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

6212B Manual Version 0.60

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Operations and Specification Manual for the

Lasercheck 6212B System

Manual Revision 0.60

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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	6 (Six) AA Batteries

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

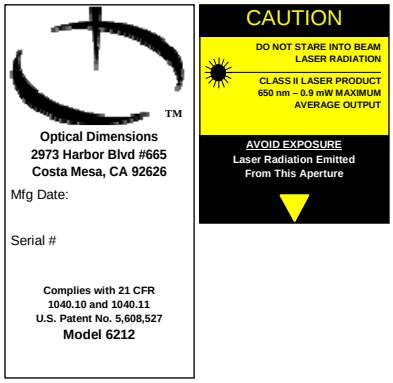
Lasercheck has been designed as a sealed and enclosed system. Voltages to operate the measurement sensor are low (0 to +5 Volts) to minimize shock hazard.

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, repeatable, 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 roughness is calculated for the illuminated area. This roughness value is then displayed on the LCD screen of the Lasercheck control unit. Measurements are saved in comma separated value text (.csv) file format. The Lasercheck download software can be used to transfer roughness values to a computer via RS232 connection in CSV text file format for reading into a variety of spreadsheet and analysis software packages.

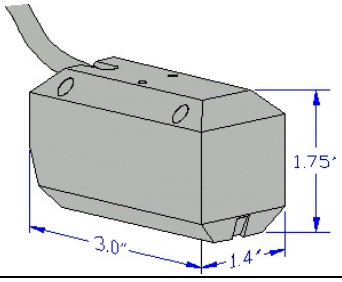
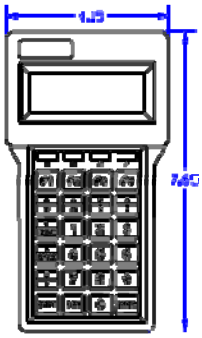
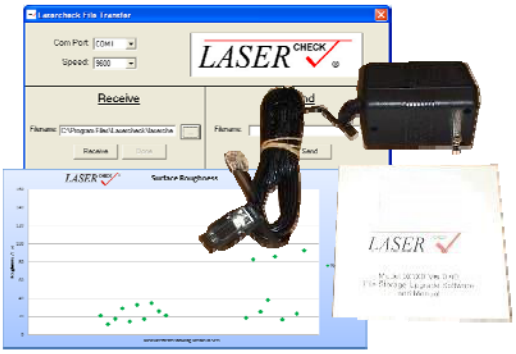
The model 6212 Lasercheck sensor has been designed for a nominal height standoff of 0.1 inch $\pm$ 0.01 inches (2.5 mm +/- 0.25 mm) from the measurement surface. Motions and vibrations within that tolerance range are monitored continuously and roughness measurements are corrected for vibrations using patented software algorithms during every measurement cycle to ensure accurate results.

The model 6212 Lasercheck has been designed for setting on a flat or cylindrical surface to measure. For other shaped surfaces, a custom footplate or fixture may be required to set the correct alignment and / or standoff distance. Please see the section on LASERCHECK ALIGNMENT PRINCIPLES AND PROCEDURES.

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 Sensor	
2. Standoff plate (0.100 inch / 2.5 mm)	Attached to measurement sensor for quick set up tests. Remove for non-contact system installation.
3. Lasercheck LCD Display and Control unit	
4. 110/ 220V Adaptor &RJ12 / Serial Interface Connecting Cable and Software (optional).	
5. Alignment Fixture for cylindrical surface measurement (optional). **6. Alignment Fixture for ID Bore surface measurement (optional).** **7. Lasercheck CD or USB Stick with Installation Program, Manual and Support Files**	

Basic Connections

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

The optional 110V / 220V Adaptor & RJ12 / Serial Interface Connecting Cable 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 RJ12 connector port for attaching one end of the cable. The second end has a 9 pin serial connector should be attached to an available serial port

on your host computer. Finally there is a 110V or 220V wall brick adaptor with the cabling that is plugged into any 110V or 220V outlet.

Note: During normal measurement operation this computer connection is not required. This is used for transferring measurement files to a host computer for storage or input into SPC, spreadsheet, or other data analysis software. The wall brick adaptor can be used for power to conserve batteries.

Physical Mounting

The model 6212 Lasercheck sensor head is designed for setting on flat surfaces. If surfaces are cylindrical, then optional alignment feet should be used. For surfaces with different geometry or for on-line automated applications, alignment fixturing must be used. An understanding of alignment procedures for Lasercheck is required for development of fixturing. Please read the section on Mounting/Fixturing Lasercheck in the appendix of this manual.

Orient the long axis of the head perpendicular to the dominant "lay" of the surface that you wish to measure. The long axis of the head determines the direction of measurement the same as direction of motion of a stylus on a stylus gage determines the direction of measurement.

Software Setup

The control unit has software that controls the instrument and 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 USB stick 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 or USB stick. This software is installed on a separate computer and uses the optional 110V / 220V Adaptor & RJ12 / Serial Interface Connecting Cable to communicate with the control unit.

To Install Lasercheck Software from Windows

1) Insert Lasercheck CD or USB stick into the computer.
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 6212B Setup.exe** or **Lasercheck 6212B File Storage Interface Setup.exe.**
6) Finally, click on **Finish** button.

Basic Operation

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. Following is an abbreviated description for setup and performance of a measurement sequence.

Control Unit and Displays

LCD Screen

The Lasercheck Sensor Control Box has a 4-line X 20-character LCD display. There are also 4 push button inputs to control measurements, data storage, and data transfer.

Push Buttons

The four push buttons on the top row of the controller are labeled as following (in the following order left to right) and are for:

- *MEAS* Take measurement at any time from main window
- *SAVE* Saves a measurement immediately after taken.
- *SEND* Sends saved measurement values to host PC (requires optional software and cable set)
- *SETUP* Used for calibration and data management.

There are 20 more alphanumeric pushbuttons on the controller. These buttons are used to enter values such as calibration numbers. A shift key is used to enter some characters. For example, pushing the shift key will allow entering the negative sign for negative numbers or entering a comma (,) instead of a period (.).

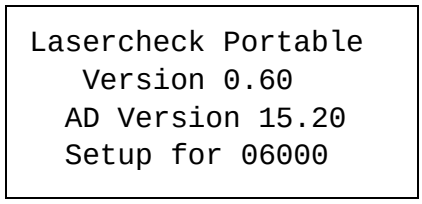
NOTE: It is important to push the shift key a second time to return to the “lower” characters on the split keypads. For example, once the shift key has been pushed, only a comma (,) can be entered. The period (.) character cannot be entered until the shift key is pushed a second time to return to the lower values on the split pushbuttons

Turning the System On

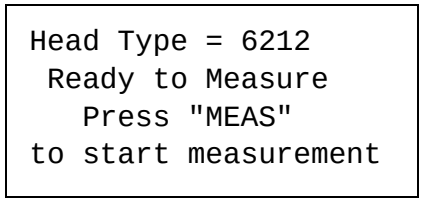
The control unit has an on/off power button on the side of the case. The control box also provides regulated DC power to the Lasercheck head. The control unit also powers the internal electronics, and automatically loads and executes software internal to the control unit.

Main Screen

When the main power switch is turned to the “on” position the internal electronics will turn on and software will begin executing. During this startup period you will see will see the words displayed on the LCD screen:



(Note: the most current version numbers of software will actually be displayed). Once the electronics and software are fully executed, you will see the LCD "Ready to Measure" screen:



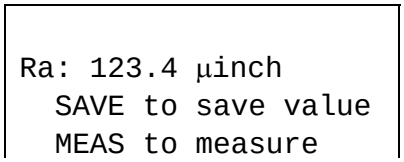
The system is now ready to perform measurements.

Performing Measurements

Once the system is powered, it is ready to begin providing roughness values. The following section covers the basics required to perform measurements.

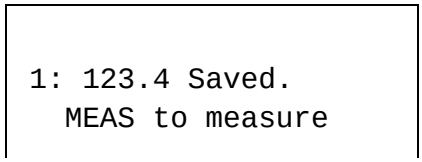
Measure Window with Results

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



Note: The display may read "Warning! Weak Signal". This indicates that the detector head has received very little light signal. A poorly aligned head often causes this. If the head is well aligned and the message persists it may indicate your surfaces are very low reflectivity or there may be a problem with the laser head. Contact our service assistance number provided earlier in the manual if this message persists.

The roughness of the surface that the measurement head is placed on is displayed in microinches of roughness. Pressing the "MEAS" button will perform another measurement. Individual measurements can be saved in the control box when the "SAVE" button is pushed. The following screen will be presented after the file is saved:



Optional Functions

Transferring Saved Measurements from the Lasercheck

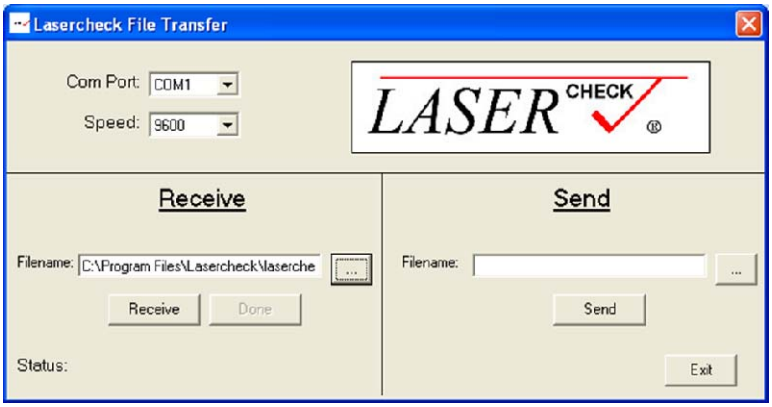
Measurements that are saved on the Lasercheck 6212B Portable controller can be stored and graphed on a computer with the optional cable and software package.

