Talysurf CCI 3D Non-Contact Surface Profiler System

User's Guide

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Chapter 1
Safety

Important Safety Information

Before operating this instrument, the operator should be familiar with this handbook and the contents of the "On-Line" Help facility within the Software, and understand the operation of the instrument.

Note: Please refer to the Installation CD for the latest version of the User Guide.

Note: Not all of the features described are available on all systems.

Note: Please retain this handbook for future reference.

Warnings, Cautions and notes

Warning: If the actions indicated in a "WARNING" are not complied with, personal injury or death could result. A Warning statement will typically describe the potential hazard, and the measures that must be followed to reduce the hazard.

Caution: If the action specified in the "CAUTION" is not complied with, damage to your equipment could result.

Note: A "NOTE" provides supplementary information, emphasizes a point or procedure, or gives a tip for easier operation.

Safety Information

The Talysurf CCI system is designed to be safe when the following conditions apply:-

- The system is located indoors in dry conditions.
- The altitude does NOT exceed 2000m.

Warnings

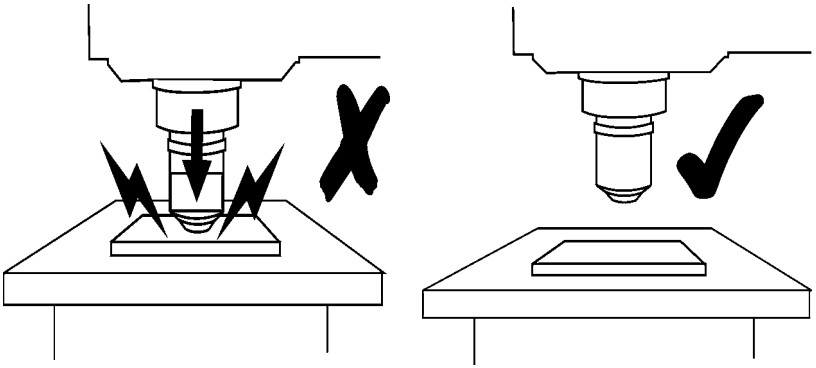
The following must be observed, failure to do so may expose the operator or other persons to risk of serious injury or death:-

- **It is essential that the electrical supply to this instrument consists of a THREE WIRE SYSTEM in which one wire is the earth. The instrument must NEVER be connected to a two wire system with, or without, a separate earth. Failure to connect the system to the correct type of supply could lead to an increased fire risk and even result in severe injury or death.**
- **The electrical supply to the instrument should be CONNECTED VIA A SEPARATE MAINS ISOLATING SWITCH and that prior to connection this switch is set to the "OFF" position. Failure to do so could expose you to severe injury or even death.**
- **The mains lead MUST BE DISCONNECTED before making any system interconnections or attempting to change a fuse. Failure to do so could result in severe injury or even death.**

- **The CCI is a heavy item, weighing 210kg (depending upon model). Exercise extreme caution when moving the instrument. Failure to do so could result in severe injury or even death. Ideally you should use wheels if provided, a pallet truck or a fork lift to move the instrument. Desktop versions have handles provided for lifting. It is recommended that four people are used to move the base. Screw in carrying handles are provided for use with moving the base.**
- **DO NOT attempt to lift the column by the leadscrew or the handwheel if fitted. Failure to lift the column in the correct manner could result in severe injury or even death.**
- **DO NOT under any circumstances leave a column standing in the vertical position if it has not been bolted into place. Failure to secure the column could result in severe injury or even death.**

Cautions

- **If it is required to PAT test the equipment for earth continuity, it should ONLY be tested at a maximum test current of 200mA. Test currents above this could damage the sensitive electronic equipment within the system.**
- **Before placing the Measuring head on the carriage adaptor plate, ensure that the adaptor plate is firmly secured to the column carriage.**
- **When the objective lens is close to the surface of the component, take care not to impact the objective or the PZT into the component as this may damage the objective or the PZT scanner. THIS IS NOT COVERED BY WARRANTY. There may be a piezo buzzer that warns of the contact of the objective with the component.**



- **The PZT (see picture above) is easily damaged and very expensive. DO NOT PUT any undue force on the the PZT and when transporting, remove and pack in a sealed bag with silica gel.**

Chapter 2
System Requirements and Specification

Talysurf CCI

Electrical Supply

- Mains supply voltage: 90 to 240VAC

Caution.

The light unit and PC may have a switchable voltage selector. Ensure that it is set to the correct setting before connecting and switching on.

- Frequency: 50/60 Hz
- Power Consumption: 500VA Maximum

This equipment is intended for installation category (low-voltage category) II, in accordance with EN 61010-1 (2001).

Note: For details of the power requirements for the computer and any accessories that do not derive their power from the CCI system, refer to the manufacturer's documentation.

Environmental Conditions

For operation within performance specifications,

Ambient temperature range:

- Operating: +15^{o}C to +30^{o}C

- Storage: -10^{o}C to +50^{o}C

Ambient relative humidity:

- Operating:<70% non-condensing
- Storage:10% to 70% non-condensing

Caution:

The piezo unit is very sensitive to high humidity and may be damaged if operated outside of this range. Take extra care when moving from a cold area to a humid environment.

Temperature gradient:<2^{o}C/hour

Air flow: <0.5m/s

Talysurf CCI 6000 System Specification

Vertical resolution (best). 0.1Å (10pm)

RMS repeatability (Z). 0.03Å (3pm)

Measurement range (X,Y). 0.36mm - 7.0mm

Lateral sampling resolution (X,Y). 0.35 µm (best)

Step height repeatability . 0.1nm (best)

Linearity (Z). +/-0.05%of measured value

Maximum Resolution (dependant on mode). X/Y: 1024 x 1024 pixels

Resolution of Manual Z stage. 0.4mm/revolution

Reflectivity. Greater than or equal to 0.1%

Stage Range.

- X and Y: 25mm (Manual) OR
  112 x 75mm (Motorised option) OR
  150m x 150mm (Auto option 1) OR
  250mm x 200mm (Auto option 2)
- Z (column): 100mm
- θx and θy: +/-4^{o}

Component size. X and Y: up to 300mm

Component size. Z: up to 100mm

Component weight. up to 10kg

Vertical scanning range. up to 100µm or 400µm

Table 2-1: Objective lenses available

Objective Lens	Field of View/mm	Working Distance/ mm	Lateral sampling resolution/µm	Maximum component slope/°
2.5x	7.0 x 7.0	10.3	7.03	+/-2.0
5x	3.6 x 3.6	9.3	3.5	+/-3.5
10x	1.80 x 1.80	7.4	1.76	+/- 8
20x	0.90 x 0.90	4.7	0.88	+/- 14.5
50x	0.36 x 0.36	3.4	0.35	+/- 22

Talysurf CCI 2000 System Specification

Vertical resolution (best). 1Å (100pm)

RMS repeatability (Z). 0.5Å (50pm)

Measurement range (X,Y). 0.36mm - 1.8mm

Lateral sampling resolution (X,Y). 0.35 µm (best)

Step height repeatability . 0.1% on 50µm step

Linearity (Z). +/-0.17%of measured value

Maximum Resolution (dependant on mode). X/Y: 1024 x 1024 pixels

Resolution of Manual Z stage. 0.4mm/revolution

Reflectivity. Greater than or equal to 0.1%

Stage Range.

- X and Y: 25mm (Manual) OR
  112 x 75mm (Motorised option)
- Z (column): 100mm
- θx and θy: +/-4^{o}

Component size. X and Y: up to 300mm

Component size. Z: up to 100mm

Component weight. up to 10kg

Vertical scanning range. up to 100µm or 400µm

Table 2-2: Objective lenses available

Objective Lens	Field of View/mm	Working Distance/mm	Lateral sampling resolution/µm	Maximum component slope/°
10x	1.80 x 1.80	7.4	1.76	+/- 3
20x	0.90 x 0.90	4.7	0.88	+/- 10
50x	0.36 x 0.36	3.4	0.35	+/- 12

Chapter 3
Installation Instructions for the Talysurf CCI instruments

Introduction

Talysurf CCI instruments are initially installed by a representative of Taylor Hobson Limited. Any subsequent moving and re-installation should also be carried out by a representative of Taylor Hobson or a suitably trained person. This must be done with care for the instrument and consideration for its applications and location.

Having completed the system installation, all details of the basic operation of the CCI Software are obtained by reference to this handbook or the software On-Line Help facility. In case of any queries or problems Taylor Hobson Limited can be contacted at the addresses shown at the back of this handbook.

Note: Please retain this handbook for future reference.

Unpacking the Instrument

Installation is carried out by a service engineer, or a representative, of Taylor Hobson Limited.

Caution:

- **Please DO NOT unpack your instrument, or any associated products or accessories, unless with a prior agreement with a service engineer or representative of Taylor Hobson Limited.**

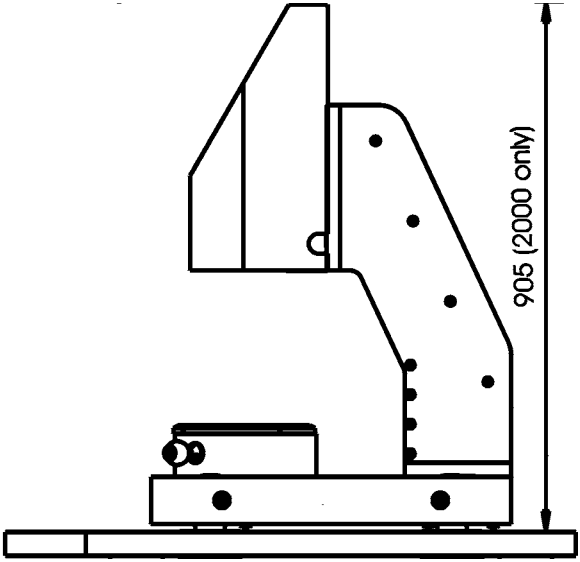
Siting the instrument

The overall accuracy of measurement results will be influenced by environmental conditions, particularly; draughts, vibration and the rate at which the ambient temperature changes. The choice of location depends on the application requirement. However, to ensure that the optimum performance is achieved, wherever possible, the instrument hardware should be installed with consideration given to the surroundings in which it will operate.

The following items must be considered when siting the instrument;

Details for recommended desk (CCI 2000)

The desk is to be provided by the customer.

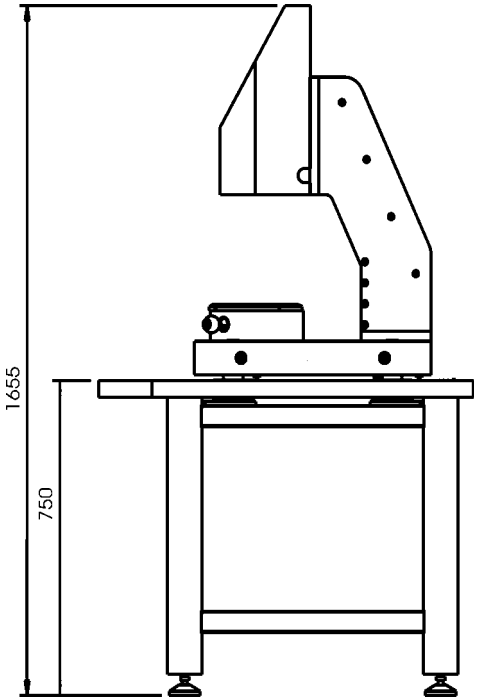


The desk top should be a minimum of 600mm square and able to safely support a minimum weight of 200kg.

A seperate desk is required to support the computer and electronics equipment. This should nominally be 900mm wide.

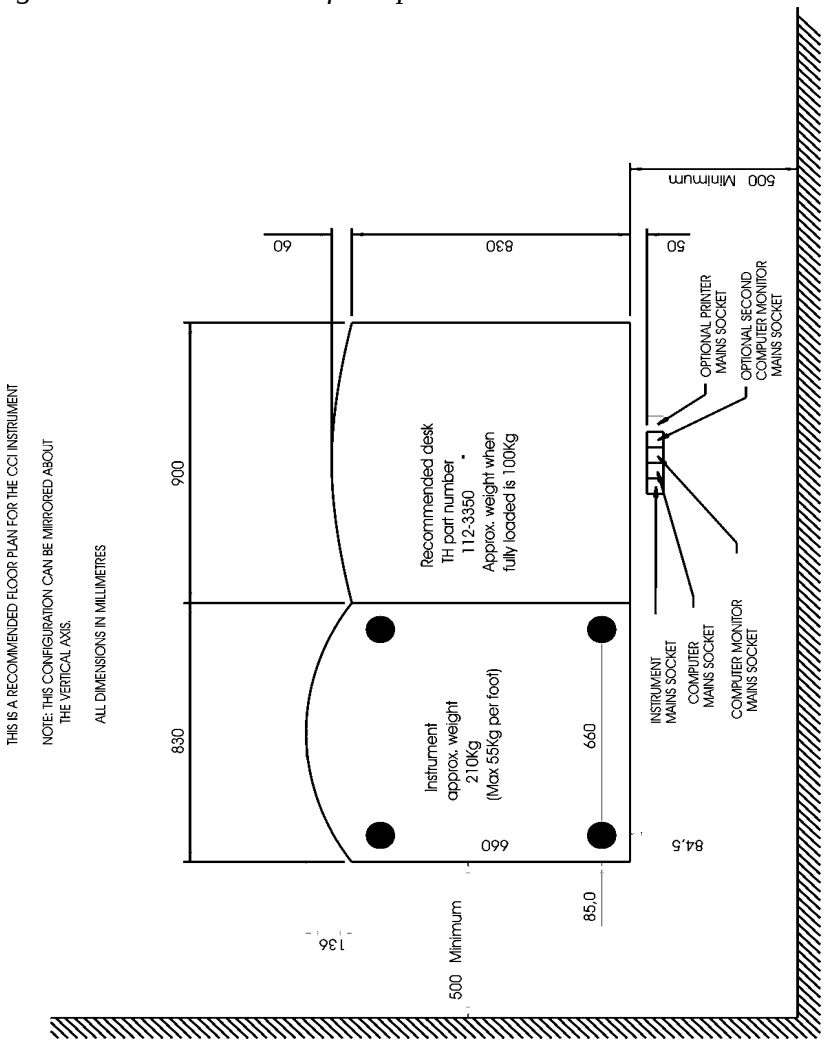
Instrument height (CCI6000)

Figure 3-1 Instrument height



Recommended Siting Plan (CCI 6000)

Figure 3-2 Recommended floor plan



Note.

The floor plan is a recommendation only and allows for easy maintenance access to the rear of the instrument.

