

NOTE: *Do not assume that a 100% reading in the Measure/Align dialog box is correct. Always move the head back and forth to find and update a true maximum 100% value.*

You should also note that the maximum reading observed on SUM will typically be lower on rough or non-metallic surfaces than on smooth and metallic surfaces because less light is reflected and scattered into our detectors on rough or non-metallic surfaces.

Verifying Alignment Procedures

Set Head Close Correct Position

Horizontal and vertical alignment should be close before performing any alignment with Measure/Headtest or Lasercheck Windows software. If Lasercheck is badly misaligned, than the software cannot locate the specular laser beam for vertical alignment and has little or no signal for horizontal alignment.

Align Horizontally

Horizontal alignment works best on a clean, rough surface (greater than 10 microinches) with a dominant roughness direction, for example a ground surface. With an alignment aid, Measure/Headtest or Measure/Align, set the horizontal alignment as close to optimal as possible. This is done by maximizing the value of SUM displayed on Measure/Headtest software or by maximizing the horizontal alignment percent within Measure/Align.

Align Vertically

Vertical alignment works best on a smooth surface. Move the head up or down over a smooth area (or a rough area coated with a film of oil). Use Measure/Headtest to position the specular beam on # 6.

Verify Alignment

Check visually and with software that horizontal alignment has not changed during the process of performing vertical alignment.

As surfaces get rougher (greater than 20 microinches), resolution of Lasercheck decreases and sensitivity to misalignment increases. Mounting and alignment stability becomes more important to maintaining high repeatability from Lasercheck. The important issue to appreciate is that on smoother surfaces, Lasercheck has more tolerance to misalignment, shaking, vibrating, etc. On rougher surfaces, Lasercheck does not have as much tolerance for misalignment, shaking, or vibrating.

Appendix - Setup Files

Triggering measurements

An external trigger (foot pedal, pushbutton, proximity sensor, trigger from the manufacturing or automated inspection process, or any type of input that momentarily closes contacts) can be hooked to the 6212A controller to control the measurement. Use input 1 for starting a measurement, input 2 for stopping a measurement, and input 3 for saving a measurement.

See the Appendix – Input and Output Pinouts for the details of wiring the inputs.

Specific instructions must be loaded into the control box in a Lasercheck setup file ("filename.set"), which is a text file containing calibration, display and operation configuration for the Lasercheck instrument.

For instructions about how to create or edit a setup file see the section in this manual under "Appendix - Calibration Procedures". For instructions about how to load a setup file into the control box see the section in this manual under "File Management / Receive Command".

Setup file format

```
RECEIVE_NAME=          example.set
FILENAME=       example
START_INPUT=  MEAS / SERIAL / EXTERNAL1
RA_UNITS=       MICROINCHES / MICRONS
RA_LIMITS=      15.00    20.00
LOW_ANALOG=15.00
HIGH_ANALOG=           20.00
RA_THRESHOLD=          12.00
CAL_TYPE=       POWER / EXPONENTIAL
CAL1=   -11.90  14.81   0.00    0.46
CAL2=   0.00    3.90    2.50    4.70
CAL3=   1.10    -6.44   26.80   MAX
CAL4=
CAL5=
PCAL1= 12.791  0.6404  MAX
EOF
```

RECEIVE_NAME

This is the name that will be saved in the control box and displayed on the control box LCD screen. The name must be any number of characters up to eight in length.

FILENAME

This is the prefix of the filename to which the data is saved. The prefix must be five characters that are used to create an incremental data file; abcde will create files named abcde001.txt, abcde002.txt, etc. If “DATE” is used, then the system date will be used to start the file name (i.e. 0428_001.txt).

START_INPUT

MEAS

Default. Responds only to front panel pushbutton. Single value response only sent to front panel LCD and to serial port.

SERIAL

As soon as receives command from serial port, responds as fast as can send to front panel LCD and to serial port.

EXTERNAL1

Starts as soon as receives command from EXTERNAL1, respond as fast as can to front panel LCD and to serial port.

RA_UNITS

This sets which units the Ra is displayed on the LCD screen.
The RA_UNITS options are microinches, microns, or nanometers.

RA_LIMITS

This option accepts two numbers; the first is the minimum and the second is the maximum Ra value of the surface specification. This sets the specification range for Ra values. If a measured Ra is outside (lower than the minimum or higher than the maximum) these values pins on the control box output port (Ra_Limit) momentarily close. An “out of spec” indicator, or automated part rejecter can be connected to these pins to alert operators and / or reject parts when they are outside of specification.

ANALOG_OUTPUT

LOW_ANALOG

This option is used to configure the low current or voltage setting of the Analog_Out pin of the output connector. This number shall determine the Ra value that will generate 0 Volts or 4 milliamps output at the pins.

HIGH_ANALOG

This option is used to configure the high current or voltage setting of the Analog_Out pin of the output connector. This number shall determine the Ra value that will generate 10 Volts or 20 milliamps output at the pins.

Jumper Settings for Setting Analog Output to 4-20 mA or 0-10 V

Jumpers JP2 and JP3 on top board inside of control box must be set to configure 0-10V voltage or 4-20 mA current output. Set JP2 and JP3 to “C” for 4-10 mA current output or to “V” for 0-10V voltage output.