Receiving Measurement Data with the Windows Software

- Start the Lasercheck Data Download Software by clicking on icon in the Start Menu under “Programs / Lasercheck / Lasercheck File Transfer”.
- 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: 9600
  Filename: C:\Program Files\Lasercheck\yourname.csv

- Leave the filename in csv format so that it will work correctly with the included Excel spreadsheet for graphing the measurement data.



File Transfer Software Configured to Receive Saved Measurements

- Click the “Receive” button. Click "OK" if prompted regarding overwriting the file. Follow the directions below for sending the data from the Lasercheck Controller.

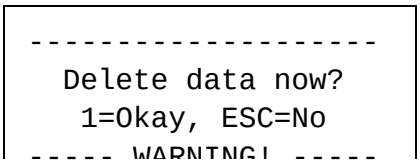
Sending Measurement Data from the Lasercheck Controller – The SEND Button

- From the keypad on the controller press the “SEND” button.
- The text data file begins immediately transmitting out the controllers COM port.
- When data transmit is complete a screen similar to the following is displayed:

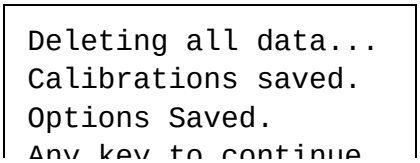
```
Send Done.
10 Lines sent.
Check file!
Press any Key
```

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. Check the received file before proceeding.

- Pushing any key on the controller will display the following:



- Pressing the “ESC” key will return you to the Lasercheck Setup Window. If the “1” key is pushed, all measured and saved data will be erased and the following screen will be displayed when this is completed:



- After data is deleted, press any key to continue. You will be returned to the main menu.

Reviewing the Lasercheck Data Measurements in Excel Spreadsheet

The saved measurement data is in csv file format which is a native Excel and compatible with many text, display, and commercial SPC and related business software programs. To view the data file, double click on it. Excel will be launched and you will see a data file similar to the example below.

RECEIVE_NAME=	YOUR DATA SET		
FILENAME=			
RA_UNITS=	MICROINCHES		
RA_THRESHOLD=	-1		
CAL1=	-11.9	14.81	0
CAL2=	0	3.9	2.5
CAL3=	1.1	-6.44	26.8
Date Time	Roughness		
12:07:00 AM	20.97		
12:08:00 AM	11.57		
12:08:00 AM	17.76		
12:08:00 AM	29.03		
12:08:00 AM	14.61		
12:08:00 AM	33.01		
12:08:00 AM	17.38		
12:08:00 AM	34.92		
12:09:00 AM	25.86		
12:09:00 AM	21.09		
RECEIVE_NAME=	6212GD		
FILENAME=			
RA_UNITS=	MICROINCHES		
RA_THRESHOLD=	-1		
CAL1=	-11.9	14.81	0
CAL2=	0	3.9	2.5
CAL3=	1.1	-6.44	26.8
Date Time	Roughness		
12:09:00 AM	107.49		
12:09:00 AM	18.72		
12:09:00 AM	82.65		
12:09:00 AM	25.32		
12:10:00 AM	38.26		
12:10:00 AM	85.91		
12:10:00 AM	16.62		
12:10:00 AM	139.13		
12:10:00 AM	23.19		
12:10:00 AM	92.82		
38 lines transmitted.			
EOF			

The top rows are header information containing details about the measurement such as setup file, measurement units and calibration values. Roughness measurement values are provided in 2 columns. Column 1 contains time / date stamp recorded by the controller firmware. Column 2 contains the measured and saved roughness value. A break in data is inserted whenever the Lasercheck controller is power cycled.

Important Time/Date Stamp Information

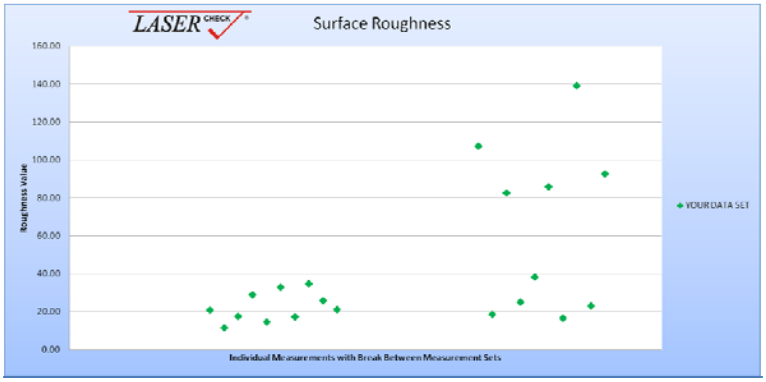
Time and date is set at the factory. Electronics require installed batteries to maintain the time/date setting. When changing batteries, the time/date should be re-set. See the “Appendix D Firmware Configuration and Software Upgrade Instructions: at the end of this manual for instructions on how to perform this function.

Time and date setting will be maintained when the system is powered off with good batteries installed. If the “powersave” function in the software and electronics automatically turn the system off the time and date setting will not be maintained. See the “Advanced Functions” section later in this manual for instructions on activating and de-activating the “powersave” battery saving function.

Graphing the Lasercheck Data Measurements in Excel Spreadsheet

The saved measurement data can now be graphed for visual display in the included Excel spreadsheet.

- Open "Lasercheck Portable Data Graph.xls".
- If prompted about "Enabling Macros" select the "Enable Macros" button.
- Once the program is open, push the "Update Data" button. It will prompt you to select your saved csv file. The graph will be automatically updated with your new file values.
- Vertical axis represents roughness readings, the horizontal axis provides each measurement with an obvious break between each measurement set

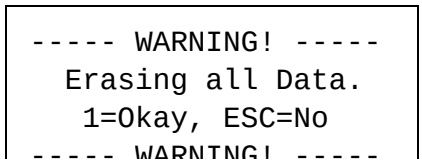


Saved Measurements graphed in Lasercheck File Transfer Software

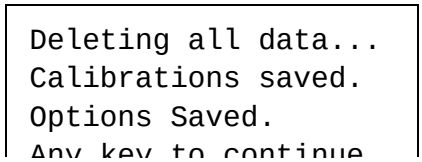
Deleting Measurement Data from the Lasercheck Controller

If the data stored on the Lasercheck Controller was not deleted after sending to the computer, it can be deleted at any time to free up memory and so measurements are not downloaded with additional measurements later.

- Push the "SETUP" button on the controller.
- Then push "2" to Delete Data. A warning screen will appear:



- Pressing the “ESC” key will return you to the Lasercheck Setup Window. If the “1” key is pushed, all measured and saved data will be erased. The following screen will be displayed when this is completed:



- After data is deleted, press any key to continue.
- Push the "ESC button to exit". This will return you to the "Ready to Measure" screen.

Advanced Functions

Lasercheck Setup Window

Pushing the “SETUP” button will display the following window:

```
--Lasercheck Setup--
  1 = Setup/Calibrate
  2 = Delete Data
SETUP=next  ESC=exit
```

Pressing ESC will return you to the Lasercheck Ready to Measure Screen.

Pressing “SETUP" again will cycle through the other setup screens.

```
--Lasercheck Setup--
  3 = Head Setup
  4 = Options
SETUP=next  ESC=exit
```

```
--Lasercheck Setup--
  5 = Version Info
  6 = Diagnostics
SETUP=next  ESC=exit
```

```
--Lasercheck Setup--
  7 = head type

SETUP=next  ESC=exit
```

Pushing the “ESC” key will send you to the previous menu. You can continue pressing this key until you reach the “Ready to Measure" screen.

Setup 1 – Setup/Calibration

When the “1” key (Setup/Calibrate) is pushed from the Lasercheck Setup Window will display the following window:

```
---Setup/Calibrate---
   1 = Review
   2 = Change
SETUP=next  ESC=exit
```

1 = Review Calibrations

Pushing the “1” key will allow you to scroll through calibration values that are in use with the current active calibration file. A series of screens like the example below will be displayed as you scroll through.

```
Cal1 A1:   -11.9
Cal1 B1:   14.81
Cal1 C1:   0.00
Any key to continue
```

After scrolling through all the “Review” screens you will be returned to the “Setup/Calibrate” window.

2 = Change Calibrations

Pushing the “2” key from this window will display the following window.

```
--------Change-------
1 = Choose Cal/Setup
2 = Add New Cal/Setup
 SETUP=next  ESC=exit
```

1= Choose Cal/Setup

When the “1” key is pushed the following window will be displayed:

```
--Choose Cal/Setup--
Cal: 1
Name: 8826GD
 SETUP=next  ESC=exit
```

Up to 9 independent calibrations can be stored on the controller. By pushing “SETUP” you can scroll through Cal 1 through Cal 9. The location number and name of the calibration will be displayed. Pushing “ESC” will activate the calibration displayed on that window.

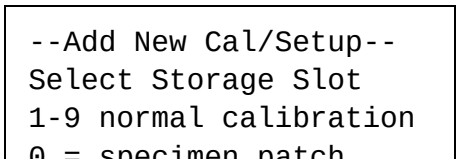
Note: When the system is powered off, it automatically reverts back to the calibration in location 1 when it is rebooted.

2= Add New Cal/Setup

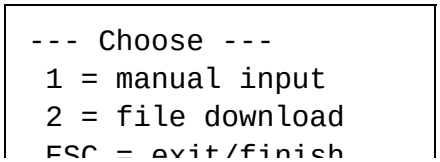
When adding or changing calibrations all measurements saved in memory are erased when storing the new calibration values. When the “2” key is pushed the following window will be window.

```
----- WARNING! -----
Will Erase all Data.
   1=Okay, ESC=No
----- WARNING! -----
```

This window is warning you that you will lose any stored measurements. This is important if you have the optional serial cable for downloading stored measurements. Pushing the “1” key from this window will display the following window.