Recommended positioning of the components

Figure 3-3 System components in their recommended location

Clean area

All forms of airborne particle are detrimental to the performance of the instrument but particularly smoke, dust and airborne oil particles. Ideally the instrument should be located in a clean environment.

Draughts

Draughts and airborne vibration should be avoided. Avoid placing the instrument in draughts or directly under or next to air conditioning vents. Ideally an Environmental enclosure should be used to minimise the airflow around the component measurement area.

Temperature Gradients

Avoid siting the instrument in areas that have a very rapid temperature gradient, and avoid siting near windows or skylights where sunlight may fall on the instrument.

Areas that experience temperature gradients of over 2°C/hour are not ideal for measurement.

Vibration

Both air borne and ground based vibration is particularly detrimental for the measurement of surface texture. It is recommended that all sources of vibration are removed. All Talysurf CCI instruments are supplied with anti-vibration mounts. It is also important that cables should be run away from sources of vibration and located where they cannot be kicked or jarred.

Power Supply

It is important that a clean power supply should be provided to the instrument. If in doubt, many computer peripheral dealers can supply a suitable Uninterruptible Power Supply (U.P.S.).

The power supply voltage must conform to the following

- Mains supply voltage: 90 to 240VAC

Caution.

The light unit and PC may have a switchable voltage selector. Ensure that it is set to the correct setting before connecting and switching on.

- Frequency: 50/60 Hz
- Power Consumption: 500VA Maximum

This equipment is intended for installation category (low-voltage category) II, in accordance with EN 61010-1 (2001).

Hardware Installation (CCI 6000)

System Components

M112/3505-XX TALYSURF CCI 6000 MEASURING INSTRUMENT.

comprising:

- K510/3038-XX - Granite Base with Steel Base Frame and Pneumatic AV

- 112/3493-XX - CCI Measuring Unit consisting of
  - TalySurf CCI Measurement Head

  - External CCI Light Source with filter changer

- 112/3416-XX - CCI Application Software Pack
- K505/70 - CCI User Guide
- K505/72CCI - Quick Reference Guide for Clean Rooms

- 112/3348-XX - Light Source Bulb (Spare)
- 600-14 - Exploring Surface Texture
- K501-3065-XX - Power Distribution Unit Assembly

Computer options.

- 265-1035E Personal Computer, English version
- 265/1078E Personal Computer, English version Dual Monitor

Options

Lenses.

- 112/3290-XX - 2.5x Objective Lens 7.0mm x 7.0mm field of view see note
- 112/3291-XX - 5x Objective Lens 3.6mm x 3.6mm field of view
- 112/3292-XX - 10x Objective Lens 1.8mm x 1.8mm field of view
- 112/3293-XX - 20x Objective Lens 0.9mm x 0.9mm field of view
- 112/3294-XX - 50x Objective Lens 0.36mm x 0.36mm field of view

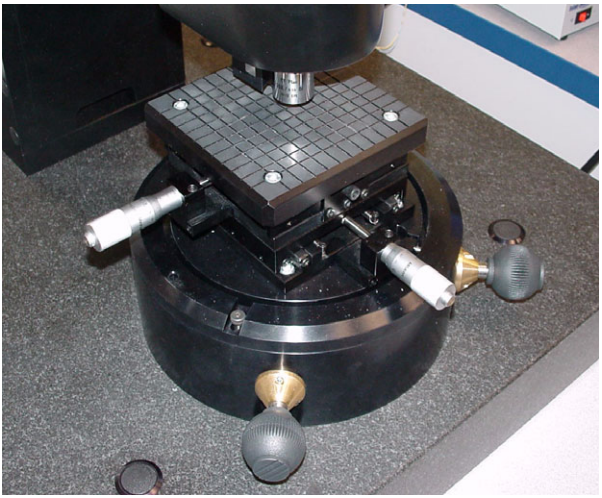
Note: 2.5x lens will not operate with standard piezo 265/1031, use either 265/1073 (2.5 only) or 265/1063 (all lenses)

Talymap options.

- 112/3579-01 Talymap Platinum
- 112/3580-01 Talymap Gold
- 112/3581-01 Talymap Silver

Stages options.

- 112/3514-XX - Manual X/Y/Z/θx/θy Stage with 25,25,100mm, 4^{o} and 4^{o} Range respectively.

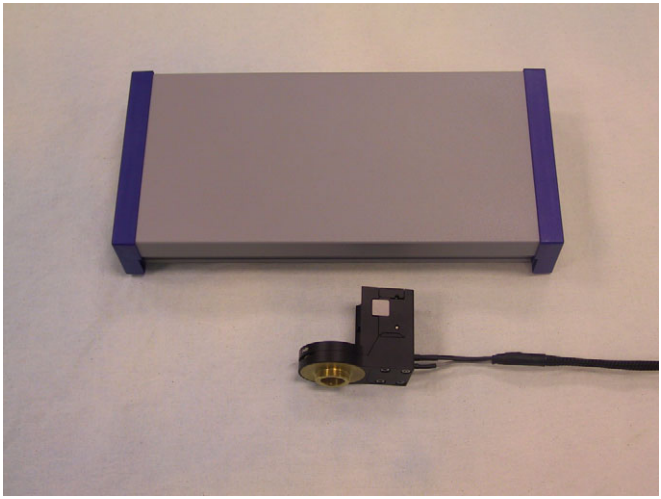


- 112/3515-XX - Motorised (joystick only) X/Y Stage 110x75mm Range, Manual Z/θx/θy Stage with 100mm, 4^{o} and 4^{o} Range respectively.

- 112/3516-XX - Automatic X/Y/Z Stage 150x150x100mm Range, Manual θx/θy Stage with 4^{o} and 4^{o} Range respectively.
- 112/3524-XX - Automatic X/Y/Z Stage 150x150mm Range, Manual Z/θx/θy Stage with 100mm, 4^{o} and 4^{o} Range respectively.
- 112/3517-XX - Automatic X/Y/Z Stage 250x200x100mm Range, Manual θx/θy Stage with 4^{o} and 4^{o} Range respectively.

Piezo options.

- 265/1031 - 100µm Piezo & Controller (100µm Vertical Range) for 5x, 10x, 20x & 50x lens



- 265/1073 - 100µm Piezo & Controller (100µm Vertical Range) for 2.5x lens
- 265/1063 - 100µm Piezo & Dual Controller for use with 2.5x, 5x, 10x, 20x & 50x lens
- 265/1079 - 400µm Piezo Controller for use with 10x, 20x & 50x lens

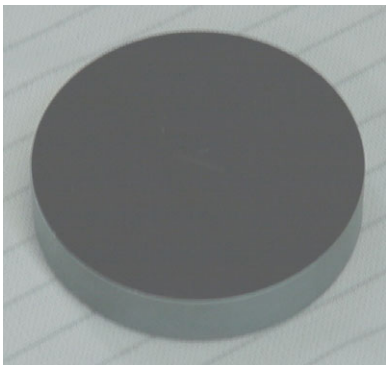
Accessories

- 112/3560-XX - Environmental Cabinet

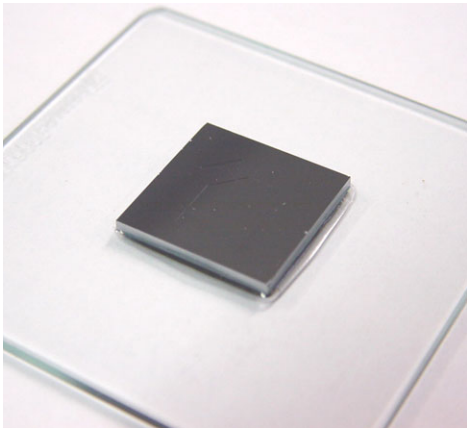
Calibration/Setting Standards.

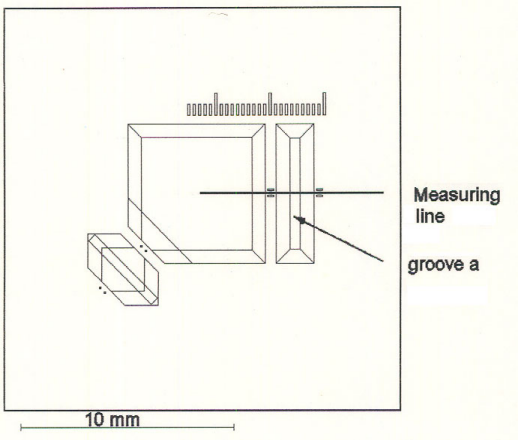
- 112/3323-XX - Lateral Calibration Standard for all lenses
- 112/3498-XX - Lateral Calibration Standard with Traceable Calibration Certificate

- 112/3298-XX - 5µm Step Height Calibration Standard with Traceable Calibration Certificate



- 112/3499-XX - 50µm Step Height Calibration Standard with Traceable Calibration Certificate





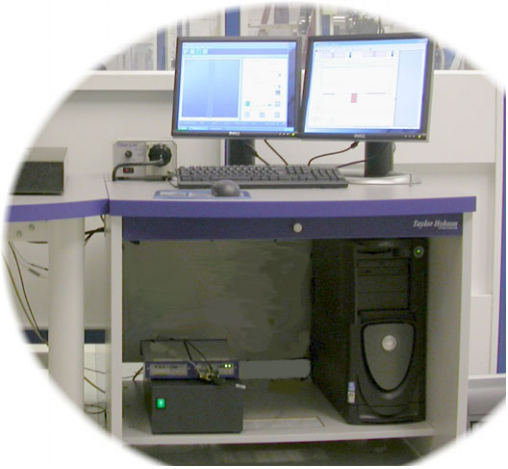
- 112/3297-XX - Calibration Flat Mirror 0.2nm RMS with Non-traceable Calibration Certificate
- 112/3507-XX - Calibration Flat Mirror 0.2nm RMS with Traceable Calibration Certificate

Printers.

- 112/2902-XX - HP DeskJet Printer
- 112/2696-XX - LaserJet Printer
- 112/3217-XX - HP Business Inkjet Printer

Furniture.

- 112/3350-XX - Talysurf CCI Computer Desk



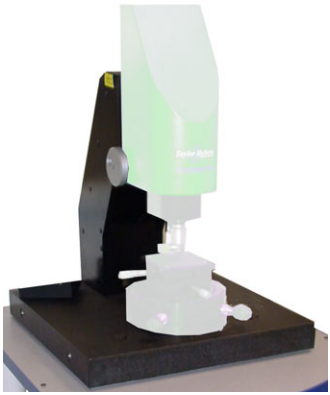
Hardware Installation (CCI 2000)

System Components

M112/3613-XX TALYSURF CCI 2000 MEASURING INSTRUMENT.

comprising:

- K510/3061-XX - Granite Base with Rubber AV Mounts, desk mounted.



- 112/3614-XX - CCI Measuring Unit consisting of
  - TalySurf CCI Measurement Head.

- 112/3416-XX - CCI Application Software Pack
- CCI User Guide
- K505/72CCI - Quick Reference Guide for Clean Rooms
- 112/3348-XX - Light Source Bulb (Spare)
- 600-14 - Exploring Surface Texture

Computer options.

- 265-1101E Personal Computer, English version

Options

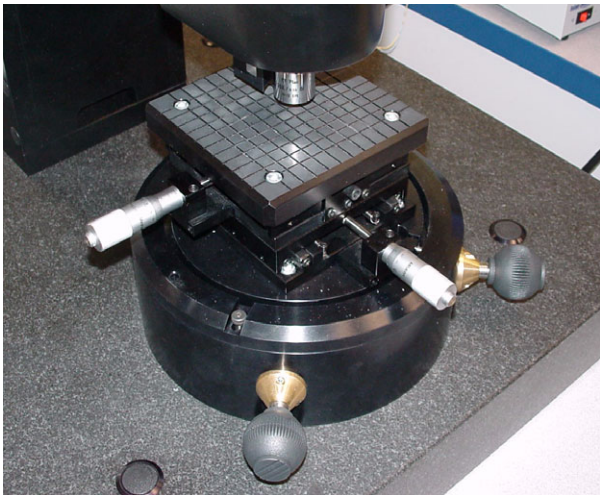
Lenses.

- 112/3292-XX - 10x Objective Lens 1.8mm x 1.8mm field of view
- 112/3293-XX - 20x Objective Lens 0.9mm x 0.9mm field of view
- 112/3294-XX - 50x Objective Lens 0.36mm x 0.36mm field of view

Talymap options. As for CCI 6000.

Stages options.

- 112/3514-XX - Manual X/Y/Z/θx/θy Stage with 25,25,100mm, 4^{o} and 4^{o} Range respectively.



- 112/3515-XX - Motorised (joystick only) X/Y Stage 110x75mm Range, Manual Z/θx/θy Stage with 100mm, 4^{o} and 4^{o} Range respectively.

Piezo options.

- 265-1099 - Piezo and controller. 100µm vertical range with LVDT feedback.

Accessories

As for CCI 6000.

Installation procedure

The installation process will be performed by a Taylor Hobson Service Engineer or other similar representative of Taylor Hobson. Any subsequent moving and re-installation should also be carried out by a representative of Taylor Hobson or a suitably trained person. This must be done with care for the instrument and consideration for its applications and location.

Adjusting Anti Vibration air mounts (CCI 6000 only)

Place spirit level on granite base and level by adjusting frame feet.

Using a pump and the valves mounted on the front of the frame, inflate each AV mount so that the diaphragm is level. (This is best done by slightly over inflating and letting air out of the mount to bring the base down to the required level).