RA_THRESHOLD

The Ra threshold is the value in microinches the control box Ra calculation program switches between rough and smooth algorithms. For most surfaces and processes 12 microinches is recommended.

CAL_TYPE

Lasercheck software calculates a raw, uncalibrated relative roughness value. To display “calibrated” values calibration equation values must be mathematically applied to the uncalibrated Lasercheck value. For information on calibration, see the section in this manual under “Appendix - Calibration Procedures”.

POWER

Applies “power based” calibration to Lasercheck raw roughness values. Reads and applies calibrations from values in setup file line named “PCAL1”.

EXPONENTIAL

Default. Applies “linear and exponential based” calibration to Lasercheck raw roughness values. Reads and applies calibrations from values in setup file lines named “CAL1, CAL2, CAL3, CAL4, and CAL5”.

CALIBRATION

The calibration conversion equations, CAL1 through CAL5, are in the form Ax^2 + Bx + C followed by a break point which transitions to the next calibration equation or region. There are up to 5 “calibration” regions . Setting the break point value to “MAX” indicates that data set is the last “calibration” region.

PCAL1 are calibration conversion values used in “power based” calibration equations.

Default.set setup files

Many different setup files can reside on the controller so users can scroll to, and use these different setups for different applications. The first setup file to “load” when the controller is started is typically the most recent setup file that was loaded onto the controller. If desired, one setup file can be configured to always be the one that first loads whenever the system is turned on. Naming the setup file “Default.set” will cause that file to always be loaded when the controller is first started. The first two lines of the setup file should read:

RECEIVE_NAME= default.set
FILENAME= default

Appendix - Calibration Procedures

Instructions for using the Setup File and Calibration Template.xls

Calibration of the Lasercheck gage involves testing known surfaces with the Lasercheck and developing a correlation between the Lasercheck readings and the actual Ra roughness values on several surfaces with different roughness values. This correlation is stored in a setup file that is used when the Lasercheck performs a measurement.

Lasercheck requires calibrations for different processes. Lasercheck will read a turned surface different than it reads a lapped and polished surface so an independent calibration is required for each of these processes. Once a calibration is performed, Lasercheck never requires re-calibration for a given process.

Smooth and Rough Mode

Lasercheck calculates roughness using algorithms optimized for “smooth” or “rough” surfaces. Smooth algorithms provide most accurate readings on surfaces approximately 10 microinches and smoother, and rough algorithms provide most accurate readings on surfaces 10 microinches and rougher.

Lasercheck Calibration Measurements

Please refer to the subsection of the manual named “New Cal Command” in the “File Management” section.

Calibration Spreadsheet

The spreadsheet is designed to step you through the calibration process from "Step 1" through "Step 6". Follow the detailed instructions on each page of the spreadsheet. The overall process involves:

1) Perform and save measurements on calibration test surfaces with the Lasercheck using uncal_s.set file. If any test surfaces are “too rough” for uncal_s.set to properly calculate roughness an error message will be displayed. Repeat and save measurements using uncal_r.set on any surfaces that provide this error message.
2) Measure calibration test surfaces with a calibrated stylus gage (if the actual surface roughness is not known.
3) After measurements are performed, follow the specific numbered instructions on each sequential page in the spreadsheet (Step 1 Enter Ra Values, Step 2 Mid Range, Step 3 High Range, Step 4 Low Range, Step 5 Review, and Step 6 Export Setup File).

Statistics and Accuracy

It is important to remember that more calibration measurements provide better statistics and better calibration, especially if a wide range of roughness is used in the calibration. It is also important to remember that stylus gages measurements often lack repeatability depending on surface uniformity, the environment the measurement is taken in, condition of the instrument and condition of the actual stylus tip. It is a good idea, therefore, to take a few stylus gages measurements for each sample and enter the average of those values into the spreadsheet.

Instructions for using the Setup File and Calibration Template.xls

The spreadsheet is designed to step you through the calibration process from "Step 1" through "Step 6". Lasercheck calibrations often show three regions of correlation. There is an exponential correlation on smooth surfaces (a few microinches of roughness), followed by a linear correlation region (from a few microinches to 10's of microinches of roughness), followed by a final exponential correlation region (10's of microinches to approximately 100 microinches of roughness). The spreadsheet instructions will allow adjustment of calibration correlation curves in each of these regions to provide the best fit to the calibration data.

Step 1 Enter Ra Values

Below is an image of the Step 1 tab of the spreadsheet including instructions.

1. Export measurement files containing Lasercheck calibration measurement values from the Lasercheck controller. Then "Left-Click" on the Push-Button below labeled "Insert Lasercheck Values" to import the values into this spreadsheet program. Select the appropriate directory and file containing the data when prompted. *Note:* Lasercheck values can also be entered manually in the Green Highlighted Column labeled **Lasercheck Ra Value** below.

2. Enter values measured with Stylus Gage corresponding to Lasercheck values in Yellow Highlighted Column labeled **Stylus Ra Value** below.