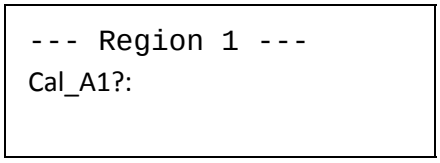


Select the calibration number (1 to 9) that you wish to have the Setup/Calibration file stored in. Once a location is selected the following window is displayed: *Note: location 0 is reserved and cannot be overwritten.*



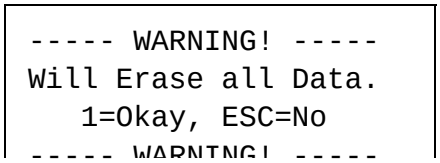
1 = Manual Input Setup File Calibration Values

Press the "1" key for "manual input" of calibration setup file values. When you push the "1" key the following screen will appear:

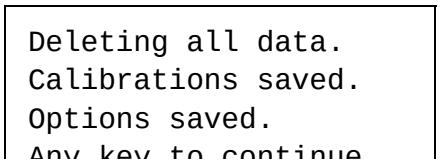


Enter the value of Cal_A1 from the "Manual Input" Calibration Setup File created by the Setup File and Calibration Template.xls spreadsheet then press the enter button.

You will then be prompted to enter Cal_A1 from the "Manual Input" Calibration Setup File. Enter that value and continue entering values from the setup file as prompted until the last value (Threshold) has been entered. You will be periodically prompted to save your inputs or repeat some of them as you go through so that you can ensure the inputs have been done correctly. The final input will be Measurement units. After selecting this and saving your entries the following screen will be displayed:



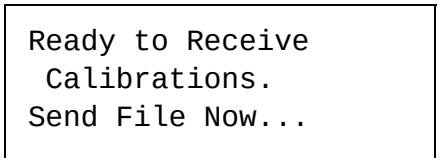
Pushing "ESC" will allow you to discard all entries made. Pushing "1' will display the following window.



By pushing any key on the control box, you can return to the calibration screen and pushing the "ESC" key a few times will return you to the measure menu.

2 = File Download of Setup File Calibration Values

Press the "2" key for "file download" of calibration setup file values. This is only available with the optional Computer File Storage Interface. When you push the "2" key the following screen will appear:

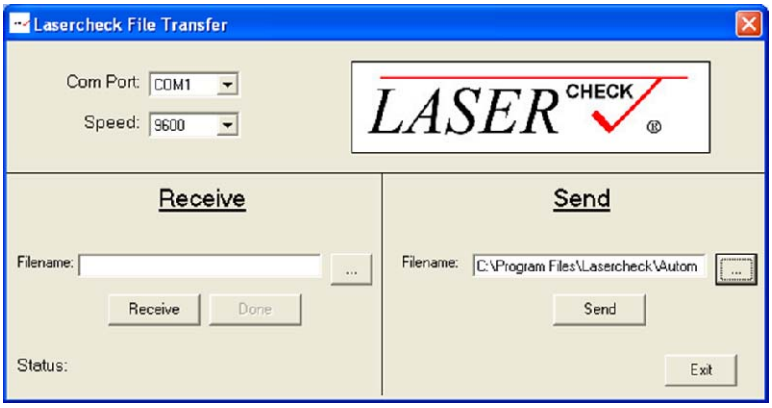


Sending Calibration / Setup Data with the Windows Software

- Start the Lasercheck Data Download Software by clicking on icon in the Start Menu under "Programs / Lasercheck / Lasercheck File Transfer".
- 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:	9600
Filename:	

- In the Send "Filename:" input box find and select 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.



File Transfer Software Configured to Send Calibration / Setup File

- Click the "Send" button. The "Status" indication in the windows software will indicate "Finished Sending". The control box will display:

```
Success!
New Calibration Set
Any key to save.
```

- By pushing any key on the control box, the following screen will be displayed:

```
Deleting all data.
Calibrations saved.
Options saved.
Any key to continue
```

- By pushing any key on the control box, you can return to the calibration screen and pushing the "ESC" key a few times will return you to the measure menu.

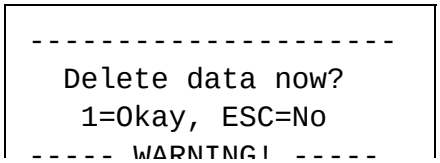
3= Measurement Units

Pushing the "3" key will allow you to select or change measurement units that will be displayed with the currently active calibration/setup file.

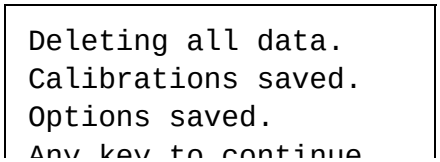
```
--Measurement Units—
 1 = Microinches
 2 = Microns
 3 = Nanometers
```

Setup 2 – Delete Data

This option deletes saved measurement data stored on the control unit. It does not delete any setup, configuration, or calibration values or files on the controller. When the “2” key (Delete Data) is pushed from the Lasercheck Setup Window will display the following screen:



Pushing “ESC” will return to the main startup menu. Pushing “1’ will display the following window.



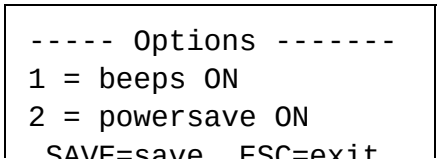
By pushing any key on the control box, you will return to the previous setup menu and all measurement data files will have been deleted from the controller.

Setup 3 – Head Setup

This option is for factory configuration of the Lasercheck and should not be changed by the user.

Setup 4 – Options

Pushing the 4 button (Options) will display the following window:



1 = beeps ON / OFF

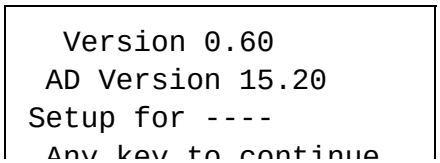
Pushing the “1” key will toggle this option between on and off. When on, an audible beep sound will be heard whenever a key is pushed

2 = powersave ON / OFF

Pushing the “2” key will toggle this option between on and off. When powersave is "ON", Lasercheck will power off after 5 minutes of inactivity to preserve battery power.

Setup 5 – Version Info

Pushing the 5 button (Version Info) will display the following window:



This screen displays version of controller and display software as well as version of embedded firmware (AD).

Setup 6 – Diagnostics

This option provides diagnostic values that can be used for a variety of purposes. It is used with the file storage software upgrade. A description of its use in checking alignment and focus of the sensor is described in the Alignment Appendix in the back of this manual.

Setup 7 – Head Type

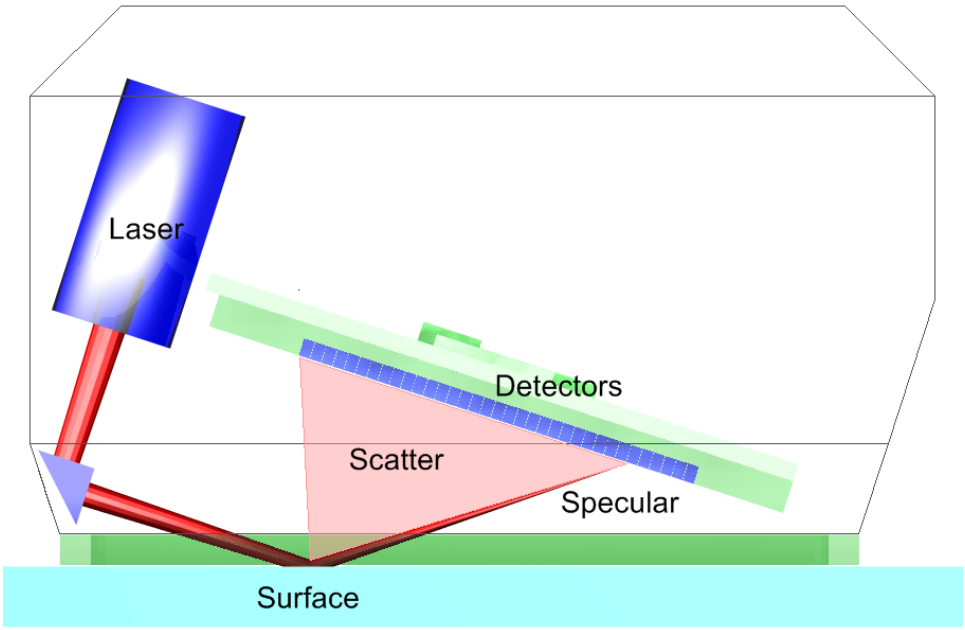
This option provides ability to change model of Lasercheck used with this controller. This is factory set and should not be changed unless instructed to do so by factory service personnel.

Appendix A – Lasercheck Alignment Principles and Procedures

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

How Does Lasercheck Work?