Interconnection diagram (CCI 6000)

Figure 3-3 Interconnection diagram (Manual System)

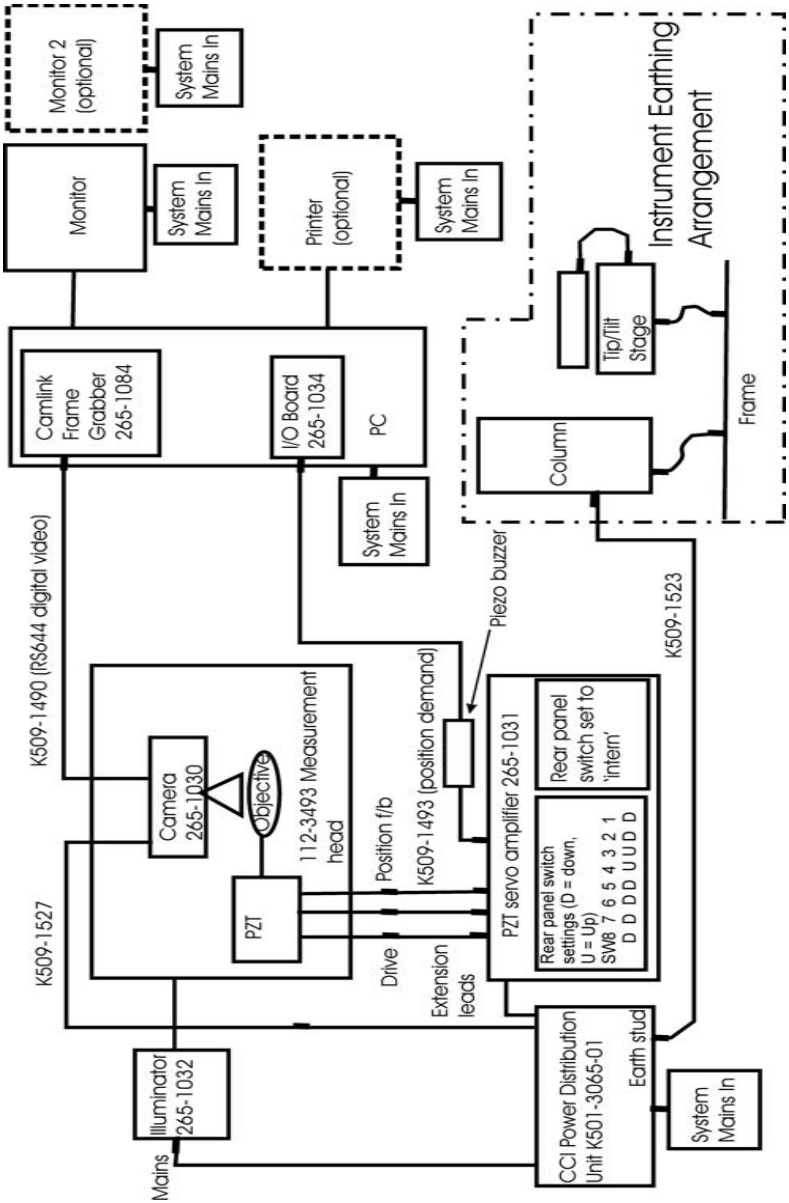
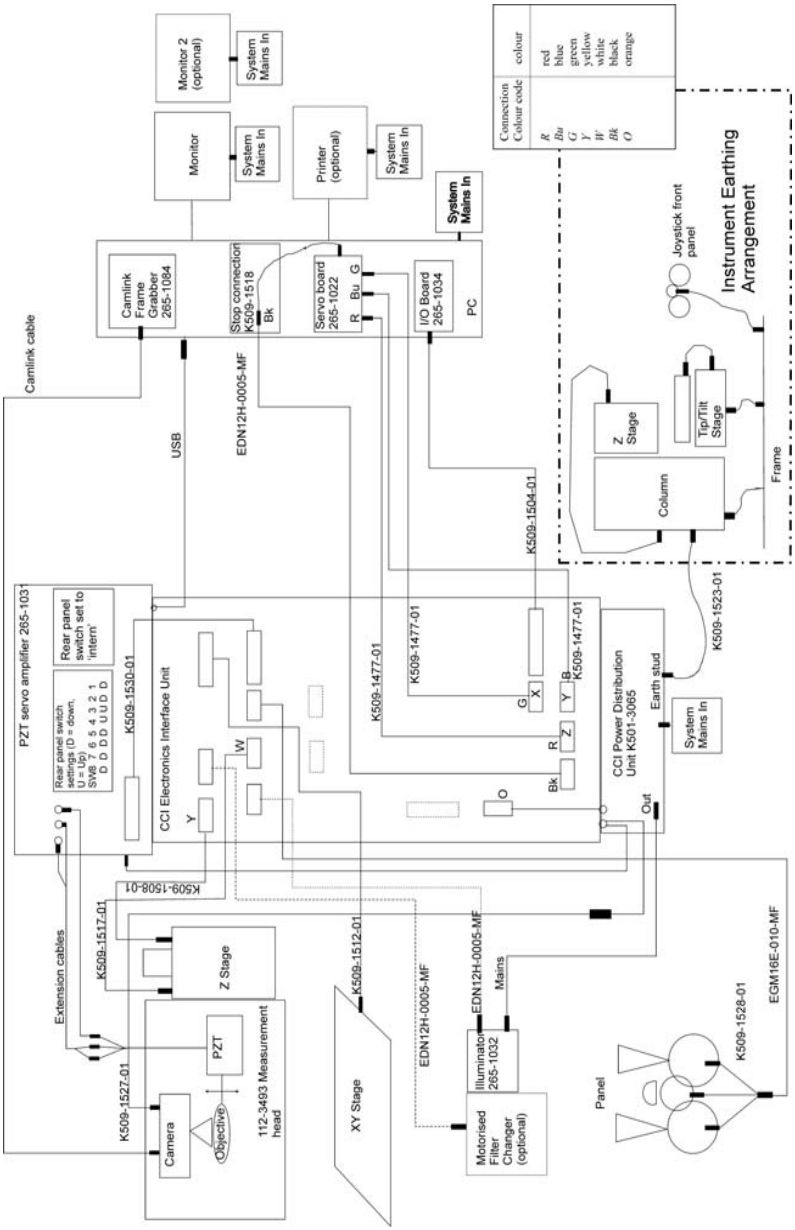
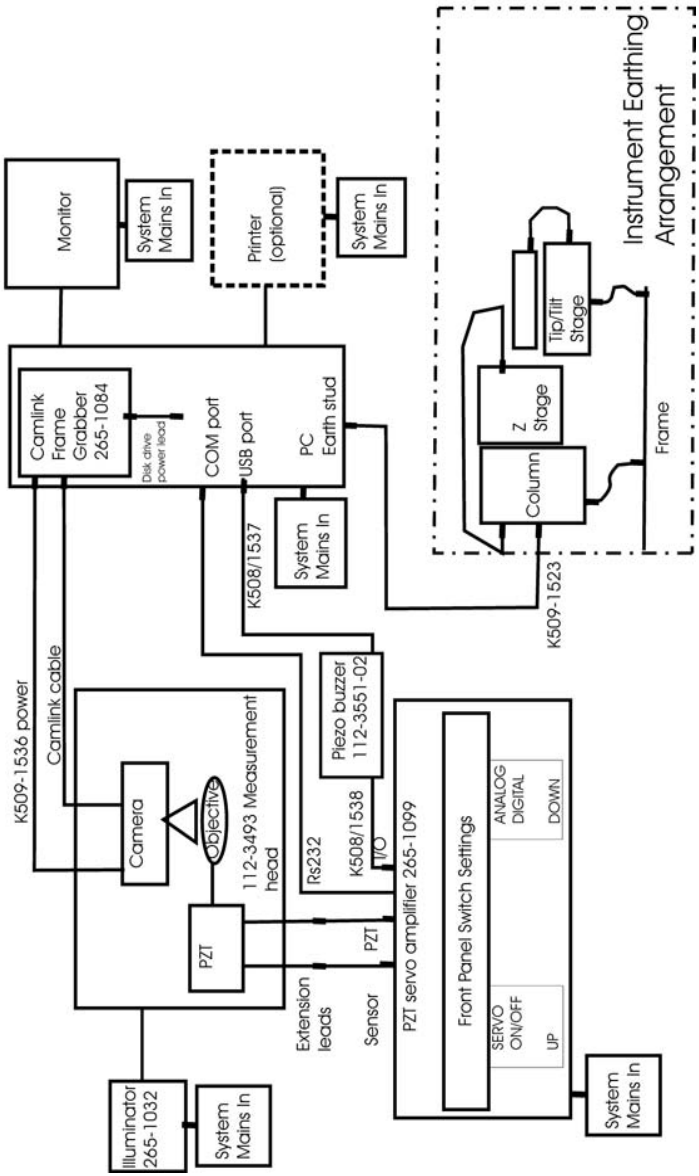


Figure 3-4 Interconnection diagram (Automatic System)



Interconnection diagram (CCI 2000)

Figure 3-5 Interconnection diagram



Installing/Upgrading software

Full instructions for the installation of the application software are provided on the Application software cd in the file ‘Talysurf CCI Software Installation Procedure’.

Networking of the PC's

The PC needs to be set up with the one User (i.e. a single User before and after networking).

If the PC is set-up with multiple users then it may be necessary to do a separate installation of the Frame Grabber for each user. See "Installing/Upgrading software" (page 3-26) for more information.

After a PC has been networked, it may not recognise the USB port (Aladin) used for the Talymap dongle. To correct this, in **Control Panel>System>Hardware Devices>Device Manager>Port**s, remove the unrecognised USB Port. Then re-boot. If the Aladin USB port is still unrecognised, select **Control Panel>System>Hardware Devices>Add New Hardware Device**.

User Rights

If a new user is added to the PC, then they need to be given ‘Power User’ or ‘Administrator User’ rights, as the CCI Application software modifies files in the installation folder located in C:\program Files.

Setting Up the System

Once the instrument is assembled and all the connections are made the instrument is ready for use. The representative of Taylor Hobson will then set up the instrument for use.

System pre-packing instructions

In the unlikely event that it becomes necessary to return the instrument, it should be carefully re-packaged. This should be performed by a representative of Taylor Hobson or a suitably qualified person.

Chapter 4
Operating Instructions

Introduction

The Operating Instructions are organised into a number of sub-sections to enable you to find the information required quite quickly.

The first sub-sections describe the Instrument controls and the User Interface in terms of the main screens, the toolbar and the menus. This is provided as an introduction to the User Interface and also to aid in the familiarisation with the instrument away from the instrument itself.

Note: Not all procedures are available on all versions of the instrument.

The remaining sub-sections of this chapter describe 'How Do I' operations to enable you to calibrate the instrument, make a simple measurement and then do more advanced operations with the instrument.

The sub-sections are as follows:

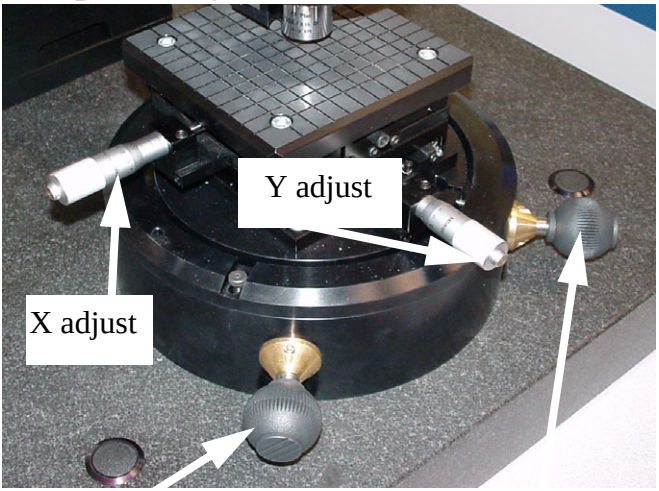
- Instrument Controls - Page 4-2.
- User Interface - Page 4-4.
- How Do I Change My Password - Page 4-16.
- How Do I Configure My Instrument - Page 4-16.
- How Do I Calibrate My Instrument - Page 4-18.
- How Do I Make a Simple Measurement - Page 4-29.
- Advanced Measurement Topics - Page 4-38.

Description of instrument controls

Z stage control (manual)

Z Control, one each side. Used to move the measuring head vertically so that the camera image is in focus and the fringes are visible.

X,Y and Tip tilt stage controls (manual)



Left hand tilt adjust θx Right hand tilt adjust θy

The stage controls are used to angularly and laterally align a feature on the part with the measuring head.

Motorised X,Y stage controls

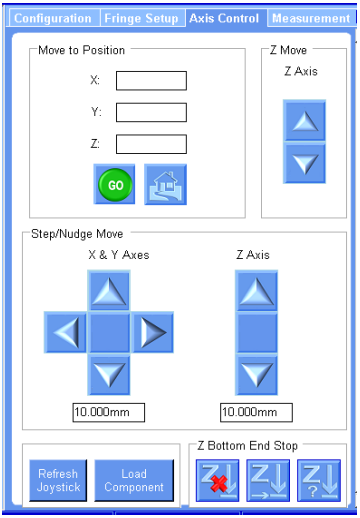
The motorised X,Y stage is the stand alone Axis control and is driven by a stand alone joystick, that has three different speed set by the switch on the joystick.

Automatic X,Y,Z stage controls

The left joystick controls the movement in the X-Y plane and the right hand joystick controls the Z axis. The switch on top of the joysticks controls the speed of movement, when activated the speed is the fastest of two speeds. When either switch is pressed, all axes move at high speed. The stop button is located between the two joysticks.

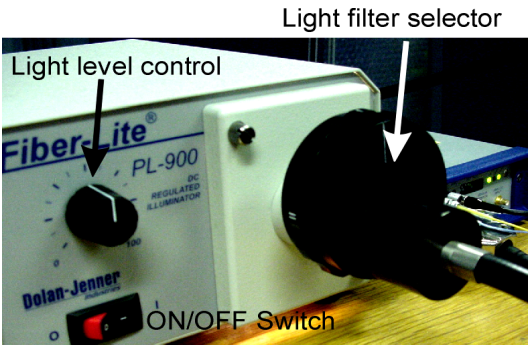
Move to position: moves the X, Y or Z axis to the position entered into the appropriate box when GO is clicked.

Step/Nudge move: Moves the X, Y or Z axis in steps as defined by the value entered into the box.



Z Move. moves the Z axis in the direction specified at low speed.

Light Unit Controls



The light level controls are used to adjust the light level that illuminates the component being measured so that an optimum level of illumination is produced at the camera. The light filter selector has four settings:

I. - This is the broadest bandwidth filter used for normal measurements ie x1 speed.

II, III and IV - These settings represent the other filters that have progressively narrower bandwidths. The narrower bandwidths provided are used for fringe findings and fast measurements.

Description of User Interface

User Interface Introduction

The complete User Interface (UI) for the Talysurf CCI system consists of two main applications:

- The Talysurf CCI Application, which controls the measurement and collection of measured data from the instrument.
- The TalyMap application, which performs the actual analysis of the measured data. TalyMap is described in the TalyMap application On-Line Help

The Talysurf CCI application UI itself consists of a live video screen and a surface screen both located on the left hand side of the UI and accessed through tabs.

- The live video screen displays a continually updated image of the surface as seen through the CCI instrument camera.
- The surface screen displays an image of the last measured surface.
- The light level display can be used as a focus aid (see page 4-37) and to set the light level for measurements.

On the right hand side of the UI are three tabs that access the Configuration, Fringe Setup and Measurement areas. During the process of preparing to take and actually taking a measurement you should step through the three tabs in order, that is configuration, fringe setup and finally measurement. An additional tab is available for axis control if you have an automated system.