Measure #	Stylus Ra Value	Lasercheck Ra Value
1	2.770	0.450
2	4.803	0.900
3	10.367	1.980
4	17.200	3.200
5	31.500	6.000
6	67.767	9.100
7	1.340	0.200
8	2.210	0.350
9	4.150	0.750
10	8.730	1.610
11	18.100	3.500
12	38.200	7.000
13	64.600	9.000
14	125.000	12.300
15	2.150	0.350
16	4.310	0.790
17	9.480	1.900
18	15.490	3.300
19	31.710	6.000
20	55.450	8.000
21	0.995	0.200
22	1.870	0.300
23	4.505	0.820
24	8.140	1.580
25	16.345	3.620
26	30.610	6.230
27	56.475	9.000
28	114.155	12.200
29		

3. Enter new name for the Setup File or finishing process that is being created by this spreadsheet beside **Filename =** in Yellow Highlighted Space below. Name must Be 5 letters or less.

Filename = ProcessA

4. Use Drop Down Box to select "Meas" if measurements to be taken by operator in a manual / pushbutton mode, "Serial" if measurements to be performed by operator control or fully automated external input control of Lasercheck Windows Software, or "External_1" if measurements to be performed by external input control in a manual single measurement mode.

Control = MEAS MEAS

5. Use Drop Down Box to select "Microinches" or "Microns" for the roughness units you wished displayed by the Lasercheck display.

Units = MICROINCHES MICROINCHES

6. Use Drop Down Box to select "EXPONENTIAL" or "POWER" depending on curve fitting routine selected that is best fit to correlation between stylus and Lasercheck values

Cal Type = EXPONENTIAL EXPONENTIAL

Stylus and Lasercheck Ra Values

All Lasercheck values are imported or manually entered into this spreadsheet. The known (or stylus gages measured) values taken on the same area of the same surface are manually entered into the spreadsheet beside the corresponding Lasercheck value.

*Note: This spreadsheet is designed for inputting stylus values in **microinches**. The final setup file can be configured to provide results in microinches or microns, but it is important to input stylus or actual surface values in microinches only in this spreadsheet.*

Filename =

Manually enter a filename here. This will be carried through the spreadsheet and used in naming the setup file when transferred into the controller. Try to use a name that is descriptive of either the process or the job and parts that it is to be used on.

Control =

Use the drop down dialog box to select how measurements will be performed. Options are:

- MEAS Controlled by front panel pushbutton (Only option available with this system)
- SERIAL Controlled by external software (Not available with this instrument)
- EXTERNAL_1 Controlled by external trigger (Not available with this instrument)

Units =

Use the drop down dialog box to select measurement units to be displayed. Options are:

- MICROINCHES
- MICRONS
- NANOMETERS

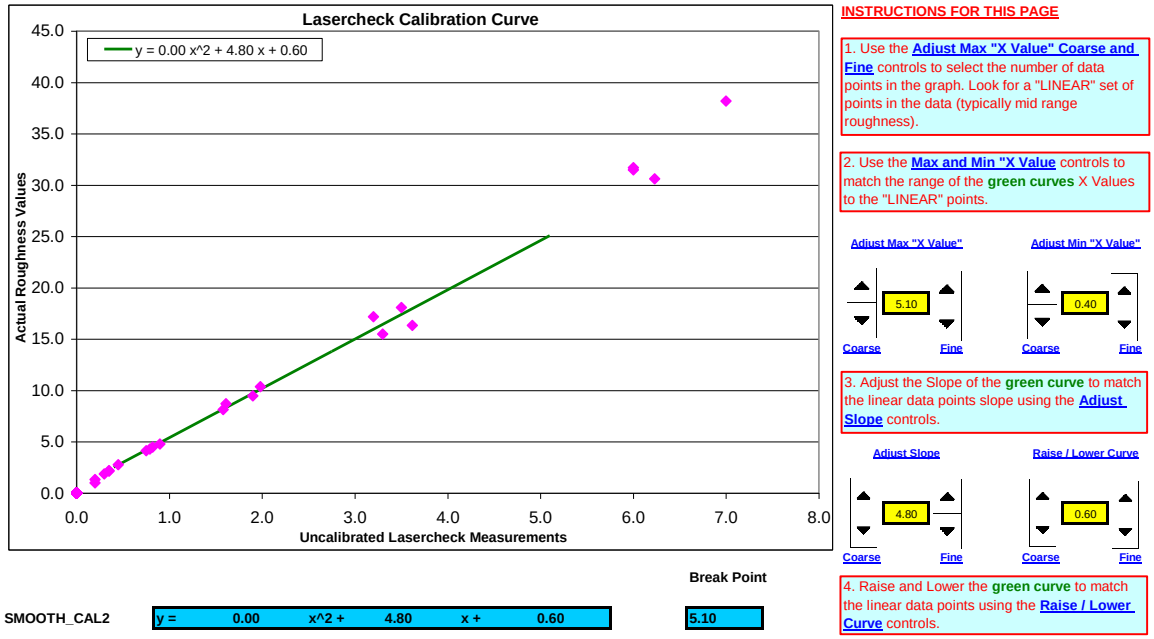
Cal Type =

Use the drop down dialog box to select “curve fitting mathematics” to be used for creating calibration values. Options are:

- EXPONENTIAL Linear and exponential equations (Only option available with this system)
- POWER Power based equations (Not available with this instrument)

Step 2 Mid Range

Below is an image of the Step 2 tab of the spreadsheet including instructions.