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



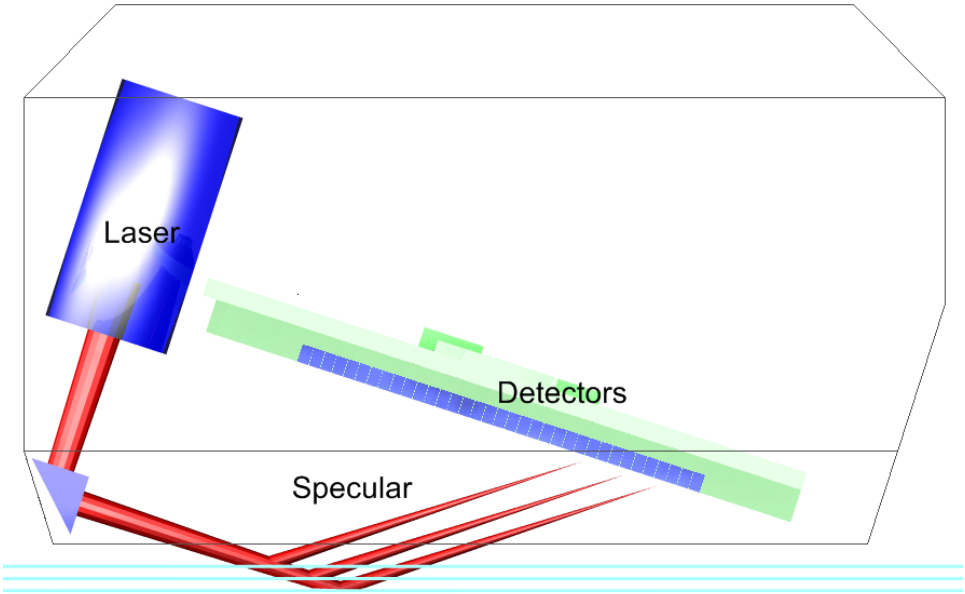
Schematic Diagram of Lasercheck Instrument

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

Alignment

Vertical

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



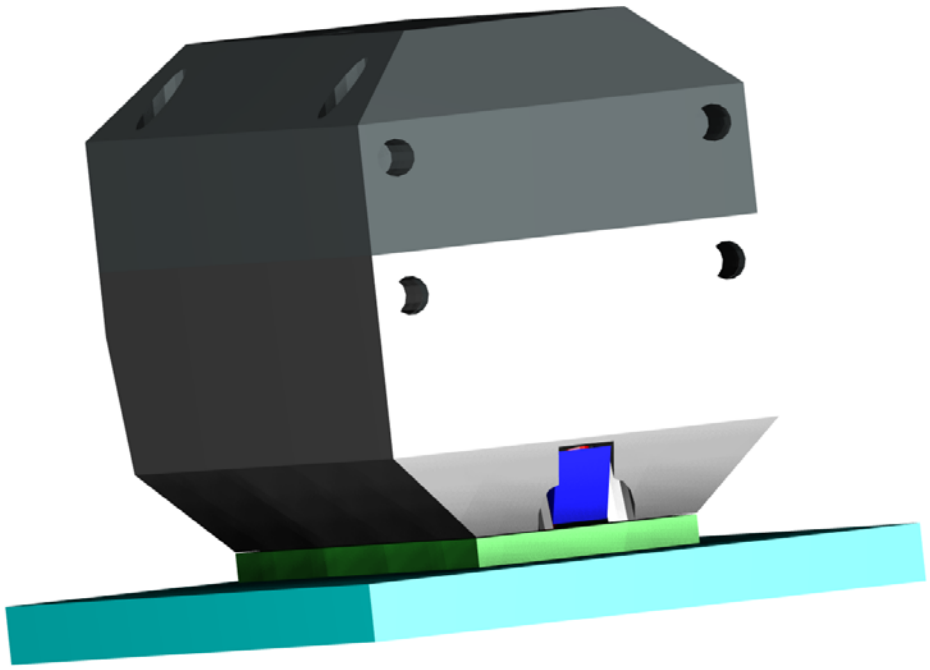
Three Surface Locations – Too Close, Correct, Too Far