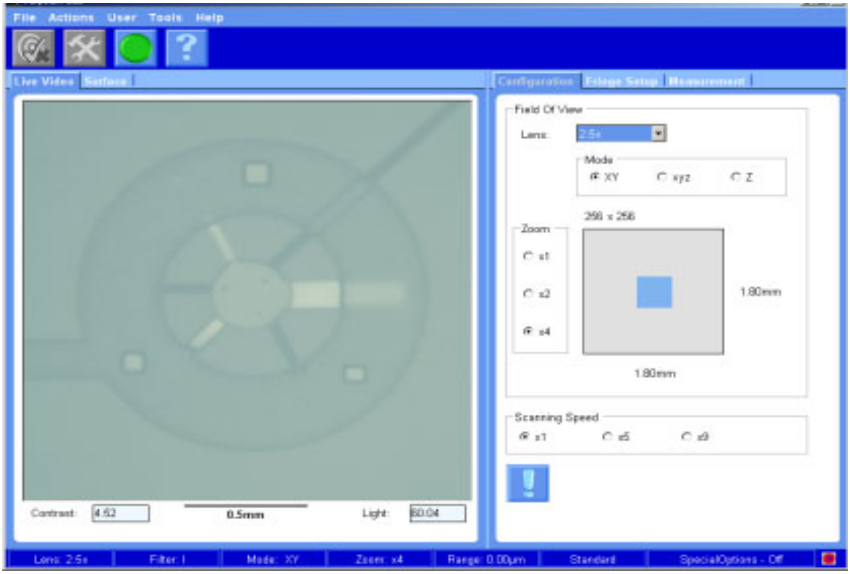
There are four buttons on the toolbar located above the live video/ surface screens. These icons are Calibration Wizard, Diagnostics,

Measure and Help. An additional 'Stop' button is located on the toolbar for an automated system.

There are five drop down menus located above the toolbar giving access to the options File, Actions, Users, Tools and Help.

The status bar located at the bottom of the screen provides the user with a summary of the measurement settings. If you have an automated system the axes positions and Z stop are displayed.

Configuration screen



The opening screen is the configuration screen and is also accessed through the configuration tab. It provides you with a number of user options for configuring the camera and the scan. These include Field of view options such as:

Lens. The options available under this selection are:

Note. The lens installed must match the setting on the Configuration screen.

- 2.5x - Field of view 7.0mm x 7.0mm
- 5x - Field of view 3.6mm x 3.6mm
- 10x - Field of view 1.8mm x 1.8mm
- 20x - Field of view 0.9mm x 0.9mm
- 50x - Field of view 0.36mm x 0.36mm

Mode. The mode options available are

- 'XY' Mode. This mode gives the greatest lateral detail. It looks at all 1024x1024 pixels of the camera individually, resulting in a longer calculation time. This mode would, for example, be used where fine detail is required.
- 'xyz' mode. This mode applies 2x binning. This means that a square of 2x2 pixels is combined to create one, bigger, average pixel. This results in better Z resolution, but you loose out on some x-y detail.
- 'Z' Mode. This mode applies 4x binning; a square of 4x4 pixels is combined into one. This gives the best result in Z, although more x-y detail is lost. Z mode would, for example, be used for measuring step heights.

Zoom. The zoom options available are x1, x2 and x4.

Note. The zoom function is a digital zoom with the following parameters:

- ***x1 zoom gives a full XY Field of View (FOV) of 1024x1024 pixels^2***

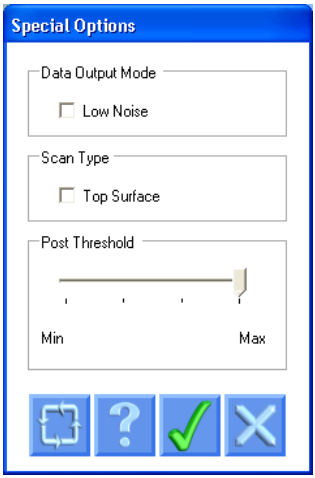
- ***x2 zoom gives a reduced XY FOV of 512x512 pixels^2***
- ***x4 zoom gives a reduced XY FOV of 256x256 pixels^2***

There is also a zoom function in the TalyMap Analysis software, refer to the TalyMap Operating Instructions or on-line help.

When the x2 and x4 zoom is selected, the area of interest can be moved by clicking and holding on the small blue square and dragging to a new location. Upon releasing the video will display at the new location.

Scanning Speed. You are also able to select the scanning speed that you desire for the scan. The options available are x1, x5 and x9, with x1 giving the highest Z accuracy result. When the scanning speed is changed a message is displayed informing you of the need to change the Hardware Light Filter (see Light Levels, page 4-37) to the correct setting.

Special Options. The Special Options are selected by clicking on the Exclamation Mark button.

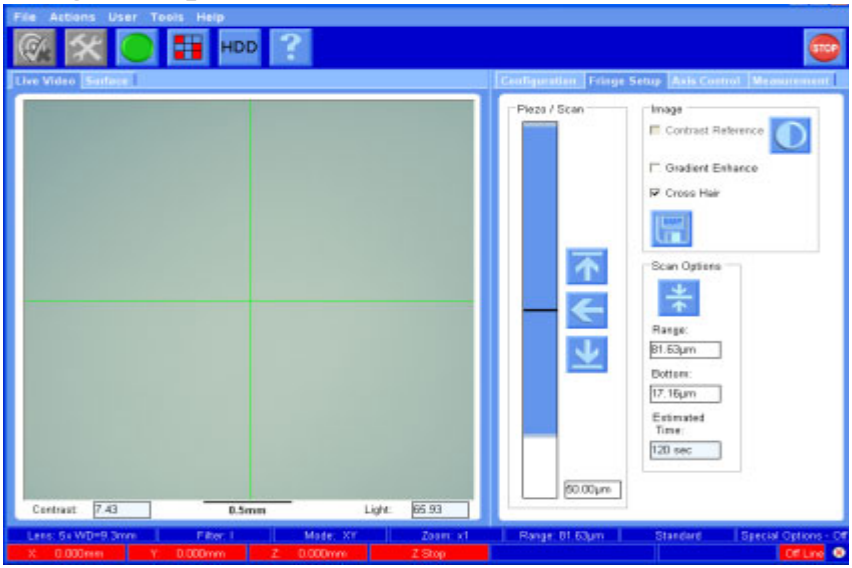


The Special options dialog offers the following functionality:

Note. For details of when and how to use each option, see page 4-48.

- Data Output Mode (Low Noise). This consists of a tick box to select Low noise, the default condition is with the tick box unselected. **What does it do:** The low noise option forces all the data to be computed in the PC. Normally some calculations are made in the camera. **Disadvantage:** Increases the measurement time. Only works with 'xyz' or 'Z' mode.
- Scan Type. The options are Top Surface selected and Top Surface unselected (default). **What does it do:** Top Surface forces the software to only measure the top most surface encountered. **Disadvantage:** Reduces the sensitivity of the system
- Post Threshold. This consists of a slider that goes from min to max (default). **What does it do:** Post Threshold adjusts the sensitivity of the algorithm allowing lower reflectivity surfaces to be measured. **Disadvantage:** Increases the possibility of the measurement containing spurious data. Only works with 'Post Process'.

Fringe set up screen



The fringe set up screen is accessed through the fringe set-up tab and allows you to define the measurement length and position, so that the scan captures all of the fringe data. This is achieved by setting the top and bottom limits of the scan by moving through the piezo/scan range by dragging the slider bar with the mouse and observing the fringes as they appear on the live video screen. By clicking on the ‘set top’ and ‘set bottom’ buttons the scan range can be set. The top point is set to be just above where the top fringe appears, while the bottom point is set to be just below where the bottom fringe appears. These points are stored in the software.

The screen also gives you the capacity to set a pointer to the middle of the piezo/scan range. The value displayed in the window below the slider, can be changed by you, allowing an alternative point on the piezo/scan range to be displayed in the video screen.

There are a number of Image focussing options available to you through the Fringe set up screen:

Contrast reference. Selecting Contrast reference makes it easier for you to pick out surface detail. It also produces a 'ghost image' that you can use to line up successive components when you require to measure the same point on a series of identical components.

Gradient enhance. Gradient enhance is useful to help you to pick out edges.

Cross hair. Turn on a cross hair cursor.

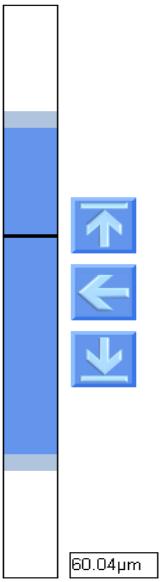
The following scan options are also available through the Fringe set up screen:

Range. This window defines the range of the scan as defined by the top and bottom limit markers. This figure can be changed by you.

Bottom. This window defines the end point of the scan defined by the bottom limit marker. This figure can be changed by you.

Estimated time. This window gives the estimated time it will take for the instrument to complete the scan.

Scan setting buttons. These buttons found on the Fringe Set up tab enable you to set a position on the piezo/scan range as the:



- Top of the scan
- Set piezo to centre of range
- Bottom of the scan

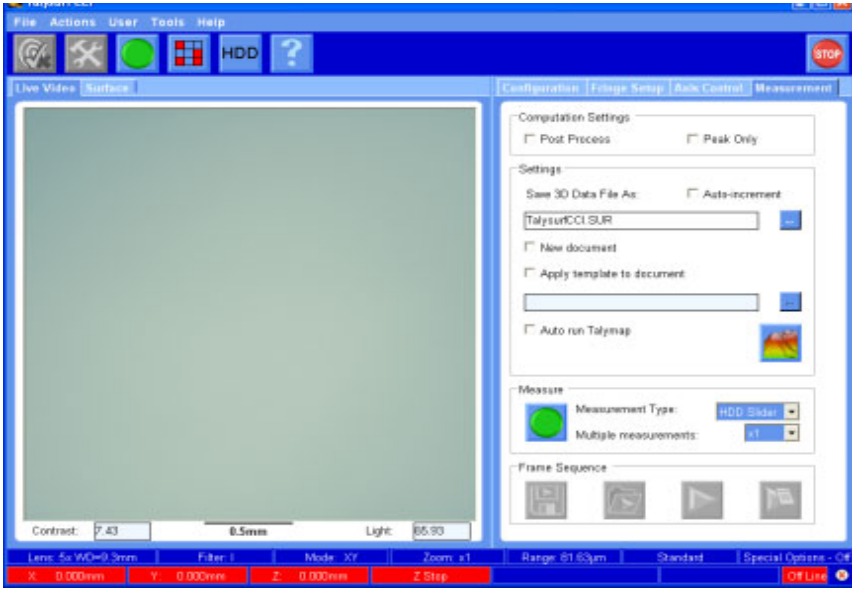
The slider. The slider shows the extent of the scan as defined by the scan setting buttons. The top line is the top limit marker and is defined by clicking on the Top of the scan button, whilst the bottom line is the bottom limit marker and is defined by clicking on the Bottom of the scan button.

The lighter areas at the top and bottom of the range represent the run-up and run-down sections of the measurement.

IMPORTANT. For the measurement to capture all of the data, all of the fringes have to appear between the top and bottom limit markers.

Light Level Setting. Not available on this version of the CCI.

Measurement screen



The measurement screen is accessed through the measurement tab and gives you the functionality for defining a measurement, saving the results and beginning the TalyMap program. The options given on the screen are:

Computation settings. Two selections are provided giving you the option of selecting:

- Post Process. If 'post' is selected the computer waits for the scan to complete, then the data from the camera is processed. Using post processing can decrease the number of missing data points, especially on low reflective surfaces.
- Peak Only. Coatings on a sample or rough surfaces can confuse the algorithm, in these cases use ‘peak only’ setting. This option can be changed before or after a measurement.

Settings. The settings options available are concerned with how the data from a measurement is saved and passed to the TalyMap analysis software.

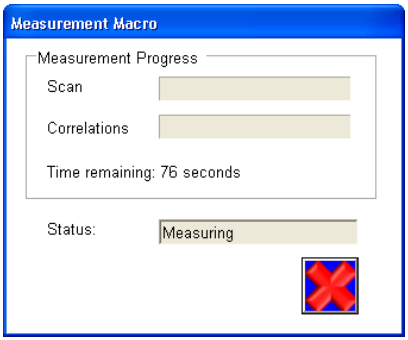
- Save 3D Data File As. The user is able to enter into the given box, the filename of the .sur file that is to be assigned to the 3D data when it is saved.
- Auto-increment. If the box is ticked then subsequent measurements will be stored with the same filename, the software will add a three digit extension to the filename, eg TalysurfCCI001.sur, TalysurfCCI002.sur, and so on.
- New document. If the box is ticked then each measurement is placed in a new Talymap document. Other wise measurements are appended to a new document.
- Apply template to document. There is also a tick box under this option that allows you to tell TalyMap to apply a particular template to the document, there is an associated box to allow you to enter a known template name, or an ellipsis [...] to allow you to select a stored template. If the template acts on a single measurement, select New document also.
- Auto-run TalyMap. With this tick box set the TalyMap analysis package is started at the end of the measurement sequence and the data collected from the scan is transferred to TalyMap.

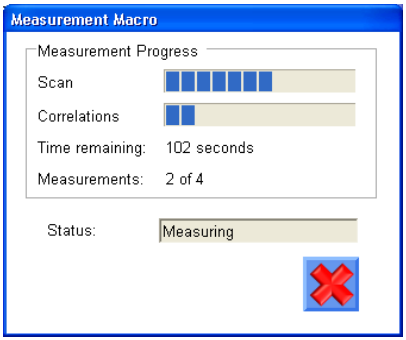
Show TalyMap button. The user is able to switch to the TalyMap 3D analysis package from within the CCI software, if required by clicking the Show TalyMap button.

Measure.

Start Measurement button. Clicking this button will start the process of making the measurement. The progress of the Scan and the subsequent Correlations

process is given by means of a progress bar on the measurement macro dialog. The time remaining in seconds is displayed. There are two measurement macro dialogs, ie single and multiple, as shown. The multiple measurements option creates an 'average' measurement from 2, 4, 8 or 16 measurements.





Measurement Type. Can be set to HDD Slider for Hard disk Drive slider measurements.