Adjust Max "X Value" / Adjust Min "X Value"

Use the scroll buttons to extend or contract the linear green curve and the associated data points that the linear curve will be best fit to. Linear fits will be found on most sets of Lasercheck and stylus values and this may include some or all of the values. Try to find the linear data set than isolate those values with these scroll buttons.

Adjust Slope

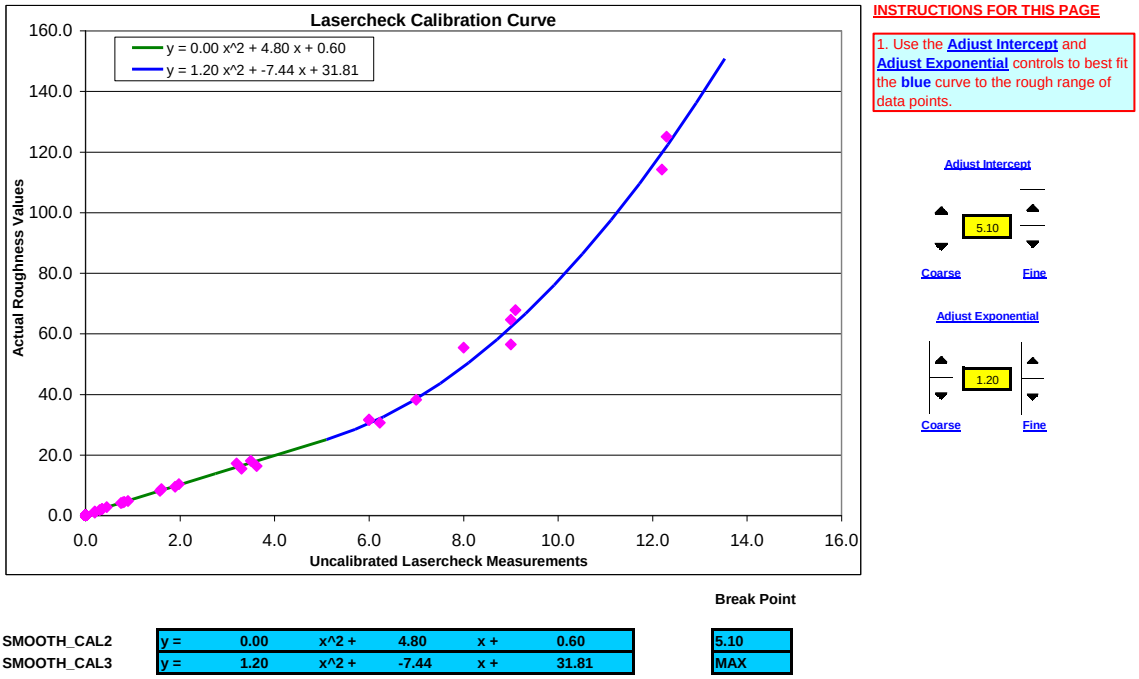
Use the Coarse and Fine scroll buttons to match the slope of the linear green curve and the associated data points.

Raise / Lower Curve

Use the Coarse and Fine scroll buttons to raise and lower the linear green curve until it best fits the associated data points.

Step 3 High Range

Below is an image of the Step 3 tab of the spreadsheet including instructions.



Adjust Intercept

Use the Coarse and Fine scroll buttons to select where the values in the graph appear to transition from a "linear" best fit to an "exponential" best fit. In most processes, Lasercheck measurements and actual surface roughness eventually exhibit an exponential relationship as the surface values get rougher.