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

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

Vertical Alignment Base plate

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

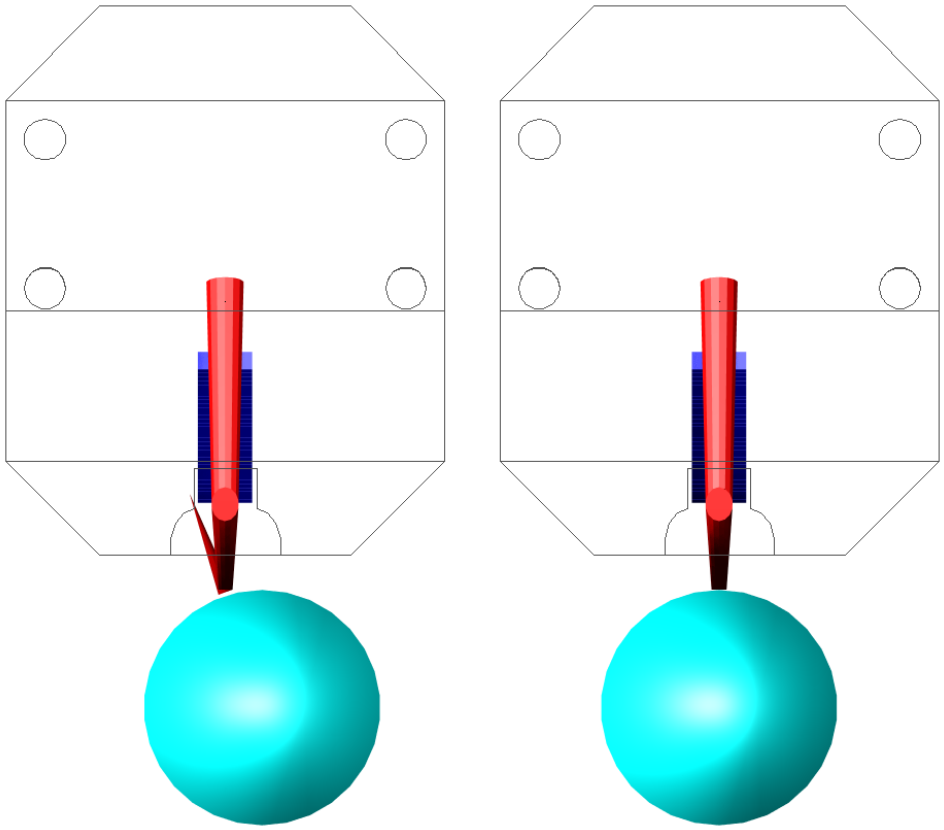


6212 on Flat Surface with 0.10 inch Base Plate to Set Vertical Alignment

Horizontal

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

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

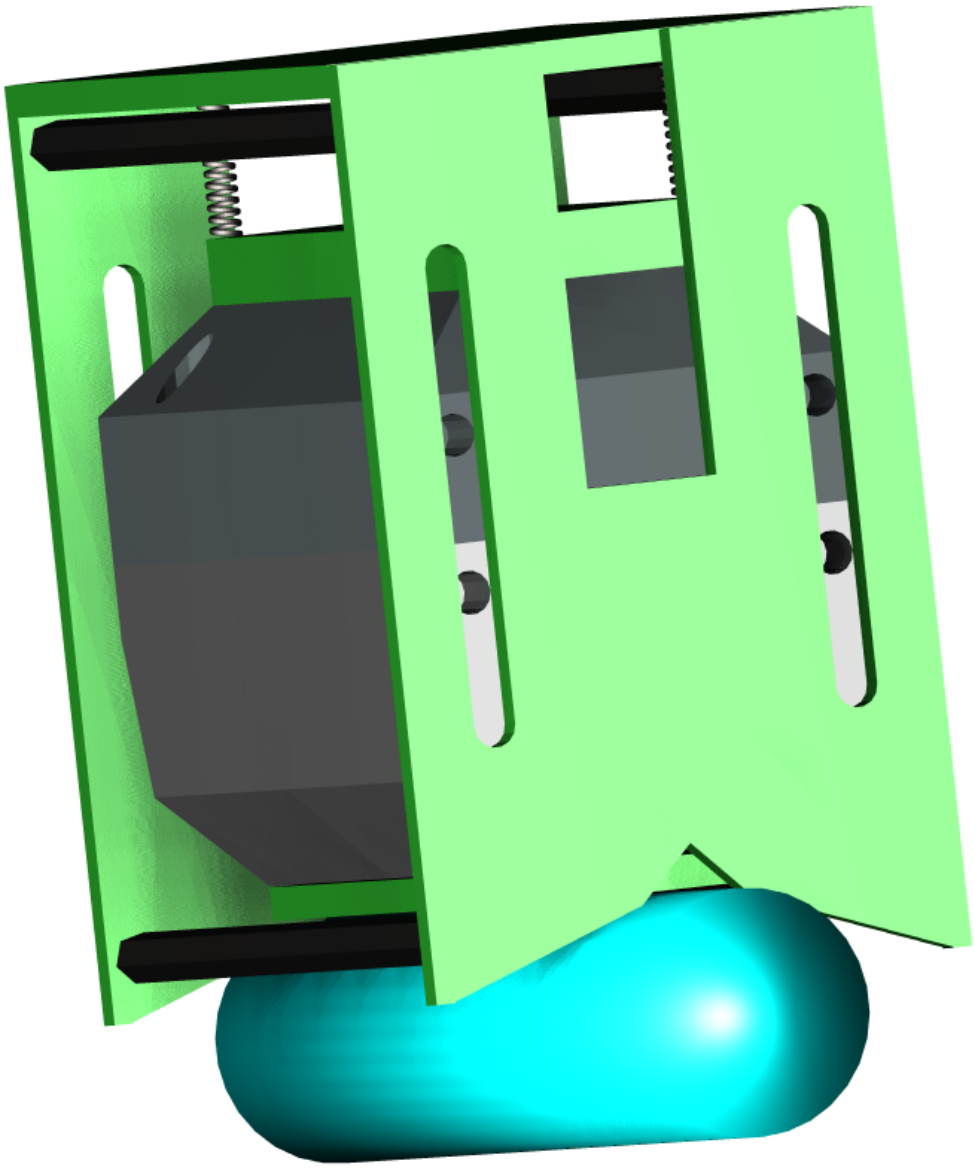


6212 End View showing misaligned and aligned cylindrical surfaces

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

Cylindrical Surface Measurement Alignment Fixture

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

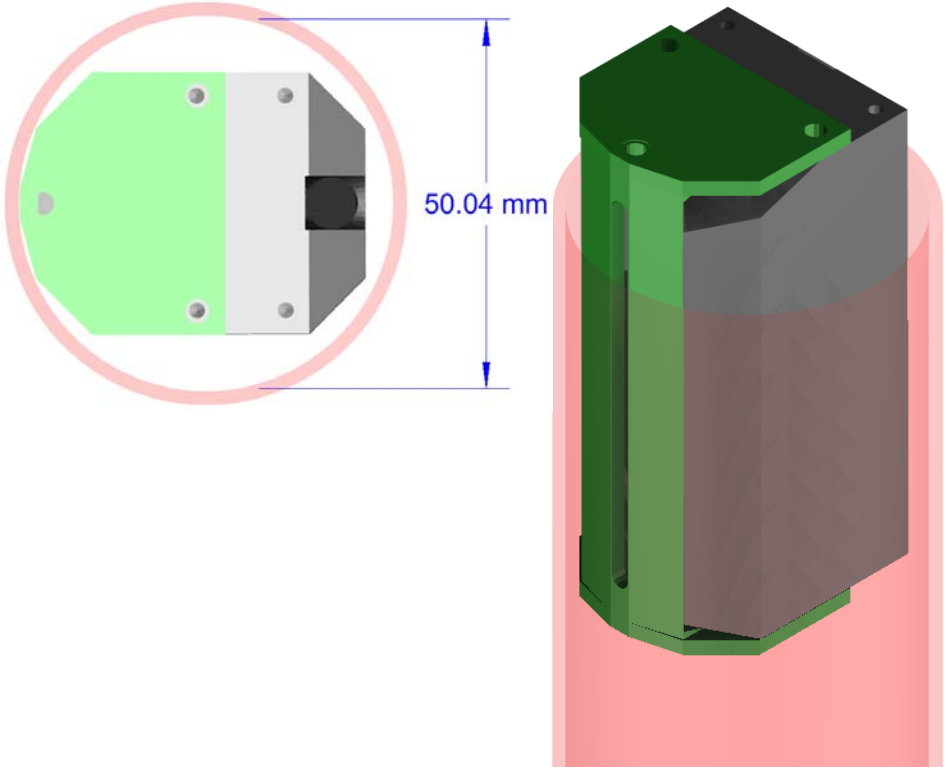


6212 on Cylinder Surface with Alignment Fixture Setting Correct Horizontal Position

Bore ID Surface Measurement Alignment Fixture

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

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



6212 in Cylinder Bore with Alignment Fixture End and Perspective View

Directional / Rotational

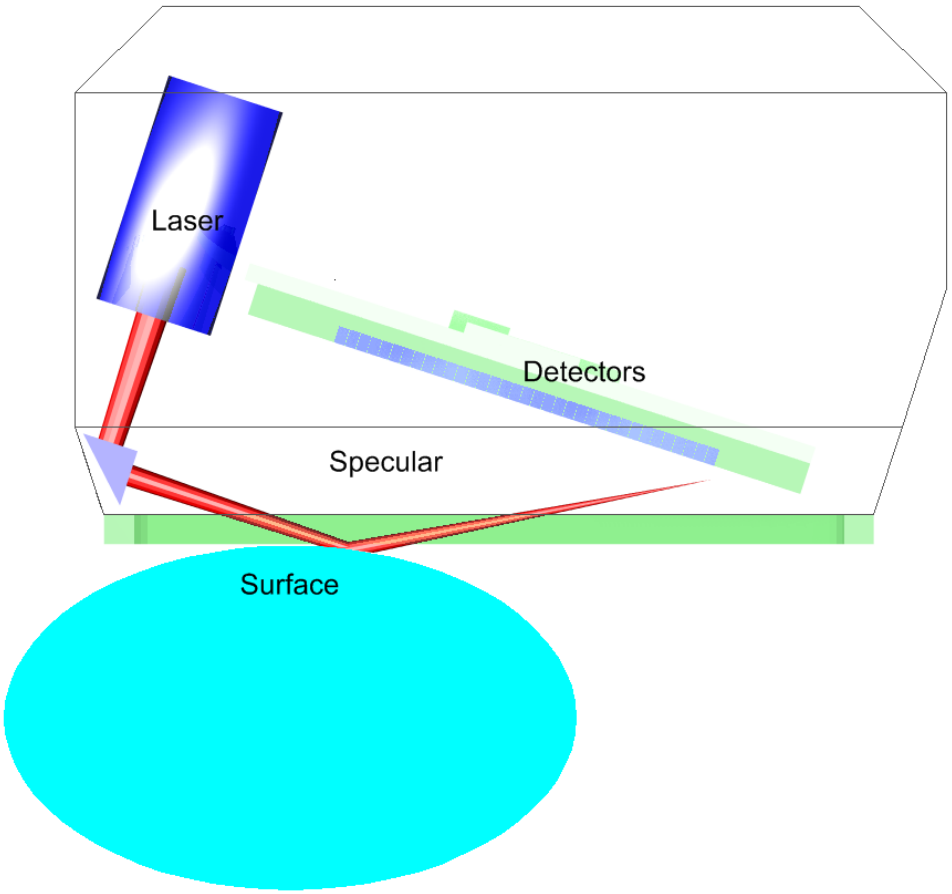
Many machined surfaces have a dominant direction of roughness. The length of the Lasercheck head must be oriented perpendicular to the direction of roughness so that the scatter strikes the detectors, which are oriented in a line down the middle of the head. Well-designed mounting hardware will ensure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

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

Custom Shapes and Fixturing

3-Dimensional Shapes

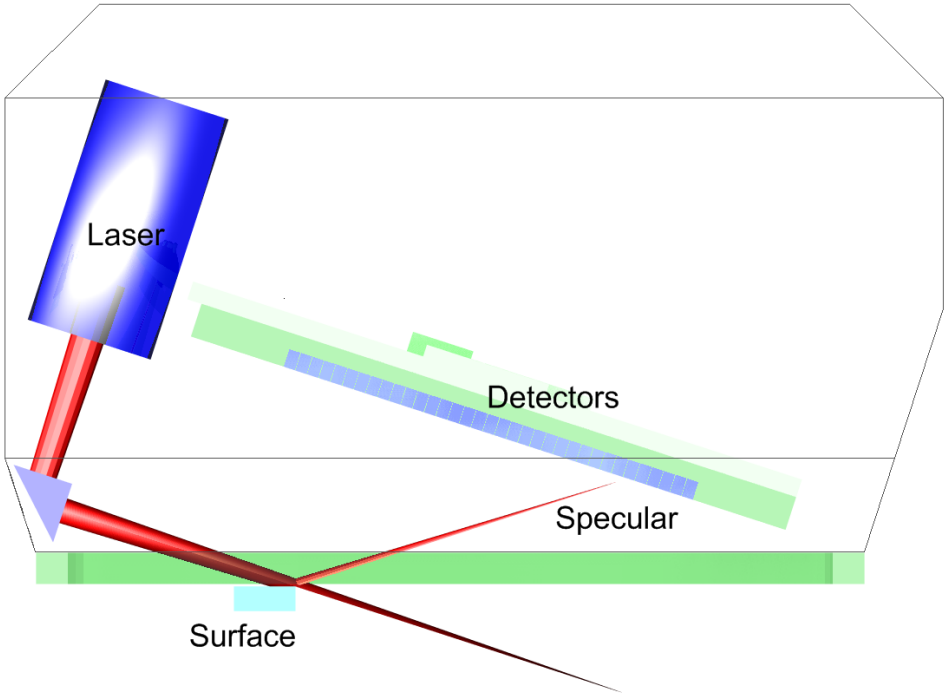
3-Dimensional curvatures and shapes cause Lasercheck to become easily misaligned either in the vertical or horizontal axis. Fixturing must be designed to carefully and repeatably control positioning in both axes so that the specular reflected beam strikes in the middle of the first 11 detectors and the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



6212 on “3-D” Curved Surfaces showing misalignment

Small Surfaces

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



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

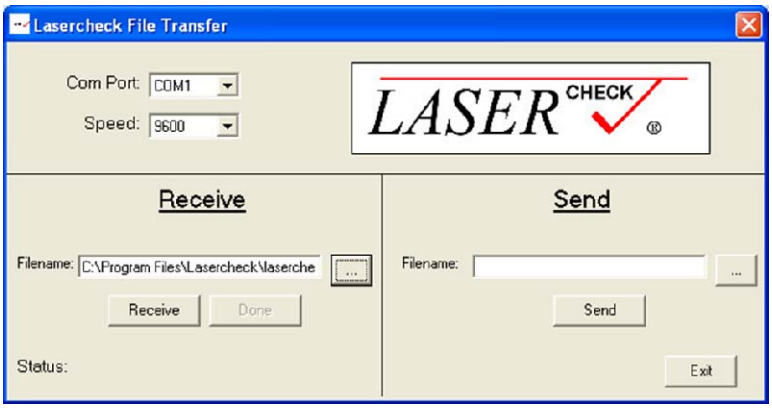
Checking Alignment Using the Lasercheck Diagnostics Option

You can check alignment of a custom fixture or even the standard Lasercheck horizontal and vertical alignment fixtures on flat or cylindrical parts.

1) Prepare Windows Software to Receive Alignment Measurement

- Start the Lasercheck Data Download Software by clicking on icon in the Start Menu under “Programs / Lasercheck / Lasercheck File Transfer”.
- 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: 9600
Filename: C:\Program Files\Lasercheck\laseralign.txt



File Transfer Software Configured to Receive Alignment

Note: Leave the filename (laseralign.txt) so that it will work correctly with the included Excel spreadsheet for graphing the alignment data.

- Click the “Receive” button. Click "OK" if prompted regarding overwriting the file. Follow the directions below for sending the data from the Lasercheck Controller.