Stop Measurement button. Clicking on this button will prematurely stop the measurement process and the measurement data is discarded. To restart the scan the Start Measurement button is pressed, however the scan restarts from its start position, not the position that was reached at the point when the Stop measurement button was pressed

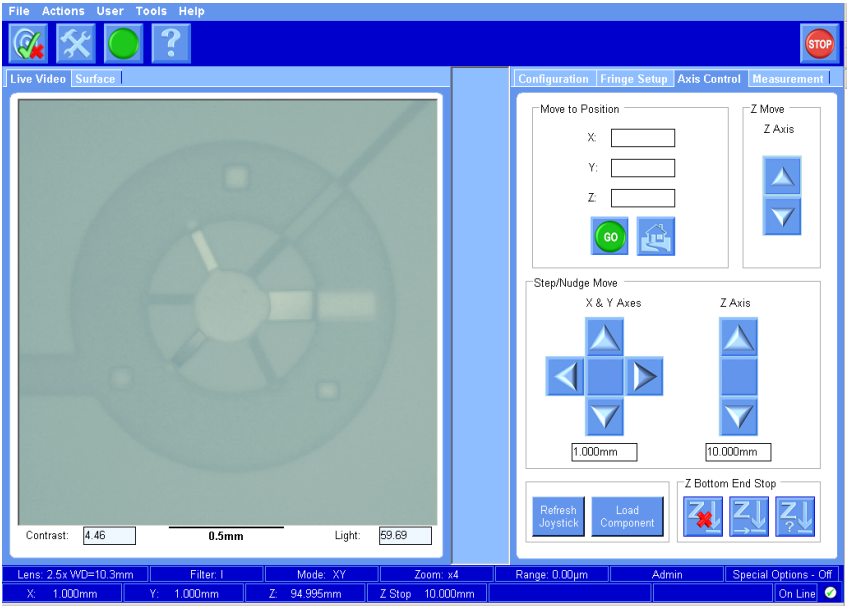
Frame sequence. The frame sequence is the series of video frames seen when going from the top to the bottom of the piezo/ scan range. It is for diagnostic use only. There are three buttons in this area:

Save Frame sequence. This button enables you to save a sequence of frames.

The user gives the sequence a filename and the file is saved as a .fgb file.

- Load frame sequence. This button enables you to load frame sequence files (.fgb) from memory.
- Show Frame Sequence. This button enables you to view the frame sequence through the video screen.

Axis Control Screen



At start up the user is prompted to optionally home the axes. This will set the axes to pre-defined positions by moving each axis to its end stop as described on the homing dialog. This homing prompt can be turned off from the dialog. It is turned on again from the menu "Tools > Options".

Move To Position.

- Specify a position for one or more of the axes and select "Go" to start the move.
- Select the home button to move all axes to their home positions.

Z Move. Select and hold the arrowed button to move the Z axis at a slow speed in the direction of the arrow. This speed is suitable for focussing and finding fringes.

Step/Nudge Move. Enter a step increment for X/Y or for Z and then press the appropriate button to move the X, Y or Z axis in the required direction. A single press of the button will move the axis the increment specified. If you hold the button then the axis will continually increment until the button is released.

Refresh Joystick. This button can be used to re-enable the joystick.

Load Component. Select this button to start a load component sequence. A dialog is displayed where one or more axes positions can be entered. Select "Go" to start moving the axes to the specified positions. When the axes have stopped moving you can load your next component. Select "OK" when prompted to return the axes back to their original positions.

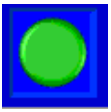
Z Bottom End Stop. The Z axis has a bottom end stop which can be set. You will typically need to set this just above the component surface so that the Z axis cannot be driven down to the component where it would damage the instrument and the component. Move the Z axis down so that the lens is just above the component surface and then select the "Set Z Bottom End Stop at Current Position" button. When the end stop is set the red highlighting is removed and the status bar will display the Z Stop value. To clear the Z Stop select the button "Clear Z Bottom End Stop". Additionally the Z Bottom end stop can be set to a pre-

determined value using the button "Set Z Bottom End Stop to value".

Toolbar

Calibrate button. The Calibrate button initiates the instrument calibration process. The calibration process uses a self descriptive wizard and requires calibration artefacts to be available during the process. Only available to Admin/Service users.

Diagnostics button. The Diagnostics button initiates the instrument's diagnostic process to enable you to determine whether the instrument is currently functioning correctly and to determine where the faults (if any) are located. Only available to Admin/Service users.



Measure button. The Measure button begins the measurement process.

Help button. The Help button takes you into the Help System. This gives you help with using the instrument in the form of 'How Do I' instructions. The glossary of terms is also provided to assist in the operation of the instrument.

Stop button. The stop button is used to stop all axes moves.

Start a pattern measurement. Only available if automated axies are connected. See Page 4-57 for further details.

Start a HDD Slider measurement. Only available if a HDD licence is installed. See page 4-61 for further details.

Main menus

File menu. The File menu provides you with the means to open the measurement setting for you to amend or execute, or to save the measurement. Program exit is also provided on the File menu.

Actions menu. The Actions menu provides options that reflect the toolbar functionality, eg Calibrate, Diagnostics and Measure. Selecting one of these options in the menu will invoke the appropriate function in the same way that the Calibrate, Diagnostics and Measure buttons do on the main toolbar.

User. The User menu enables the different levels of User ie Standard User, Admin User and Service User to log into the system and gain access to their appropriate level of privilege. Both Admin User and Service User are requested to input the appropriate password.

Both Admin and Service Users can if required change their password, see How Do I Change My Password, page 4-20.

Tools. The Tools menu enables you to select the units of measurment. The default setting for the units of measurement is the metric system. It also allows you to select Macros, where you can run and optionally create and edit macros to control the measurement. For automated systems the homing prompt at start up can be turned on.

If a licence exists for HDD Slider Measurement this menu also includes a button for launching an application to create and edit slider definition files (See section 'HDD Slider Measurement' on page 4-61).

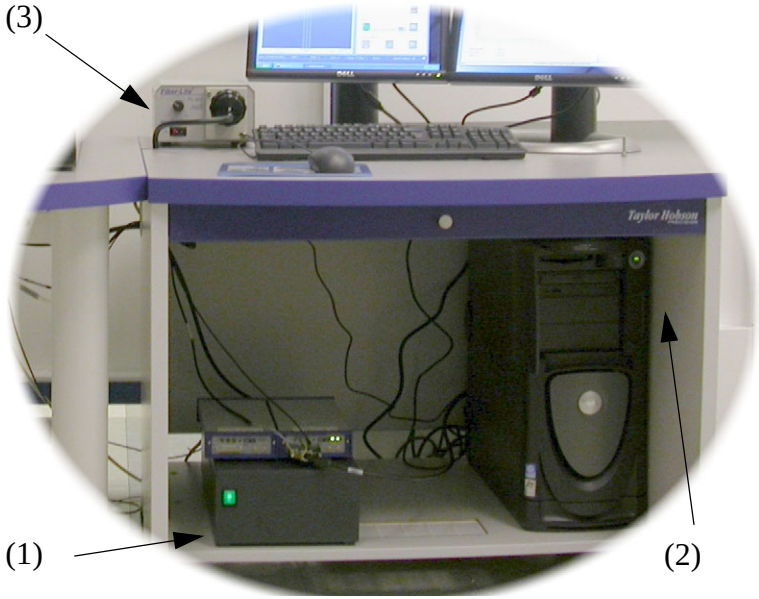
Macros are written in Visual Basic for .NET using Microsoft's Visual Studio for Applications (VSA)©.

An example measurement macro is provided. VSA includes online help for writing Visual Basic macros and macros can only be created/edited by an Admin user.

Help. Access to On-line help and to licensing information

How Do I Start The Instrument

Switch on the following items:

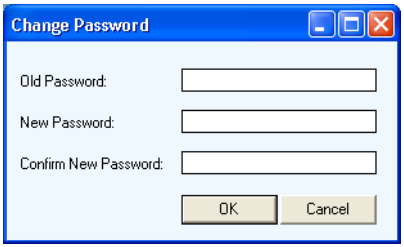


- Power Distribution unit (1)
- Computer and monitor (2)
- Light source (3)

Run the User Interface (UI) by running the Talysurf CCI application. It will open in the Configuration Tab. The instrument is ready for use.

How Do I Change My Password

To change the password for either the Service or the Admin user you should click on User Management>Change Admin User Password or User Management>Change Service User Password.



The Change Password dialog appears:

Enter the existing password in the box titled *Old Password* and then enter the new password into the box titled *New Password* and confirm this by re-entering in the *Confirm New Password* box. Click on *OK* to confirm.

How Do I Configure My Instrument

In the Configuration Tab you can choose the mode, zoom and scanning speed settings for the instrument.

Mode

Select the mode option required by clicking on the appropriate radio button, XY, xyz or Z

'XY' mode. See page 4-7.

'xyz' mode. See page 4-7.

'Z' mode. See page 4-7.

Zoom

The area of interest can be digitally zoomed, if required, by clicking on the zoom setting radio button x1, x2 or x4.

Please note that only certain combinations of zooming and mode are allowed, as shown in Table 4-1.

Table 4-1: Zoom and Binning Combinations

Zoom	Mode		
	XY	xyz	Z
x1	X	X	X
x2	X	X	
x4	X		

Scanning Speeds

Select the scanning speed required for the measurement by clicking on the scanning speed radio button x1, x5 or x9.

The 1x speed produces the most accurate results, but achieves this at the expense of measuring speed. The x5 and x9 speeds increase measurement speeds whilst sacrificing accuracy. The x5 and x9 speeds are most appropriate when the ultimate accuracy is not required, that is when measuring rough surfaces.

When the scanning speed is changed a message is displayed informing you of the need to change the Hardware Light Filter (see Light Levels, page 4-37) is set to the same setting as the scanning speed.

Special options

Select any of the Special Options as required, see page 4-48.

How Do I Calibrate My Instrument

The calibration of the instrument is performed using one of the three calibration artefacts and utilises the software calibration wizard.

Calibration Types

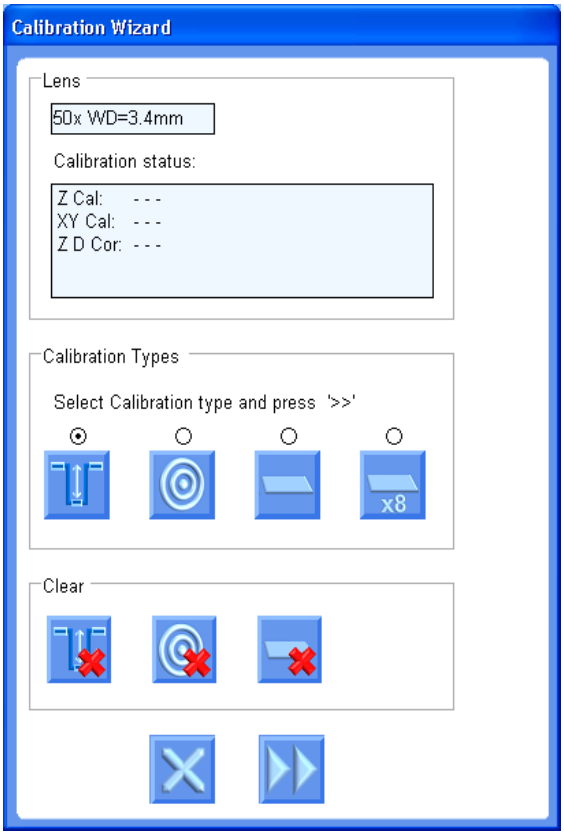
- XY Calibration (X and Y Gains)
- Z Calibration (Z Gain)
- Z Datum Correction (Z Form from a single measurement)
- Advanced Z Datum Correction (Z Form from multiple measurements)

Calibration Wizard

- You access the software calibration wizard through either the Actions menu, see page 4-19 or the button on the toolbar.

- When the wizard is opened a live video image is displayed in the main image window.
- The wizard contains a front page displaying the current lens and each of the calibration types. Selection of one of these options + "next" leads to one or more pages of information relating to that calibration type. Additionally there is an

option, one per type, to reset all of the calibrations to defaults and a finish/close option.

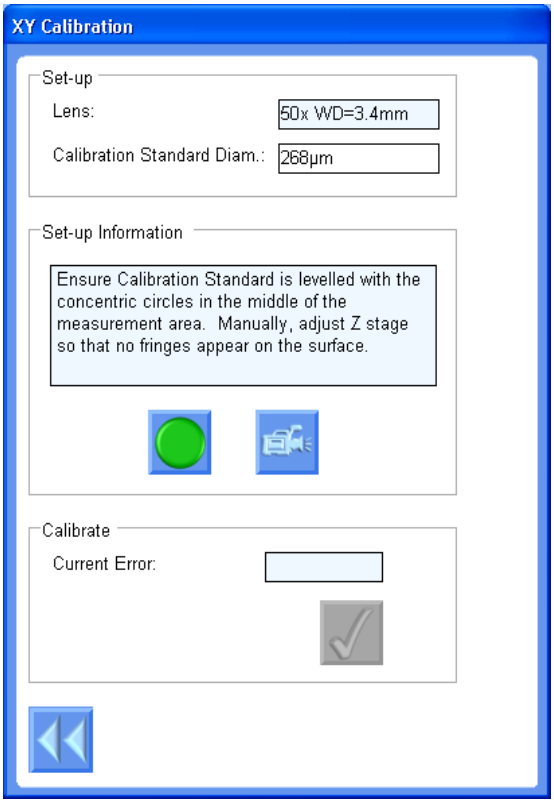


- When the wizard is closed your previous measurement and fringe set-up settings are restored.

XY Calibration (X and Y Gains)

Artefact. Glass target with concentric circles is provided as an accessory, see page 4-34.

Sequence. You access "XY Calibration" from calibration wizard.



- Set up the calibration standard by following the instructions in the wizard.
- To start the calibration you need to click on "Go" button.

- The wizard displays the "Current Error" as the difference between the measured diameter (using the previous gain) and the actual diameter (e.g. 0.15µm).
- You decide if the calibration is ok and select "Accept" button on the wizard. The wizard stores the calibration value (XY Gain) to a file against the current lens type.
- To repeat the calibration, click on the camera button. This will

return you to the live video image so that you can repeat the process.

Application. CCI applies X and Y Gain correction to all measurements.

Note. CCI will not apply X and Y Gain correction to the live video image display or its scale.