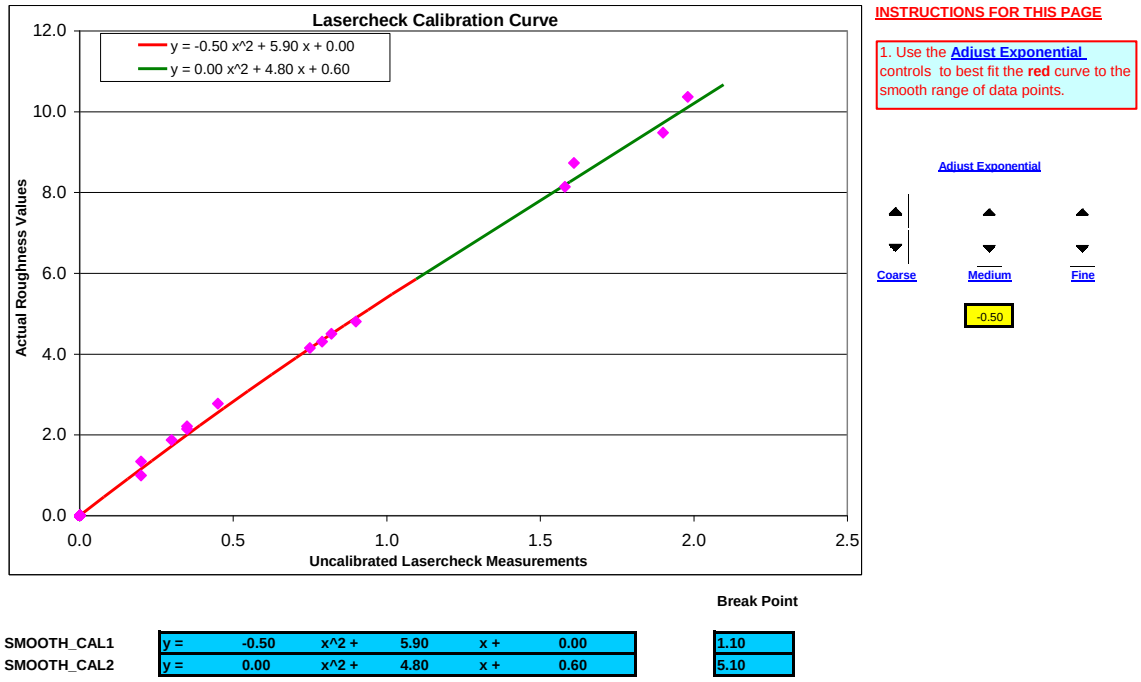
Adjust Exponential

Use the Coarse and Fine scroll buttons to match the exponential blue curve and the associated data points at the rougher range of surface values.

Note: The "Adjust Intercept" and "Adjust Exponential" operations usually are iterative operations.

Step 4 Low Range

Below is an image of the Step 4 tab of the spreadsheet including instructions.

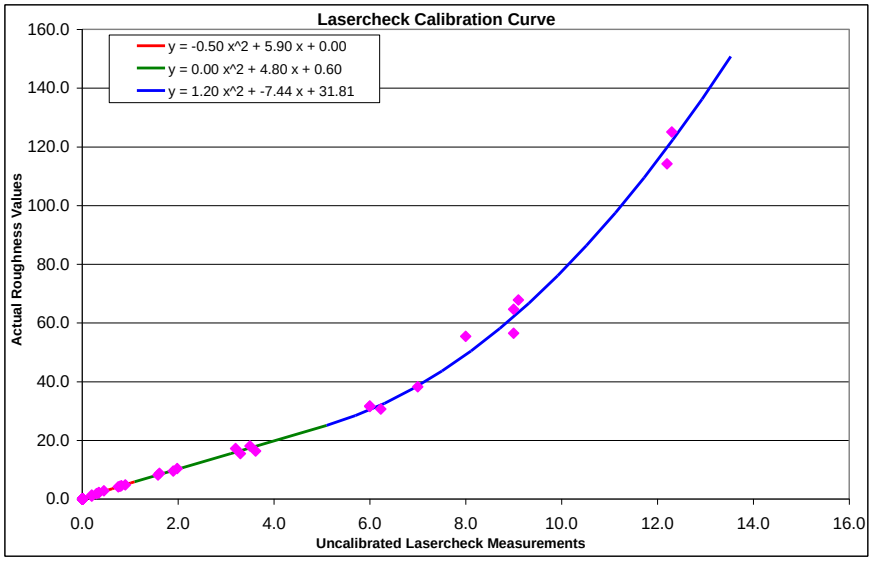


Adjust Exponential

Use the Coarse, Medium, and Fine scroll buttons to match the slope of the exponential red curve and the associated data points at the smoothest range of surface values. Lasercheck measurements and actual surface roughness eventually exhibit an exponential relationship as the surface values get very smooth (a few microinches and below).

Step 5 Review

Below is an image of the Step 5 tab of the spreadsheet including instructions. This final graph allows you to review the curve fitting of all regions of roughness that have been performed in Step 2 through Step 4. If any regions of the best fit curves do not appear to “best-fit” the data, then go back to the relevant tabs and step back through the process until “best possible fit” is obtained for all ranges of roughness.



INSTRUCTIONS FOR THIS PAGE

1. Review the overall calibration curve fits for all roughness regions. If any part of the calibration does not visually appear correct, go back to the tab corresponding to that region and make adjustments. You may have to edit other tabs after that to correct the overall calibration.

							Break Point
SMOOTH_CAL1	y =	-0.50	x^2 +	5.90	x +	0.00	1.10
SMOOTH_CAL2	y =	0.00	x^2 +	4.80	x +	0.60	5.10
SMOOTH_CAL3	y =	1.20	x^2 +	-7.44	x +	31.81	MAX

Step 6 Export Setup File

Below is an image of the Step 6 tab of the spreadsheet including instructions.

File Transfer Setup File

RECEIVE_NAME=	ProcessA.set			
FILENAME=	ProcessA			
START_INPUT=	MEAS			
RA_UNITS=	MICROINCHES			
RA_LIMITS=	15.00	20.00		
LOW_ANALOG=	15.00			
HIGH_ANALOG=	20.00			
RA_THRESHOLD=	12.00			
CAL_TYPE=	EXPONENTIAL			
CAL1=	-0.50	5.90	0.00	1.10
CAL2=	0.00	4.80	0.60	5.10
CAL3=	1.20	-7.44	31.81	MAX
CAL4=				
CAL5=				
EOF				

Manual Input Setup File

FILENAME=	ProcessA
Cal_A1:	-0.50
Cal_B1:	5.90
Cal_C1:	0.00
Cal_A2:	0.00
Cal_B2:	4.80
Cal_C2:	0.60
Cal_A3:	1.20
Cal_B3:	-7.44
Cal_C3:	31.81
Break_1:	1.10
Break_2:	5.10
Threshold:	20.00
RA_UNITS=	MICROINCHES

INSTRUCTIONS FOR THIS PAGE

1. Click on Push-Buttons Below Labeled "Export Standard Setup File", or "Export Manual Input Setup File" depending on whether new setup file created will be input into the Lasercheck electronics by computer file transfer or by manually inputting values. You may rename any of these files, but they **MUST** end in ".set". Close the new setup file that is created in Excel. When the dialog box appears asking you about saving the changes to the file, select "No".