2) Prepare Sample and Fixture

Set the measurement head on the part (or put the part on the fixture or measurement head)

3) Prepare Control Unit and Perform Measurement

Pushing the “6” key from the Lasercheck Setup Window displays the following window:

```
Enter Sensor Head
Serial Number:
```

No number has to be entered to create the alignment file. Push the enter key. The following window will be displayed:

```
Enter Sensor Head
Serial Number:
Information Sent.
Any key to continue
```

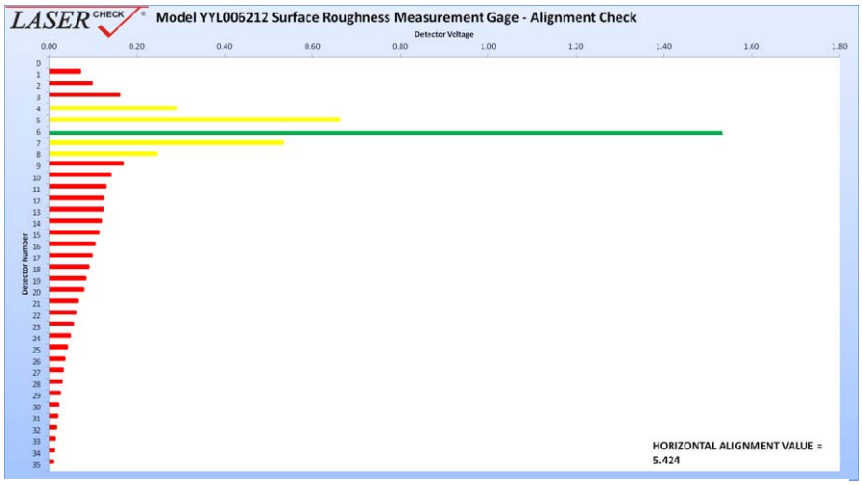
The receive operation in the windows software should finish automatically when all of the data is received from the controller. The status message in the windows software will show this by displaying “Finished Receiving”. If it does not, click the “Done” button in the windows software to finish and close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

Pushing any key will return you to the Lasercheck Setup Window. Pushing the “ESC” key will return you to the “Ready to Measure” window.

4) Graphing the Lasercheck Data Measurements in Excel Spreadsheet

The alignment measurement can now be graphed for visual display in the included Excel spreadsheet.

- Open "Model 6212 Lasercheck Alignment Check.xls" by clicking on the icon in the Start Menu under "Start/Programs/Lasercheck/Model 6212 Lasercheck Alignment Check". This will start Microsoft Excel and open the graph.
- If prompted about "Enabling Macros" select the "Enable Macros" button. (Note: macros have to be enabled for the graph to work automatically.)
- Once the program is open, push the "Insert Lasercheck Values" button. It will import and graph all of the values from the "laseralign.txt" file.



Typical Spreadsheet Alignment Curve Showing Specular on Detector 6

5) Determining Alignment using the Lasercheck Alignment Graph Excel Spreadsheet

Vertical Alignment

The Vertical portion of the alignment graph is a horizontal bar graph representing relative voltages from all of the 35 detectors. The largest bar on the graph is the specular reflection. There are 5 detectors in the center of the first eight that are color coded **yellow** and **green**. Ideally the fixture should be positioned so that the large specular reading is on the **green** detector 6. Acceptable performance will be achieved if the large specular reading is on one of the **yellow** detectors 4, 5, or 7, 8. Note in the example graph above that specular is centered on the **green** detector 6, which is perfect alignment. If the large specular reading is on one of the **yellow** detectors it will perform acceptably, but if it is on one of the **red** detectors, Lasercheck will not perform accurately.

If the largest reading is below the **green** detector 6 on the graph, then the head/fixture combination should be adjusted so that the surface is moved further away from the head. If the largest reading is above the green detector 6 on the graph, then the head/fixture combination should be adjusted so that the surface is moved closer to the head.

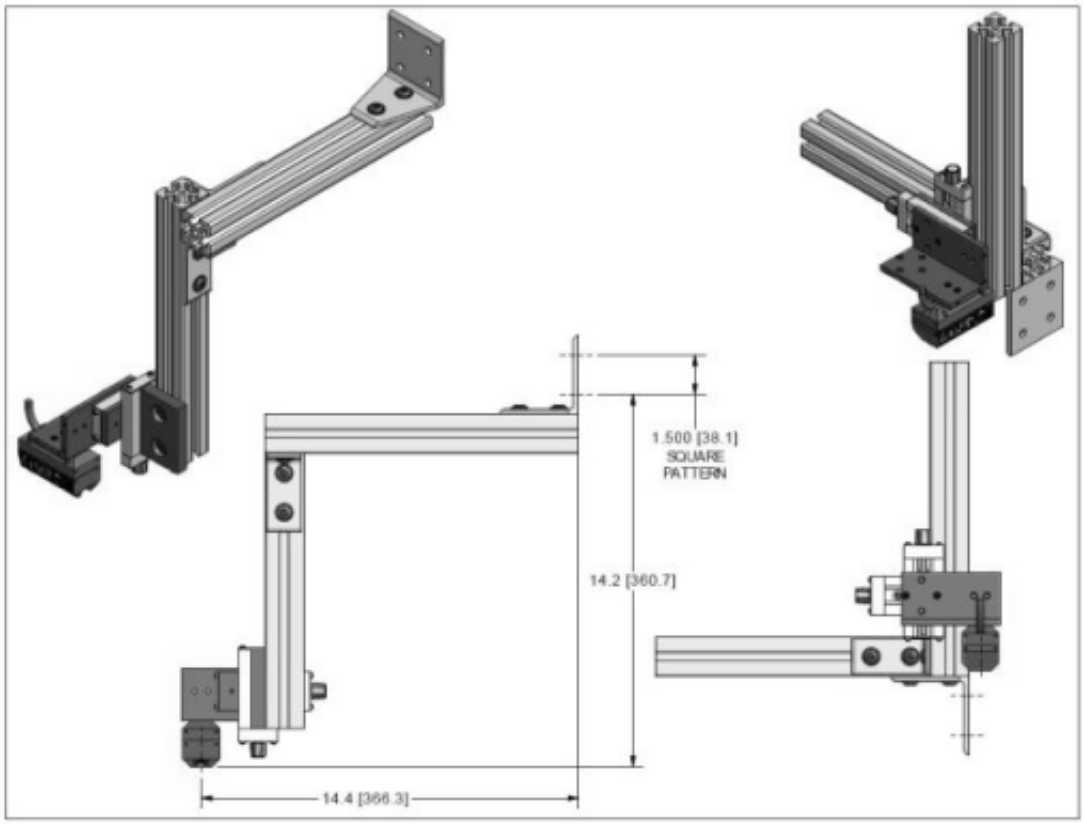
Horizontal Alignment

The Horizontal label of the alignment graph is a number shown in the lower portion of the graph labeled "HORIZONTAL ALIGNMENT VALUE = 12345". There is no "perfect" number for this value. It depends on material, size of surface, and many other factors. The idea is to take several measurements while incrementally adjusting horizontal position with fixturing to determine the highest possible value for that part. Once that highest value has been achieved, then the fixture should be secured at that location.

Appendix B – Mounting/Fixturing Lasercheck

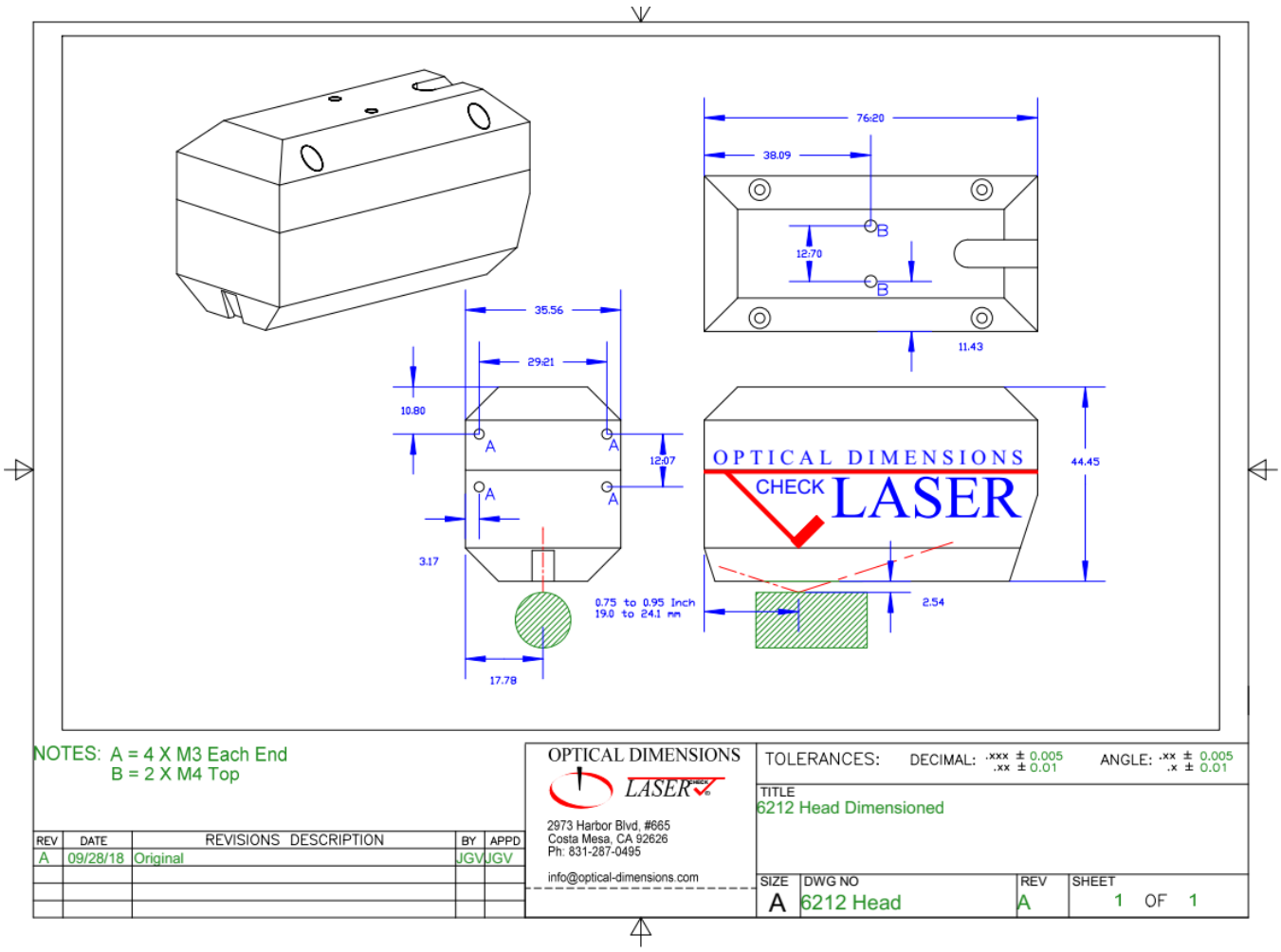
There are drilled and tapped holes on the Lasercheck sensor that can be used for mounting and installing the Lasercheck in an automated inspection application. The sensor should be positioned at a location where surface will be at the correct vertical and horizontal position relative to the gage sensor.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