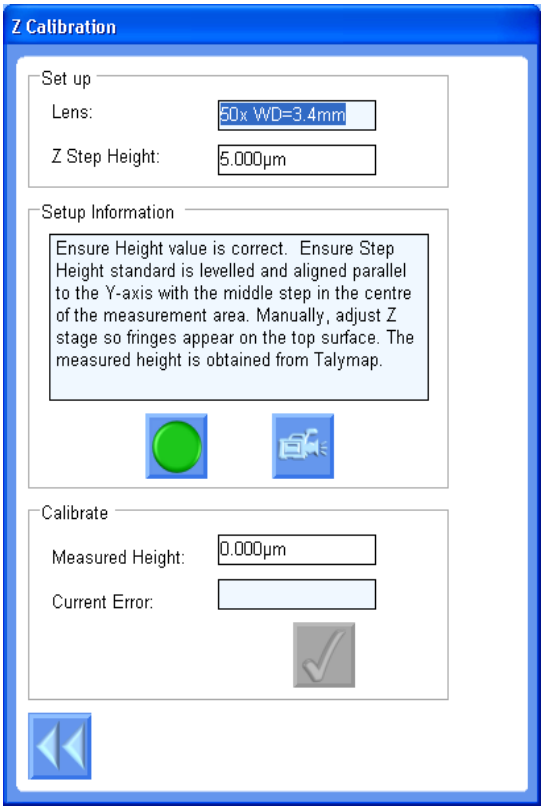
The diameter of the concentric circles on the calibration artefact are stored in a configuration file as default values. The user can supply an alternative diameter value in the calibration standard diameter box - if for example a more accurate figure was obtained from a different measuring device.

Z Calibration (Z Gain)

Artefact. 3 Line step height. TH offer two line step heights for the CCI instrument. One has a nominal step of 5µm and the other a step of 50µm You decide which to have depending on measurement range or lens type. You can also use your own standard.

If using the 50µm Step Height see page 4.29.

Sequence. User accesses "Z Calibration" from calibration wizard.

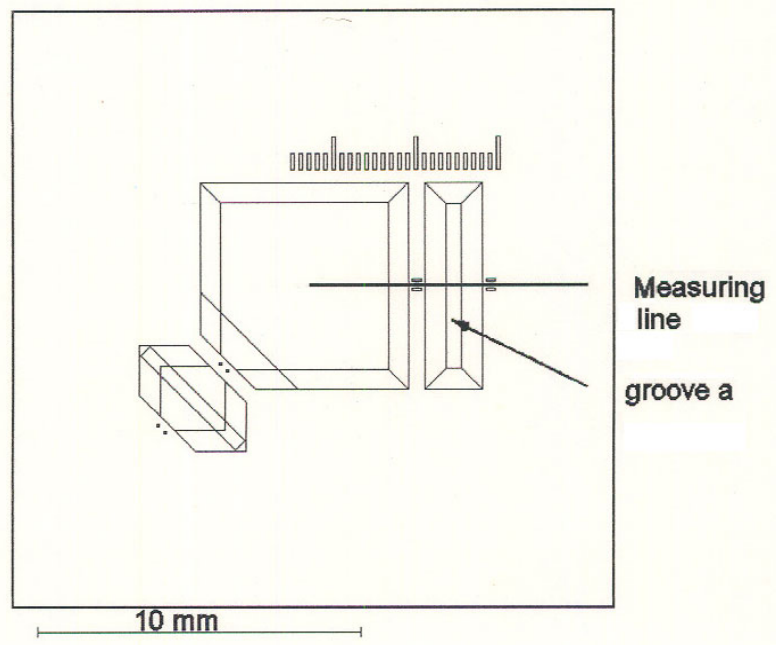


- Set up the calibration standard by following the instructions in the wizard.
- You can optionally modify a displayed actual step height value.
- To start the calibration you need to click on "Go" button.
- The wizard causes a measurement to be taken and step height to be calculated in TalyMap. A new gain is calculated.
- Alternatively you can enter the result for the calculated step height value and select the confirmation button.
- The wizard displays the "Current Error" as a difference between the measured step height (using previous gain) and the actual step height (e.g. 0.15µm).
- You decide if calibration is ok and select the "Accept" button on the wizard to cause wizard to store the calibration value (Z Gain) to a file against the current lens type.
- The CCI application applies the Z Gain correction to all measurements.
- To repeat the calibration, click on the camera button. This will

return you to the live video image so that you can repeat the process.

50μm step height procedure. Measure the 50μm Step Height and enter the measured value into Calibration wizard by doing the following:

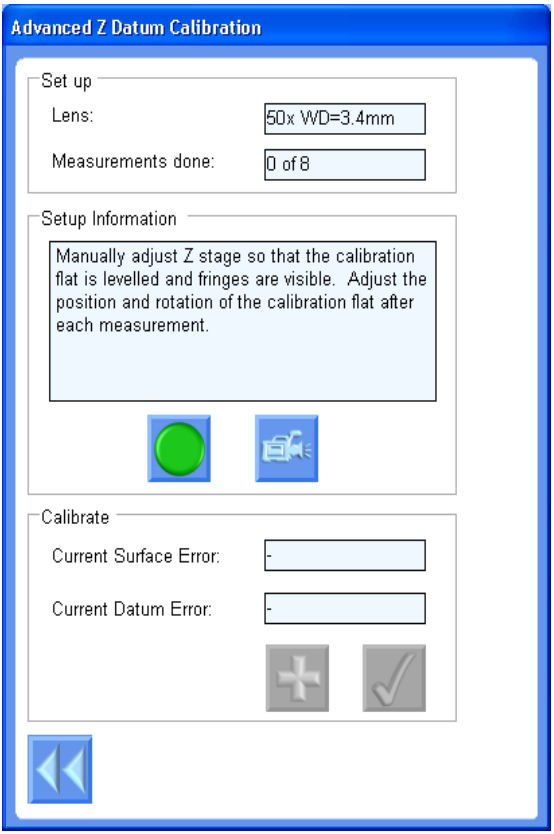
1. Run the Calibration Wizard and clear any existing Z Calibration.
2. In the Configuration Tab select 'Z' Mode, Zoom x1.
3. Ensure component is level, scan range is approx 60μm so that fringes occur on the top and bottom surfaces. Ensure the measuring line is in the centre.



4. Measure the levelled step height.
5. In Talymap, Zoom the required profile, Convert into a series of profiles and generate a mean profile. Analyse the step height of the mean profile.
6. Run the Calibration Wizard and select Calibration type Z.
7. Enter the calculated step height from Talymap into the "Measured Height" box and select "Accept" button.

Advanced Z Datum Correction (Z Form from multiple measurements)

Artefact. Circular coated glass mirror flat; Lambda / 50 is provided as an accessory, see page 4-34.



Sequence. User accesses "Z Datum Correction" from calibration wizard.

- Set up the calibration standard by following the instructions in the wizard.
- To start the calibration you need to click on "Go" button.

- The wizard causes a measurement to be taken and processed for form with the resultant surface being displayed.

Note: form processing involves levelling and filtering.

- You decide if the surface is ok and select "Add" to cause the surface to be added to the mean surface. The mean surface is then displayed and the wizard calculates "RMS" of the current surface (after software levelling and filtering) with current "mean surface" removed, i.e. datum corrected. The "RMS" value is displayed.

Note: You may choose to ignore the surface by not selecting "Add".

- Rotate and move the part.
- You then need to click on "Go" button, repeating until a pre-set number of acceptable measurements have been taken.
- The wizard calculates "RMS" of the current surface with the new "mean surface" and "RMS" of the current surface with the previous calibration's mean surface.
- The wizard displays the "Current Error" as the difference between RMS_new and RMS_previous (e.g. 0.85nm).
- You select "Accept" button on the wizard to store the calibration value against the current lens type.
- The CCI Application applies the Z Form correction to all measurements.

Z Datum Correction (Z Form from a single measurement)

Artefact. As for Advanced Z Datum Correction.

Sequence. Similar to that for multiple measurement Z Datum Correction except only one measurement is taken.

Application. As for Advanced Z Datum Correction.

Note: Only a single Z datum correction surface is to be maintained which is set either via the normal or advanced datum correction methods.

Calibration Artefacts

Available calibration artefacts for the instrument are the Step Height Calibration Standard, see figure 4-1 and 4-2, the Lateral Calibration Standard, see figure 4-3 and the Calibration flat, see figure 4-4. The Step Height Calibration Standard is used to calibrate the Z gain. The Lateral Calibration Standard consists of a number of concentric circles used to calibrate the XY gain.

The calibration artefacts available as accessories for the instrument are:

- Step height calibration standard 5μm with traceable calibration.
- Step height calibration standard 50μm with traceable calibration.
- Lateral calibration standard.
- Lateral calibration standard with traceable calibration.
- Precision flat.

- Precision flat with traceable calibration

Figure 4-1 Step Height Calibration Standard 5µm with traceable calibration

Three lines are etched onto the surface, the centre one being the calibrated line.

Figure 4-2 Step Height Calibration Standard 50µm with traceable calibration

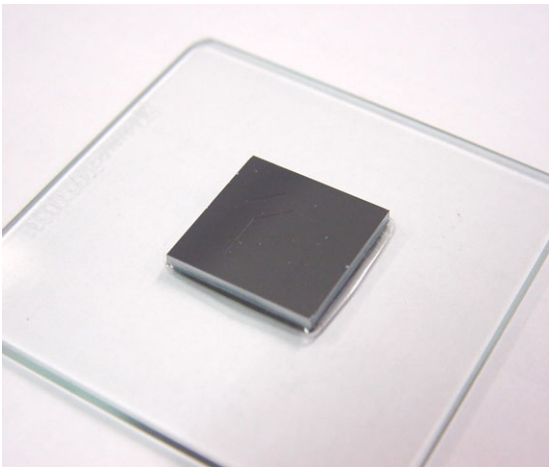
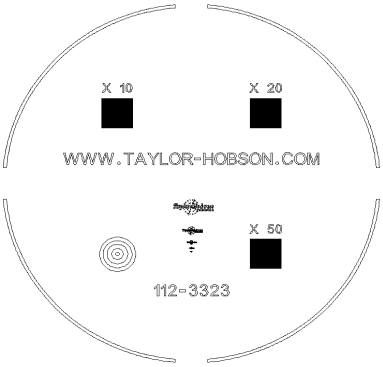
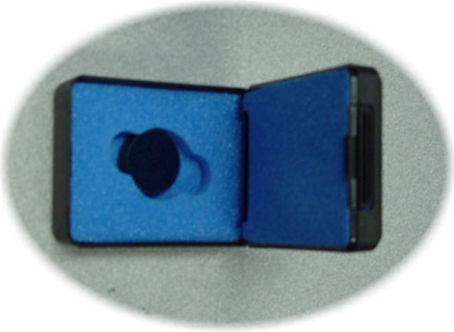


Figure 4-3 Lateral Calibration Standard with or without traceable calibration



There is an additional calibration artefact available, the Calibration Flat, that is used to calibrate and quantify the form error of the system.

Figure 4-4 Calibration Flat with or without traceable calibration



How Do I Make a basic Measurement

The steps to making a basic measurement are as follows:

- Select a lens
- Change the lens (if required)
- Position the component
- Configure the instrument
- Focus on Surface, Set Light Levels and Find Fringes
- Set Scan Length and start position
- Set up TalyMap
- Make a scan
- Analyse the results

Selecting a lens

The choice of objective lens depends on:

- how large an area you want to measure,
- the lateral detail you want to be able to resolve.

A 10x objective proves ideal if you need a medium field of view, but the 50x objective is more suitable if you need greater x/y resolving power or need to examine features that have high slope gradients.

Note. The vertical resolution of the instrument does not depend on the objective lens.

The higher magnification objectives are able to measure steeper inclines. This makes them more suitable for measuring extremely

rough surfaces and more undulating components than the lower magnification objectives, see Table 2-1 on page 2-3.

Changing lens. To change the lens, you must first unscrew the current lens from the instrument and return it to its plastic container, ensuring that it is screwed in place in the container lid. You can then remove the new lens you require from the lens container and screw this onto the instrument.

There is a quick release fitting that enables the lens to be changed quickly and easily.

Caution.

Great care must be taken not to touch the optical faces of the lens and to not drop the lens during removal and fitting.

After you have changed the lens, ensure that the correct objective lens is selected at the top of the Configuration Tab of the UI.

Positioning the component

Place the component to be measured onto the measuring table top and roughly locate the region of interest beneath the objective lens. On a textured surface you will be able to see a light spot on the area.

Configure the Instrument

See How Do I Configure My Instrument, see page 4-21.

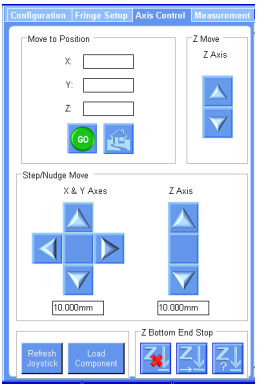
Focus on Surface, Set Light Levels and Find Fringes

The following quick procedure will focus on the surface, set appropriate light levels and find the required fringes. A more advanced procedure is given in Advanced topics, see page 4-43.

- Select the live video tab on the UI.
- Ensure x1 zoom is selected in the Configuration Tab of the UI.
- Use the Z adjust to move the measuring head closer to the component than the objective lens' working distance (see Table 2-1 on page 2-3).

OR

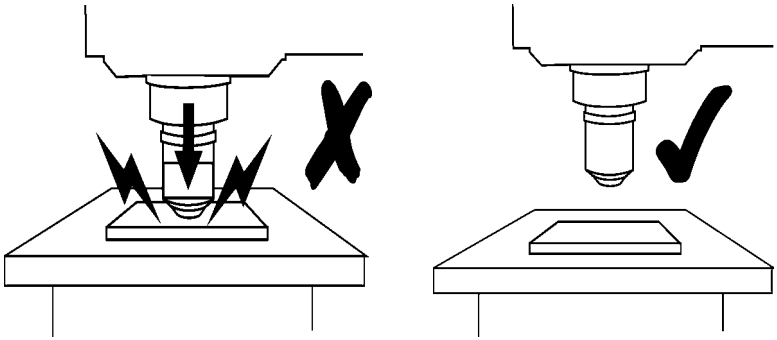
Z Control, one each side



Caution.

When the objective lens is close to the surface of the component, take care not to impact the objective or the PZT body into the com-

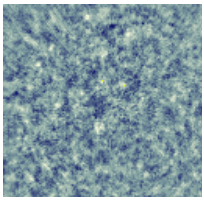
ponent as this may damage the objective or the PZT scanner. THIS IS NOT COVERED BY WARRANTY. There is a piezo buzzer that warns of contact of the objective with the component.



- Turn on the light source.
- Set the light level using the light level control so that a small yellow area can be seen on the image. Use the Z adjust to raise the measuring head. The size of the yellow area will increase to a maximum, as will the light level display. At this point you are close to the fringes.