Export "File Transfer" Setup File

Export "Manual Input"Setup File

Export "File Transfer" or "Manual Input" Setup File

Pushing either of these buttons will create a setup file with a default name of "std.set" or "manual.set". When this is done, you should rename this file to a descriptive name for the finishing process or job it is to be sued on and later loaded onto the controller. The "File Transfer" button will create a properly formatted file for downloading using the optional Computer File Storage Interface upgrade. The "Manual Input" button will create a properly formatted file that allows easy entry into the controller using the keypads.

Typical "File Download" Calibration Setup File

```
RECEIVE_NAME=       ProcessA.set
FILENAME=     ProcessA
START_INPUT=  MEAS
RA_UNITS=     MICROINCHES
RA_LIMITS=    15.00   20.00
LOW_ANALOG=15.00
HIGH_ANALOG=        20.00
RA_THRESHOLD=       12.00
CAL_TYPE=     EXPONENTIAL
CAL1=  -0.50   5.90   0.00   1.10
CAL2=  0.00    4.80   0.60   5.10
CAL3=  1.20    -7.44  31.81  MAX
CAL4=
CAL5=
EOF
```

Appendix – Input and Output Pinouts

Input: 9-Pin Female D-sub Connector

Internal Opto relay:

Pin 1, 6, 2 = Opto relay 1, 2, 3
Optically Isolated. **Must be connected to power (can use control box voltage – Pin 9).**
Pulls low to activate.
Voltage Range: 3VDC to 50VDC, ideal 5VDC
Max Ratings: 60 mA
Internal part: QT Optoelectronics MCT9001
Do NOT reverse input voltage!

Trigger pins:

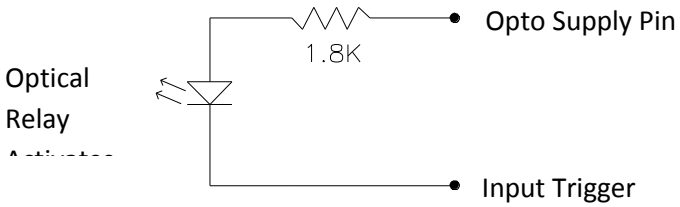
Pin 3, 8, 4 = Trigger inputs 1, 2, 3 (Start, stop, save measurements)
Normally open, "switch" low (close) to ground to activate
Pin 7 = Ground of internal power supply (Connect to input triggers)

Power pins:

Pin 9 = 12 to 13 VDC from internal power supply
Pin 7 = Ground of internal power supply
Use only for powering external triggering devices that require power (such as inductive proximity sensors) and as Internal Opto relay supply voltage.

Pin	Signal	**Function** Inspect Continuous Surface	**Function** Inspect Individual Parts
1	Opto Supply 1	Power to Opto relay 1	
2	Opto Supply 3	Power to Opto relay 3	
3	Input 1	Initialize System to Begin	Start
4	Input 3	Start	Initialize System to Begin; Save
5	No Connection	No Function	
6	Opto Supply 2	Power to Opto relay 2	
7	GND (power supply ground)	Ground for Inputs 1, 2, 3	
8	Input 2	Stop and Save	Stop
9	+12 VDC (power supply)	Power for external trigger device and Internal Opto relay	

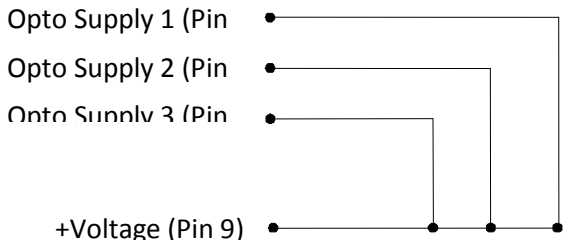
Internal Opto relay Schematic:



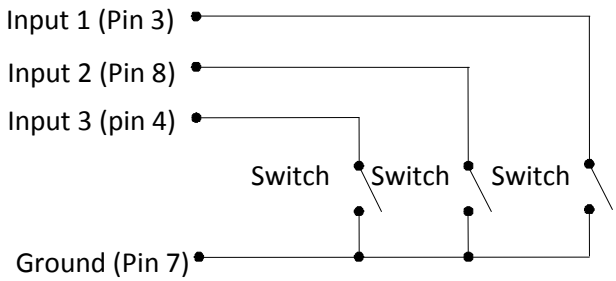
Typical Wiring Example:

1) Using Unpowered Switches for inputs:

a) Connect Power for Opto relays using Control Box Voltage (Pin 9)



b) Connect Switches between Ground (Pin 7) and Input Pin

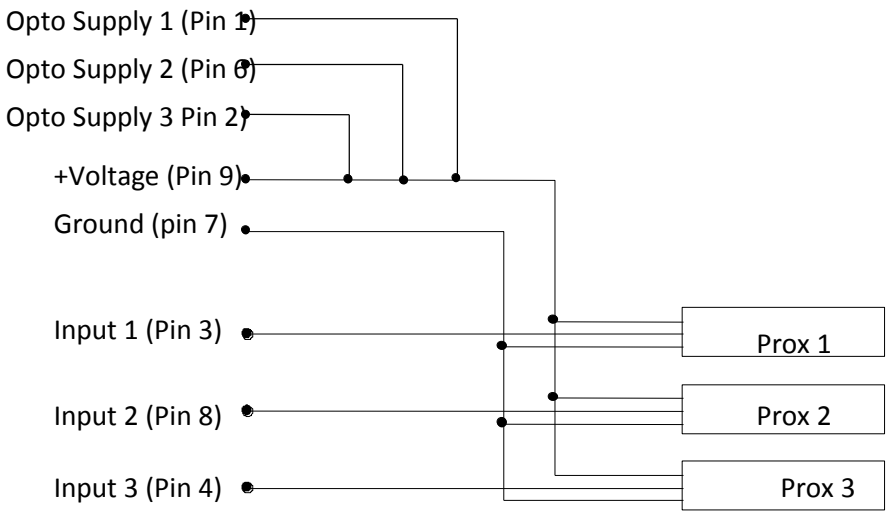


2) Using Powered Triggering Device (e.g. Proximity Sensors) for Inputs:

a) Connect Power for Opto relays and for Triggering Devices using Control Box Voltage (Pin 9)
b) Connect Triggering Devices between Ground (Pin 7) and Input Pin

Recommended Proximity Sensor Specifications:

- DC, NPN (short to ground to activate), shielded (for most applications), normally open output



Output: 9-Pin Female D-sub Connector

Failed part output. Closes when measurement is out of software specified range.

SPDT Relay, Resistive load Max: 200mA

Max Ratings: 30VDC @ 1A, 125VAC @ 0.1A

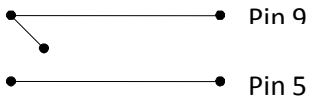
Internal parts: Omron G6E, connected internally with 28AWG ribbon cable

Pin	Signal
1*	Analog_Out + (0-10V / 4-20mA)
2	Not Used
3	Not Used
4	GND (system ground)
5	Ra_Limit (Closed if Out of Spec)
6	Analog_Out Ground (0-10V / 4-20mA)
7	Not Used
8	Not Used
9	Ra_Limit (Closed if Out of Spec)

*** NOTE:** Jumpers JP2 and JP3 on top board inside of control box must be set to configure 0-10V voltage or 4-20 mA current output. Set JP2 and JP3 to “C” for 4-20 mA current output or to “V” for 0-10V voltage output.

1) Output Schematic Ra_Limit

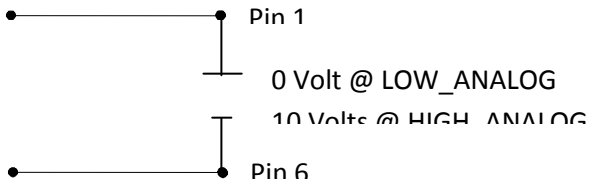
a) Normal State – Surface Within Ra_Limit – in Spec



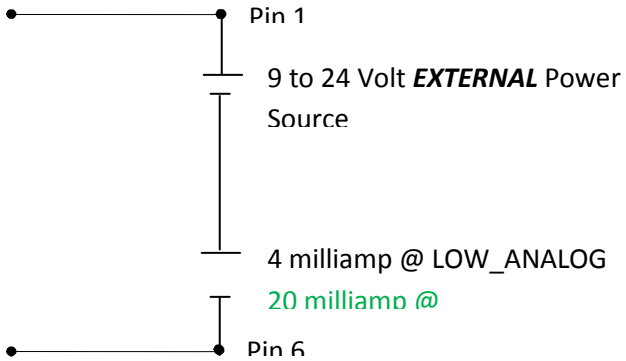
b) Surface Outside Ra_Limit – out of Spec

2) Output Schematic Analog_Out

a) 0-10V



b) 4-20mA



NOTE: 9 to 24 Volt power must be connected in series with Current Monitor (*Must be **External** power source*):

Appendix - Upgrading Controller Software

Prepare Controller

- Attach a serial null modem cable from the RS232 port on the back of the Lasercheck control to a serial (com) port on the back of your computer. (*NOTE: Some newer computers, especially notebooks, only have USB ports; a USB to serial adapter will be required – ensure that the USB to serial driver will support* ***DOS based serial transfer****, some support Windows only*)
- Connect a computer keyboard to the connector on the back of the Lasercheck control box labeled "Keyboard".
- Turn on the control box main power switch. When fully executed, the LCD screen will display:

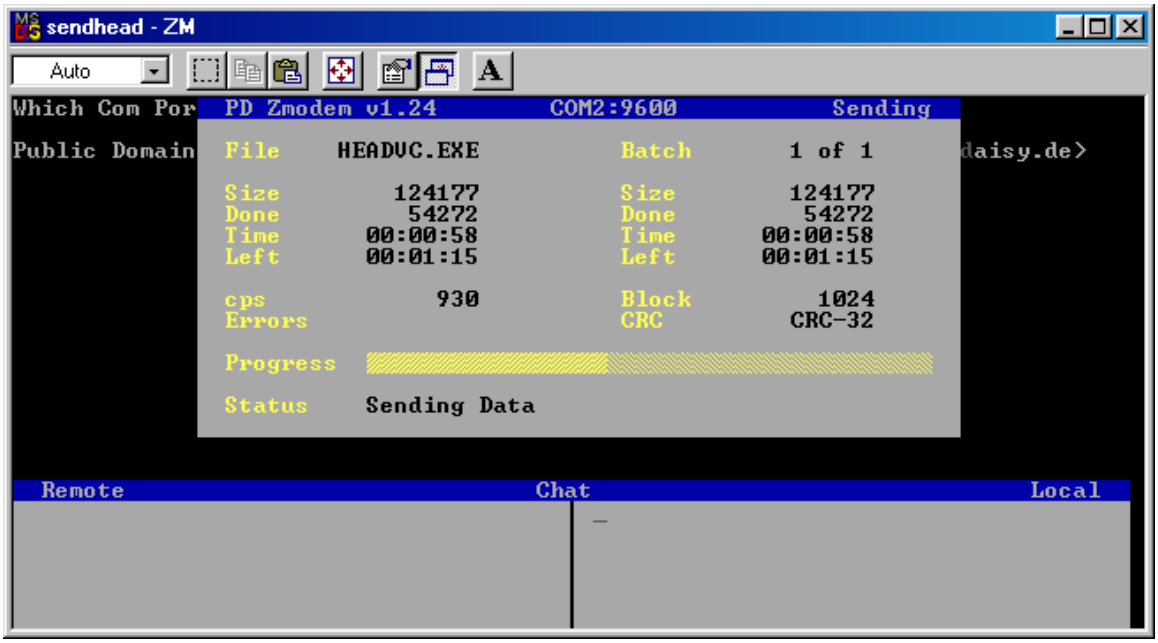
  MEASURE:>setupfile
  ^System: files

Prepare Computer

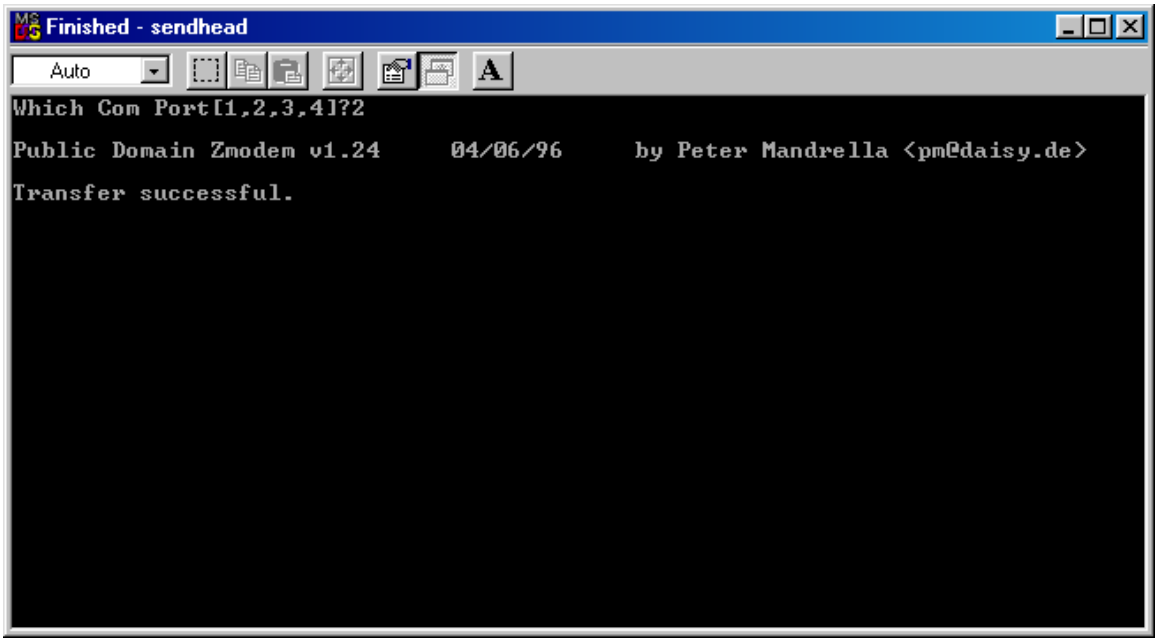
- The files named Headvc.exe, Sndhead.bat, and Zm.exe should be found in the "C:\Program Files\Lasercheck\6212A Controller Software" directory on your computer.
- Copy the new "Headvc.exe" file that you wish to transfer to that same directory.

Perform Transfer

- Push the "Esc" key on the keyboard attached to the control box. This will initiate the file transfer process.
- Double click on the Sndhead.bat file. A DOS prompt will appear asking "Which Com Port?". Type in the COM port on your computer that is connected to the serial null modem cable through to the control box.
- Transfer will begin. The PC will display a screen similar to the following DOS window with a bar graph indicating progress of the file transfer.



When the headvc.exe file has been transferred, the control box will return to the File System Window and the DOS window on the PC will indicate that the file(s) have been successfully transferred.



Finish

- Exit the DOS program.
- Power Cycle the control box (turn the main power on and off again).
- Watch for correct new version number of software to be displayed as control box executes.