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



706200 Adjustable XZ Mount

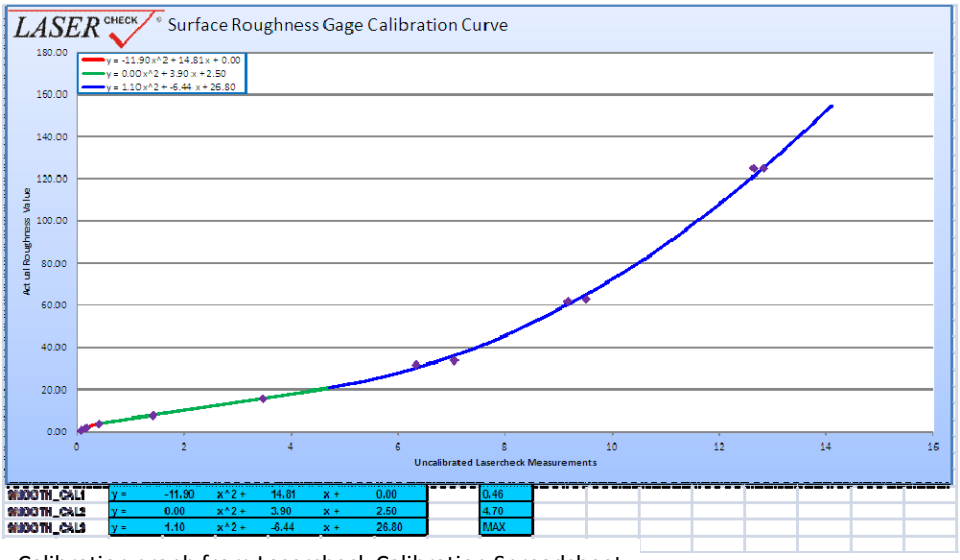
Existing mounting holes on Lasercheck sensor



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

Appendix C Calibration Process

Lasercheck is shipped calibrated to traceable standards for measurement of ground, sanded, polished surfaces. Lasercheck can be calibrated for special surface finishing processes by the user. An Excel spreadsheet calibration tool is provided to assist in the calibration process and generate a user specific calibration file.



Calibration graph from Lasercheck Calibration Spreadsheet

The calibration process involves:

1) Perform and save measurements on calibration test surfaces with the Lasercheck.
2) After measurements are performed, insert test results and known values into Setup File and Calibration Template.xls spreadsheet.
3) Follow the 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).
4) The setup file, which contains the new calibration, display units and operation modes, are then loaded onto the Lasercheck controller.

Lasercheck is calibrated based on specific finishing operations. It requires unique calibrations as the finishing operation is changed. As an example, a different calibration will be required to measure a surface that has been ground with a dominant roughness direction than a surface that has been sand-blasted with no dominant roughness direction. Once a calibration is performed, Lasercheck never requires re-calibration for a given process – it never changes.

Performing Calibration Measurements

Statistics and Accuracy

More calibration surfaces and measurements provide better statistics and better calibration, especially if a wide range of roughness is used in the calibration.

Several stylus gage measurements should be taken 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

Actual values should then be entered in the “Stylus Ra Value” column of the “Step 1 Enter Ra Values” page of the spreadsheet.

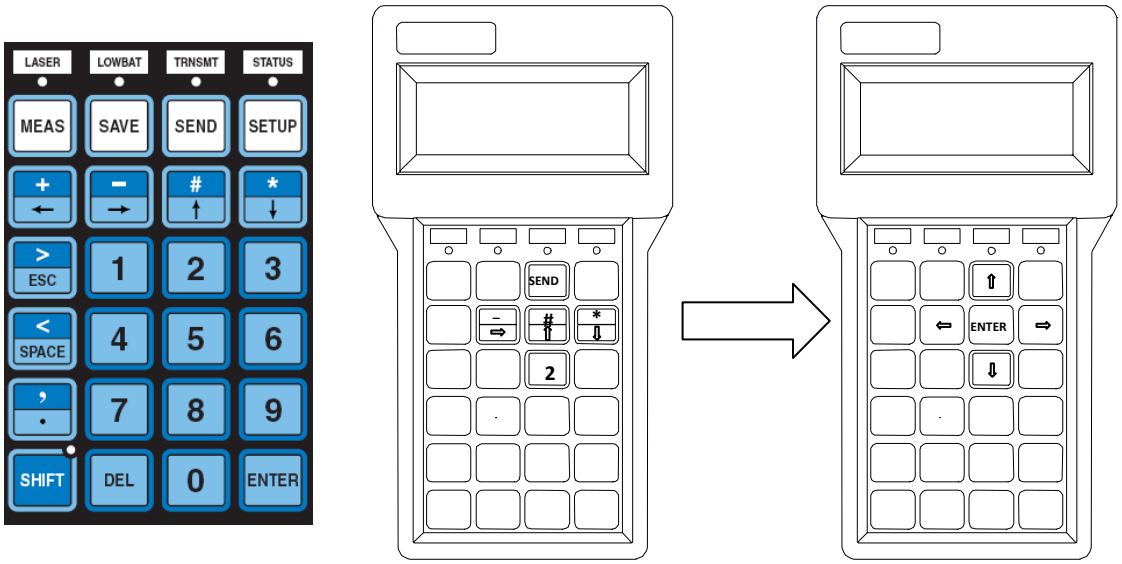
Appendix D Firmware Configuration and Software Upgrade Instructions

Control Keys

Use the following 9 keys in upper right corner of the controller keypad:

SEND = SCROLL UP
2 = SCROLL DOWN
↓ = SCROLL RIGHT
→ = SCROLL LEFT
↑ = ENTER

Note that when scrolling, the asterisk (*) indicates the currently selected menu item. When you scroll to an item, pushing ENTER ("↑") will change that item.

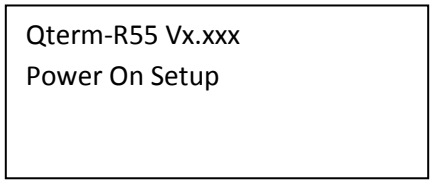


Control Key "Map" for Setting up and Programming

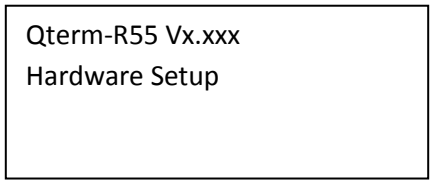
Hardware Setup Menu

Note: Steps 2 through 5 below must be done in fairly rapid succession

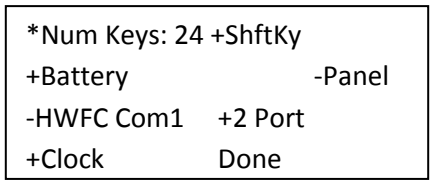
1) While pressing any 3 keys on controller keypad, turn controller power on.
2) You will see the following screen briefly displayed



3) When you see this menu, quickly release the keys and push the "ENTER" ("↑") key 2 or 3 times.
4) You will see the following screen briefly displayed



5) The following "Hardware Setup" screen will be displayed:



6) Using the SCROLL and ENTER keys, match settings to example screen above.
7) When finished, scroll to "Done" and push the "ENTER" ("↑").
8) This will present the Power On Setup Menu (POST).

Power On Setup Menu

1) When finished with the “Hardware Setup Menu” this “Power On Setup” screen should be displayed.

```
SETUP Vx.xxx
*System          Clock
 Com Setup       Defaults
 Download        Done
```

   a. If not, turn off power on the controller.
   b. While pressing any 3 keys on controller keypad, turn controller power on.
   c. You will see the following screen briefly displayed

```
Qterm-R55 Vx.xxx
Power On Setup
```

2) After you see this menu, release the keys.
3) The “Power On Setup” screen should be displayed:

```
SETUP Vx.xxx
*System          Clock
 Com Setup       Defaults
 Download        Done
```

Clock Settings

1) Scroll to “Clock”, and press “ENTER” (“↑”)
2) Set current date and time using SCROLL and ENTER keys

Com Port Settings

1) Scroll down to “Com Setup”, and press “ENTER” (“↑”).
2) The following “Com Settings” screen will be displayed:

```
        Com Settings
*Primary Port
 Secondary Port
 Back
```

Primary Port

1) Scroll down to “Primary Port”, and press “ENTER” (“↑”).
2) The following screen will be displayed:

*Baud Rate:	9600
Format:	8n1
FlowCntrl	NONE
Back/Save	

3) Set the Primary Port screen to match the settings in the screen above.
4) Scroll down to “Back/Save” in the “Com Settings” screen.
5) Push “ENTER” (“↑”) to back up to the Com Settings screen.