- Reduce the light level so that no yellow areas are present, light level is approximately 50 on light meter with no fringes visi-

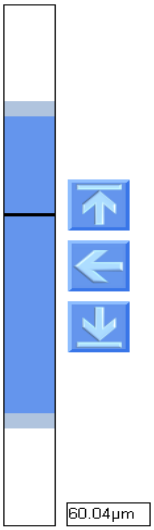
ble. This method is particularly effective with the 50x objective. Use the Z adjust to slowly move the component in Z until the fringes appear.



•If at any point you see an image similar to that shown, use the Z adjust to bring the component **closer** to the objective lens. The image is part of the instrument's optical system that has come into focus. This image is very close to the fringes with the 50x objective but gets further away the larger the objective.

Set Scan Length and position

Scan setting buttons. These buttons found on the Fringe Set up tab enable you to set a position on the piezo/scan range as the:



- Top of the scan
- Set piezo to centre of range
- Bottom of the scan

The slider. The slider shows the extent of the scan as defined by the scan setting buttons. The top line is the top limit marker and is defined by clicking on the Top of the scan button, whilst the bottom line is the bottom limit marker and is defined by clicking on the Bottom of the scan button.

The lighter areas at the top and bottom of the range represent the run-up and run-down sections of the measurement.

IMPORTANT. For the measurement to capture all of the data, all of the fringes have to appear between the top and bottom limit markers.

Turn off any focussing aids (Contrast reference, Gradient enhance and Focus filter) and use the slider to move the fringes around to check the light level. Adjust the light level so that no yellow areas are visible. Yellow areas show that there is too much light. If a pixel is saturated at any point during a measurement it will turn into missing data.

Setting TalyMap options

There are a number of options that you can set that will affect the way that TalyMap acts on the data measured.

Save 3D Data File As: Enter the filename that you wish CCI to save the measured data file under.

Auto-increment. If the box is ticked then subsequent measurements can be stored with the same filename, the software will add a three digit extension to the filename, eg TalysurfCCI001.sur, TalysurfCCI002.sur, and so on.

New document. Select this tickbox if you wish TalyMap to start with a new document when it analyses the measured data.

Apply template to document. Select the template that you wish TalyMap to apply to the analysed data. Click on the ellipsis [...] to browse the available templates. If the template operates on a single measurement, select the new document option also.

Auto run TalyMap. Select this tickbox if you wish TalyMap to automatically start once the measurement is complete.

Show TalyMap button. Click on this button to start the TalyMap program manually.

Making a Scan

To make a scan, click the go button in the Measurement Tab, a new dialogue appears detailing progress and providing you with a Stop button. You cannot move around the UI while a measurement is taking place. The only button you can press is the red stop button. If desired the component can be moved once the 'scan' progress bar is complete.

Basic Analysis

Once the measurement is complete the 'Surface' pane will show the result. The shape of the surface is suggested by a 'bluescale' image, where lower areas appear darker than higher areas. Any red spots are missing data.

The analysis of the results is performed using TalyMap. Please refer to the TalyMap system for Operating Instructions.

To start the TalyMap program click on the Show TalyMap button.

Note. After the surface has been displayed for a short while, the live video pane is automatically redisplayed

Calibration

Note. you should calibrate the instrument regularly and monitor the calibration constants to enable you to monitor the effects of the environment and time on the stability of the instrument and the measurements made.

See How Do I Calibrate the instrument, page 4-23.

Advanced Measurement Topics

Technical Description of Scanning Broadband Interferometry

An interferometer is an optical device that splits a beam of light from a single source into two separate beams. Each of these beams travel separate paths, one onto a reference surface and the other onto the surface to be measured. The beams are then recombined resulting in an interference pattern. An imaging device, usually a CCD array, is used to collect this information.

In a scanning broadband interferometer a white light source is used, this has the effect that interference reaches maximum intensity when the two paths, one to the reference and the other to the sample surface, are the same distance. By moving the interferometer vertically away from the measurement surface the point at which this interference occurs can be found for each pixel of the CCD. By tracking the position of the interferometer during this process a 3D map of the surface can be formed.

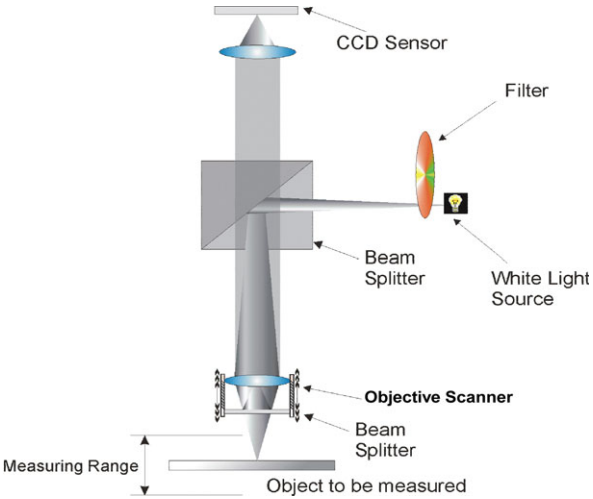


Figure 4-2 Interferometer Schematic

Sample Preparation for Measurement

Samples for measurement must be clean and free from grease, smears, fingerprints and dust. Handling procedures must ensure that the sample is not contaminated with any of these. No other preparation for the sample is necessary.

- If there are fingerprints/smears on the sample the instrument will measure them, rather than the sample itself.
- Bits of dust and dirt on the sample could end up as missing data.

Good Metrology Practice for CCI

As mentioned in Chapter 3, the following areas will affect the quality of the measurements made:

- Locating the instrument in a clean area to minimise airborne particles, ie smoke, dust and airborne oil particles.
- Draughts and airborne vibration should be avoided.
- Temperature Gradients, areas that experience temperature gradients of over 2°C/hour are not ideal for the measurement of precise form.
- Vibration is particularly detrimental for the measurement of surface texture. Sources of vibration should be removed
- It is important that a clean power supply should be provided to the instrument.

Finding Fringes and Use of Levelling Stages

Finding fringes. The following procedure defines the process for finding fringes for the two specific cases you may come across, ie a surface with defined features, or a featureless surface where the image focussing is used to assist the process:

- Turn on the light source.
- Ensure x1 zoom is selected in the Configuration Tab of the UI.
- Use the Z adjust to move the measuring head closer to the component than the objective lens' working distance (see Table 2-1 on page 2-3) given on the side of the objective lens
- Select xyz mode and ensure that the Data Out Mode > Low Noise is not selected on the Special options dialog. This reduces the camera exposure time that improves visibility of fringes when the Z axis is moving.

If the component is machined metal/rough (non-ceramic)/etched/ MEMS…

- Set the light level so that no yellow areas are visible. The video panel should show a pale blue colour.
- With no fringes visible, a light value of 50 on the light meter will give best results
- Use the Z adjust to bring the part into focus and interference fringes should become visible.
- Also turn on the gradient enhance.

If the component is smooth and featureless…

- Set light level so that no yellow areas can be seen, with no fringes visible, a light value of 50 on the light meter will give best results. The monitor should show a pale blue colour.

- In the configuration tab, set mode to xyz and scanning speed to x9, also adjust the filter on the light box to III.
- Select the Fringe Setup tab of the UI. If no features are visible click the contrast reference button and turn the contrast reference option on.
- Move the Z adjust to raise the measuring head until a surface comes into focus.
- Use the Z adjust to find the fringes.
- Set the mode, scanning speed and filter back to the required values.
- Turn off the focus aids and ensure there are no saturated (yellow) areas.

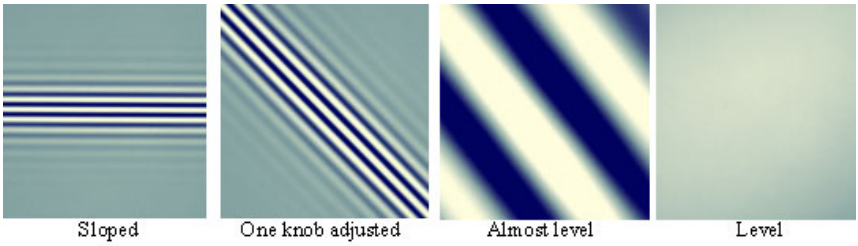
Levelling a component. The interference fringes that you see on the video screen of the software are a certain vertical distance apart. Therefore the more fringes you see or the closer the fringes are together, the less level the component is.

If you spend a little time levelling a component well, the measurement time can be reduced significantly, as the instrument does not have to scan as far as it would with an unlevelled component. The end result is also slightly better, although it should be noted that the difference created by a shallow slope is very slight.

If necessary use the focussing aids on the Fringe Setup Tab to make the fringes more obvious. Rotating a knob on the tip-tilt stage clockwise causes the fringes to rotate anticlockwise and vice versa.

To level the component you need to rotate the right-hand knob on the tip-tilt stage until the fringes spread out and cross the screen at 45°. While doing this use the Z adjust to keep the fringes on the

screen. Then rotate the left-hand knob, causing the fringes to spread out further until a single fringe can be seen on the screen.



Pre-Analysis of Results, Assessment of missing Data etc.

Once the measurement is complete the 'Surface' pane will show the result. The shape of the surface is suggested by a 'bluescale' image, where lower areas appear darker than higher areas. Any red spots on the image are missing data.

Missing data could be due to having the light level set too high, try reducing the light level and re-performing the measurement, the missing data should be reduced, see setting light levels information on pages 4-37.

Data Binning

Data Binning refers to the process of averaging the data from adjacent pixels, averaged to give one average pixel selected from the surrounding pixels.

To set the binning level you should select the appropriate resolution mode, that is ‘XY’, ‘xyz’ or ‘Z’.

- The 'XY' resolution mode gives the greatest lateral detail. It looks at all 1024x1024 pixels of the camera individually,

resulting in a longer calculation time. This mode would, for example, be used when measuring a finely polished sample.

- The 'xyz' mode applies 2x binning. This means that a square of 2x2 pixels is averaged to create one, bigger, average pixel. This results in better Z resolution, but you loose out on some x-y detail.
- The 'Z' mode applies 4x binning; a square of 4x4 pixels is combined into one. This gives the best result in Z, although more x-y detail is lost. Z mode would, for example, be used for measuring step heights.

Camera binning decreases the scan time, but software binning decreases the system noise.

How do I use the Special Options

To access the Special options, click on the Exclamation mark button in the Configuration Screen.

The Special options dialog offers the following functionality:

Note. For details of what each option does and the disadvantages of each, see page 4-8.

Data Output Mode (Low Noise).

This consists of a tick box to select Low noise, which uses software binning, the default condition is with the tick box unselected. When to use it: When the very lowest level of measurement noise is required, less than 5nm. How to use it: Select either ‘xyz’ or ‘Z’ mode, depending on lateral detail required, select ‘Low Noise’.

Scan Type.

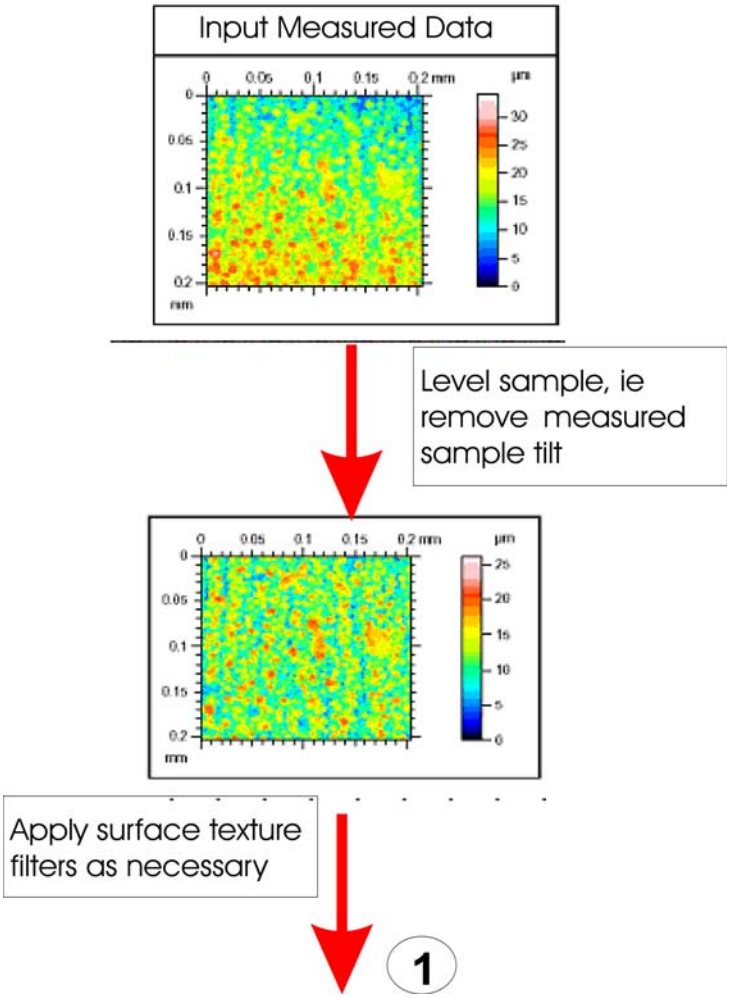
The options are Top Surface selected and Top Surface unselected (Standard). When to use it: Use it to automatically measure top surface only on samples with more than one reflective layer. How to use it: Select 'Top Surface'.

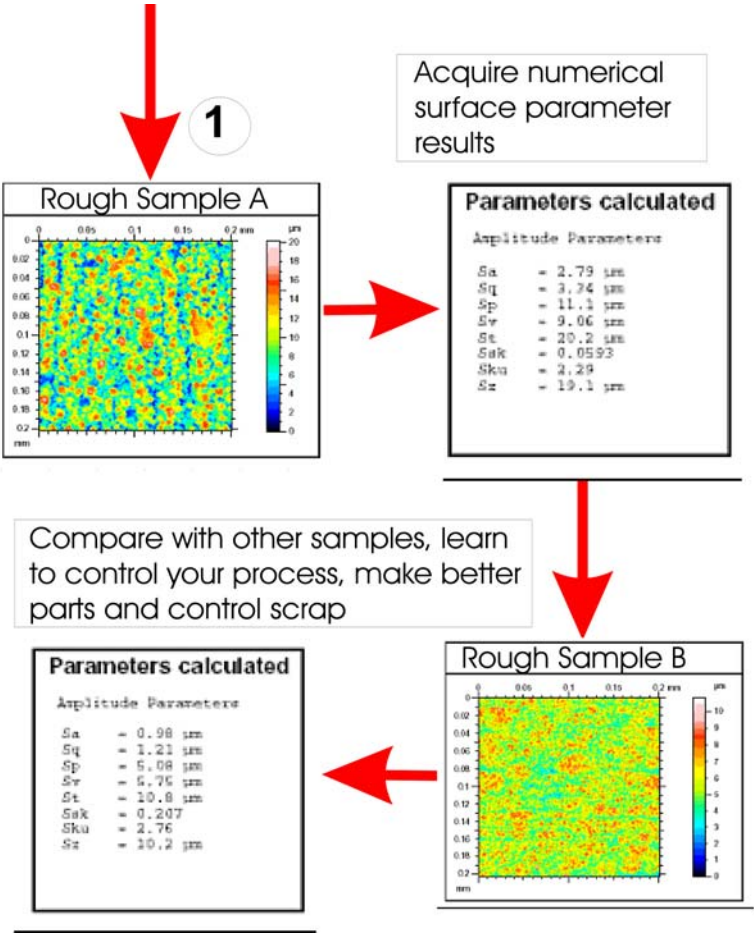
Post Threshold.