Secondary Port

1) Scroll down to “Secondary Port”, and press “ENTER” (“↑”).

*Baud Rate:	9600
Format:	8n1
FlowCntrl	NONE
Back/Save	

2) Set the Secondary Port screen to match the settings in the screen above.

1) Once both COM ports are set, scroll down to “Back/Save” in the “Com Settings” screen
2) Push “ENTER” (“↑”) to back up to the original “SETUP” screen.

Saving Hardware and Power On Setup Menu Settings

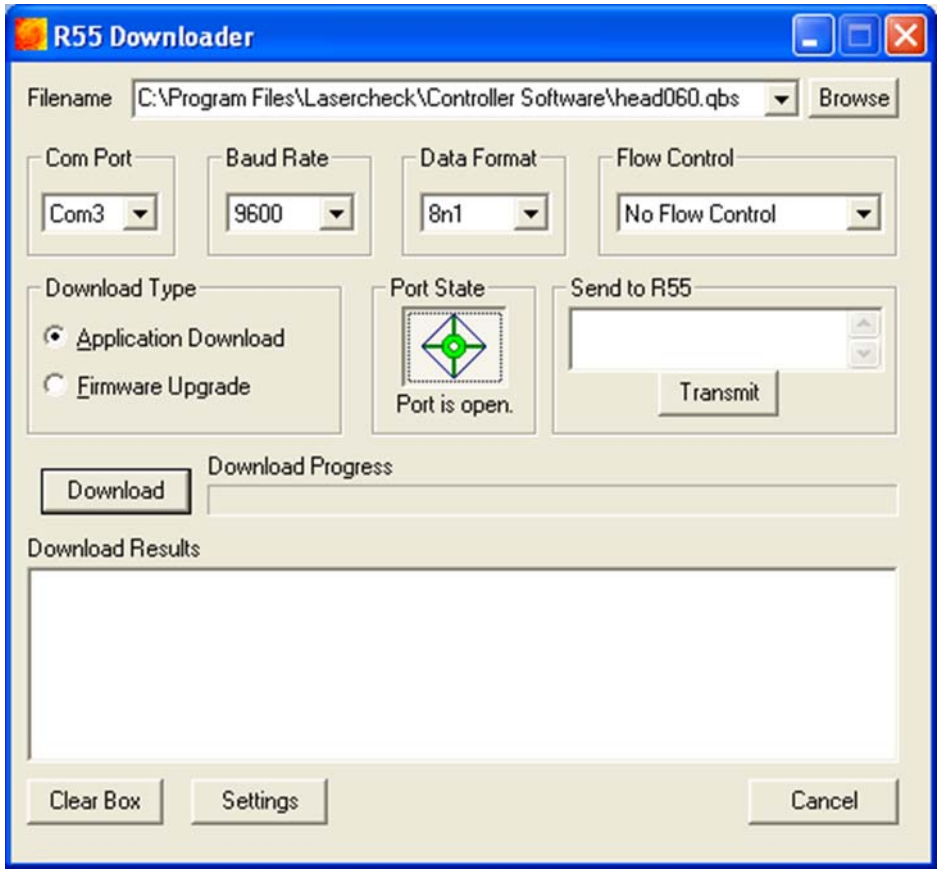
1) Once in “Power On Setup” main screen, scroll down to “Done”
2) Press “ENTER” (“↑”)
3) The system will save all new settings and reboot into a blank screen.

Upgrading Lasercheck Controller Software

Note: Optional 110/ 220V Adaptor &RJ12 / Serial Interface Connecting Cable and Software required.

Step 1 – Prepare Computer Downloading Program

1) From your computer start menu select Start/All Programs/Lasercheck/Controller Software Upgrade.
2) Select the QBS file to be upgraded by pressing the “BROWSE” button for the “Filename” (for example, “head060.qbs”).
3) Ensure “Com Port” setting is correct for your computer, and “Baud Rate” is 9600.
4) Under “Download Type” selection, check “Application Download”.
5) Ensure the “Port State” indicates “Port is Open” and the triangle in the box is green. If it is red and “Port is closed” is indicated, push the red triangle and it should change state and become green.



Step 2 – Prepare Lasercheck Controller

1) Connect power and serial cable into 110 Volt outlet and serial port of computer.
2) Power on the Lasercheck Controller by plugging in the RJ12 connector into the B Controller.
3) Let the Lasercheck Controller boot up until “Ready to Measure” is displayed.
4) Press the “SETUP” button on the B Controller.
5) The following screen will be displayed:

```
--Lasercheck Setup--
  1 = Calibration
  2 = Delete Data
SETUP=next  ESC=exit
```

6) Press the “0” button on the Lasercheck Controller (*note: the screen will not change*), then key in “4956”
7) The following screen will be displayed:

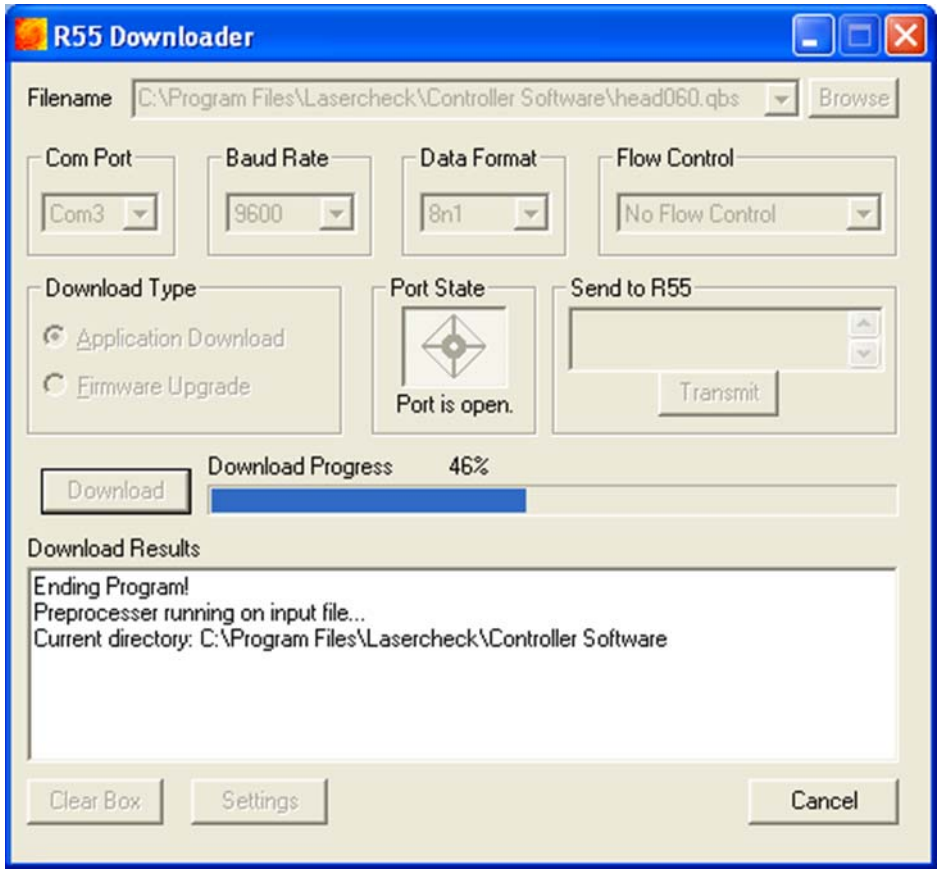
```
Ending Program!

Download File Now…
```

8) Follow directions in “Download with Computer Downloading Program”

Step 3 – Download Program Upgrade with Computer Downloading Program

1) Push “Download” button.
2) Check bar graph labeled “Download Progress” for completed Download.

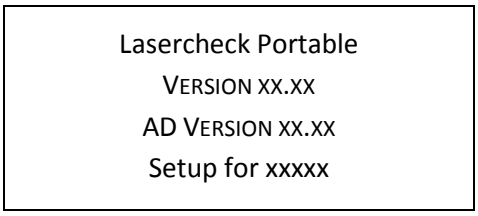


3) When completed, “Download Results” box in the Download Program should read:

Ending Program!
Preprocessor running on input file...
Current directory: C:\”your newly created directory”
>Data transmitted

Checking Controller Display and Software Versions=

1) Check B Controller screen. It should be rebooting.
2) While the Controller boots look for the Version number of software in the brief display of this screen.
3) It should read the same as the version just downloaded

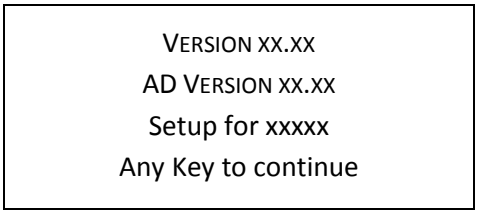


4) Record the Version number of the Lasercheck and AD software from this screen.

If you miss seeing the brief display screen with the version numbers

After the system boot up completes you can view it again:

1) Push the “SETUP” key and then “5” key. The following screen will be displayed:



2) Record the Version number of the Lasercheck and AD software from this screen.
3) Push the ESC key two times to return to the main menu

Appendix E – Battery Replacement

The Lasercheck system is controlled by six AA batteries in a compartment in the back of the controller. Under normal operation one set of batteries should last a few months of operation. Signs of weak batteries will be difficulty powering the unit, possible slow beep sounds as it tries to turn on, or extremely weak or non-existent laser beam emitting from the measurement head when attempting a measurement.

To replace batteries

- Slide battery cover off back of controller case (may be tight).
- Remove and replace all batteries, using template in case as guide for battery orientation.
- Replace cover.
- Reset time / date if desired – see instructions in Appendix D earlier in this manual.