This consists of a slider that goes from min to max (default). When to use it: Use to reduce the amount of missing data caused by low surface reflectivity. How to use it: Select 'Post' on the 'Measurement' tab. Select a lower Post Threshold to allow the system to measure lower reflectivity surfaces.

Basic TalyMap Functionality

For full operational details consult the TalyMap documentation




1
Acquire numerical surface parameter results
Rough Sample A
Parameters calculated
Amplitude Parameters
Sa = 2.79 µm
Sq = 3.74 µm
Sp = 11.1 µm
Sv = 9.06 µm
St = 20.2 µm
Ssk = 0.0593
Sku = 2.29
Sz = 19.1 µm
Compare with other samples, learn to control your process, make better parts and control scrap
Rough Sample B
Parameters calculated
Amplitude Parameters
Sa = 0.98 µm
Sq = 1.21 µm
Sp = 5.08 µm
Sv = 5.75 µm
St = 10.8 µm
Ssk = 0.207
Sku = 2.76
Sz = 10.2 µm

Using the 2.5x lens

Interconnection of Piezo Servo Amplifier (2.5x lens) and Installation of lens

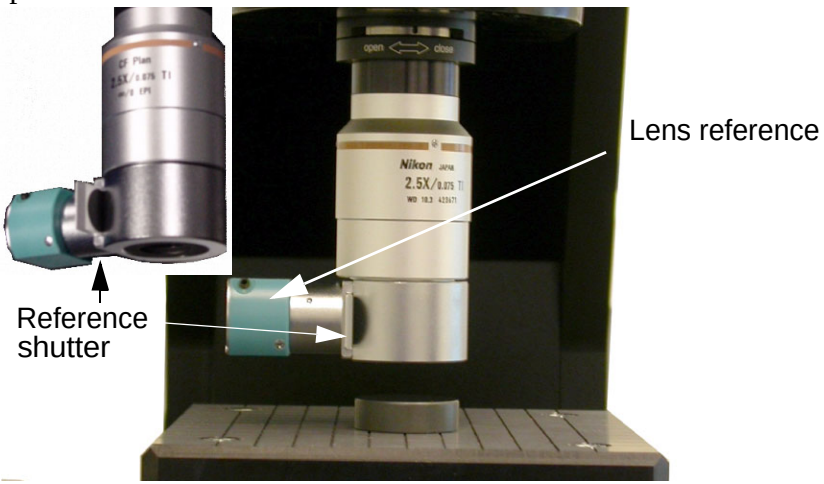
Switch off the power to both of the piezo/servo amplifiers.

Caution.

Failure to switch off the power to the piezo/servo amplifiers before removing or connecting cables could result in damage to the piezo/servo amplifier.

Installation of lens. To install the 2.5x lens, you must first unscrew the currently installed lens from the instrument and return it to its plastic container, ensuring that it is screwed in place in the container lid. You can then remove the 2.5x lens from the lens container and carefully screw this into place on the instrument.

Ensure that the lens reference is at the Left Hand Side and the reference shutter is in the forward position as shown in the photograph.

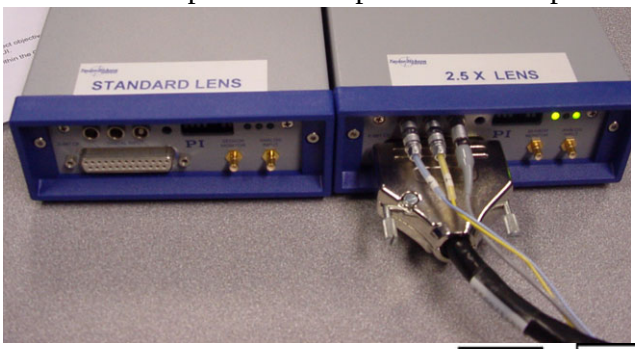


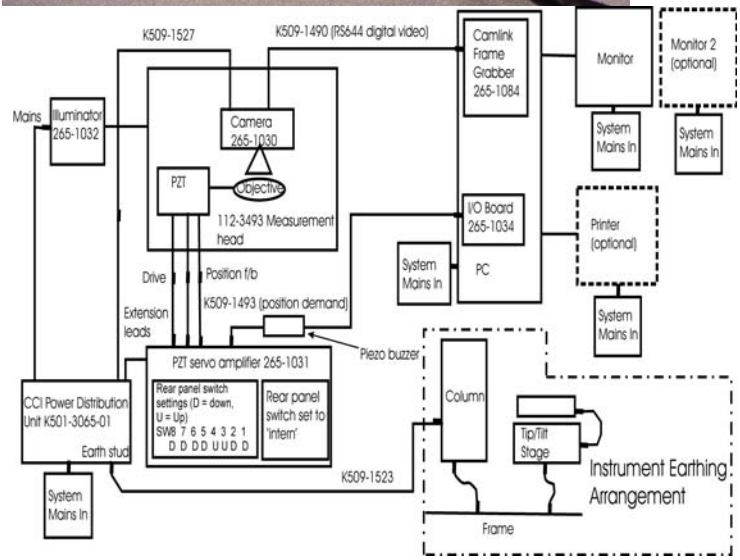
Caution.

Great care must be taken not to touch the optical faces of the lens and to not drop the lens during removal and fitting.

Remove the power lead, the three Lemo coaxial connectors and one D type connector from the standard Piezo Servo Amplifier and connect to the Piezo Servo Amplifier specially configured for the 2.5x lens, see photograph and interconnection diagram.

Switch on the power to the piezo/servo amplifiers.





Using the lens. After you have changed the lens, ensure that the correct objective lens is selected at the top of the Configuration Tab of the UI. The following procedure needs to be used to perform the Z Calibration (see also page 4.27 of User's Guide):

Measure the levelled step height using zoom magnification of x2.

In Talymap apply the template "StepHeight.MNT" which will determine the step height value.

Run the Calibration Wizard and select calibration type Z.

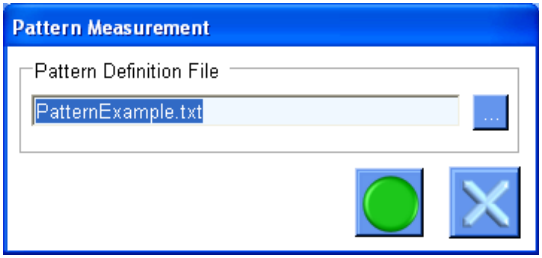
Enter the calculated step height from Talymap into the "Measured Height" box and select the "Accept" button.

After taking a measurement TalyMap can be used to zoom to the required field of view. An example TalyMap template is available named ZoomFor2.5xLens.mnt and this can be specified in the UI's Measurement tab.

Patern measurement

Pattern Control

The pattern is controlled via a pattern file, described later, which includes X Pitch, Y pitch, X measurements, Y measurement. The user may select which pattern file to use via a dialog shown below, at the start of the pattern measurement. The selected file will be checked to ensure it is valid and any errors reported.



Alignment information consisting of up to 2 points (defined in grid relative co-ordinates) is also stored in this file.

Alignment point indices are based on an index of 1 (instead of standard zero based index).

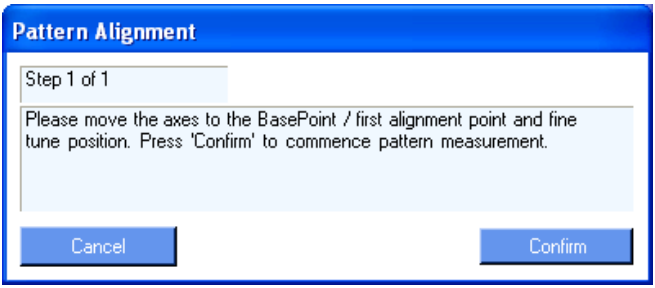
Automatic positional correction / tracking is available for X, Y & Z axes and can be turned on or off via the 'XYCorrectionRequired' and 'ZCorrectionRequired' settings in the definition file.

An example file is available, PatternExample.txt (in the Application's installation folder).

Pattern Execution

During pattern execution live video is displayed (no surface images).

Alignment dialog displayed if necessary asking the user to move to / confirm position of 1st (and 2nd if required) alignment point as defined in pattern file. This only appears if "AlignmentRequired" is set to 'true' in pattern file.



A Progress dialog is displayed during a pattern measurement to indicate pattern site and total sites.

Movement. A raster movement is performed across all sites. First site is current position. On completion the system moves back to the first position. Movement order is along increasing X, move to next Y and return to start of X, etc.

Measurement/Analysis. This is done at each site using current measurement and Talymap settings. If Talymap parameters are calculated then an export of Talymap data is done and concatenated into a file, "PatternResults.txt", overwriting the existing file.

If the user stops the pattern or an error occurs then the user is prompted for "Repeat the measurement", "Go to next measurement" and "Abort".

At the end of the pattern the axes and piezo are returned to their starting positions.

Pattern File

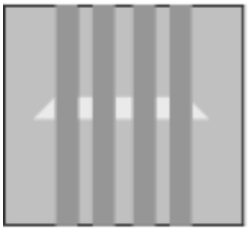
The pattern file consists of the following entries:

Line	Comments
[GridPatternSettings]	Section Header for measurement positions
X Pitch MM=0.01	Distance between X positions (mm) 0 and above.
Y Pitch MM=0.01	Distance between Y positions (mm): 0 and above.
X Total=3	Number of X positions: 1 or more.
Y Total=3	Number of Y positions: 1 or more.
MeasureAllPointsInGrid =True	Set to "True" to measure all points in a grid. False is not yet supported.
[Alignment]	Section Header for alignment information
AlignmentRequired=False	"True" if alignment points are to be used.
Number of Alignment Points =2	Number of alignment points to be used 0,1 (X1,Y1) or 2 (X1,Y1 and X2,Y2)

X1 Index=1	X Index of first alignment point, typically 1: 1 to <X Total>.
Y1 Index=1	Y Index of first alignment point, typically 1: 1 to <Y Total>.
X2 Index=2	X Index of second alignment point, typically <X Total>: 1 to <X Total>. 0 if not required, Y2 must also be 0.
Y2 Index=1	Y Index of second alignment point, typically <Y Total>: 1 to <Y Total>. 0 if not required, X2 must also be 0.
[AutoCorrection]	Section Header for auto correction (tracking) information
XYCorrectionRequired =False	"True" if tracking in XY required. Only valid for HDD measurements, and uses HDD reference position to align XY for next measurement.
ZCorrectionRequired =False	"True" if tracking in Z required (uses mean surface height and adjusts the piezo position for the next measurement).

Hdd Slider Measurement

The slider should be set up with fringes normal to the head as shown below.



Actions menu and toolbar button to start a slider measurement. Only available if licence is registered.

The HDD Slider information dialog contains fields for the user to enter slider type, related information and results file name. The user has the option to specify whether a single slider or a slider holder is to be measured.

The slider type is specified as a file name. This file contains details of each step to be measured on the slider. File details are provided below.

The results file contains settings and results for each slider measured. A new file is created at the start of each slider holder measurement. File details are provided below.

After an HDD slider measurement the enhanced surface image will be displayed.

After an HDD slider measurement selecting/deselecting the 'Peak' radio will only display the enhanced SUR file output and not toggle between peak and phase results.

Help menu contains licence item. Selection displays licence status and option to enter a new licence that matches the unlock code of the PC.

Slider measurement

This is carried out with the following measurement settings:

- Mode: XY
- Zoom: x2 (recommended)
- Concurrent
- Special options: Off
- Slider Type definition file.

Slider Holder Control

The pattern feature is used to control the measurement of each slider site on a slider holder. The pattern file is provided by the user via the slider settings dialog.

The output from each slider measurement is appended to the results file. Note: If it is a holder measurement then the existing file will be deleted first.

Slider Definition Set-up

A graphical interface is provided via the Tools menu HDD Set-up option to allow creation / editing of slider definition files. The system should be set up as it would for a slider measurement with a sample slider in focus then run the HDD Set-up dialog. Follow the instructions in the dialog to create or edit a settings file and then use this settings file in the HDD Settings Form (See 'Hdd Slider Measurement' section above).

Slider File Format

An example slider file is shown below:

Line	Comments
[Coating Definition]	Section header for type of coating
DLC Coated = 1	Identifies if slider is DLC coated. "1" =Coated, "0" = Not Coated
[Position Find Definition]	Section header for reference point definition (see Note 2).
HorizFindOffset = 31	Distance up from horizontal reference used to find vertical reference line.
HorizFindLength = 100	Length of horizontal search centred around vertical reference line.
[Normalisation Definition]	Section header for normalisation area definition. (Should be AlTiC)
Width = 224 Height = 35 Left = -112 Top = -55	Position and area parameters (see Note 1).
[Reference Definition]	Section header for reference area definition. (Should be planarised AlTiC)
CorrectFull = 0	Correction to full reference area, used if the form of the AlTiC area is to be measured.

	"1" = on, "0" = off. Note: Step heights are always calculated relative to the defined reference region.
Width = 224 Height = 144 Left = -112 Top = 34	Position and area parameters (see Note 1)
[Step 1 Definition] definition	Section header for first step
Name =S1	Step identifier. This will appear in the results file.
AlumOxide = 0	Identifies region step is in. "1" = Aluminium Oxide region, "0" = Magnetic Region
Width = 60 Height = 3 Left = -30 Top = 23	Position and area parameters (see Note 1)
[Step 2 Definition]	Section header for second step definition Up to 10 'step' definitions may be provided, use the following section headers: [Step 1 Definition] [Step 2 Definition] … [Step 10 Definition]

Note:

1.Position and area parameters

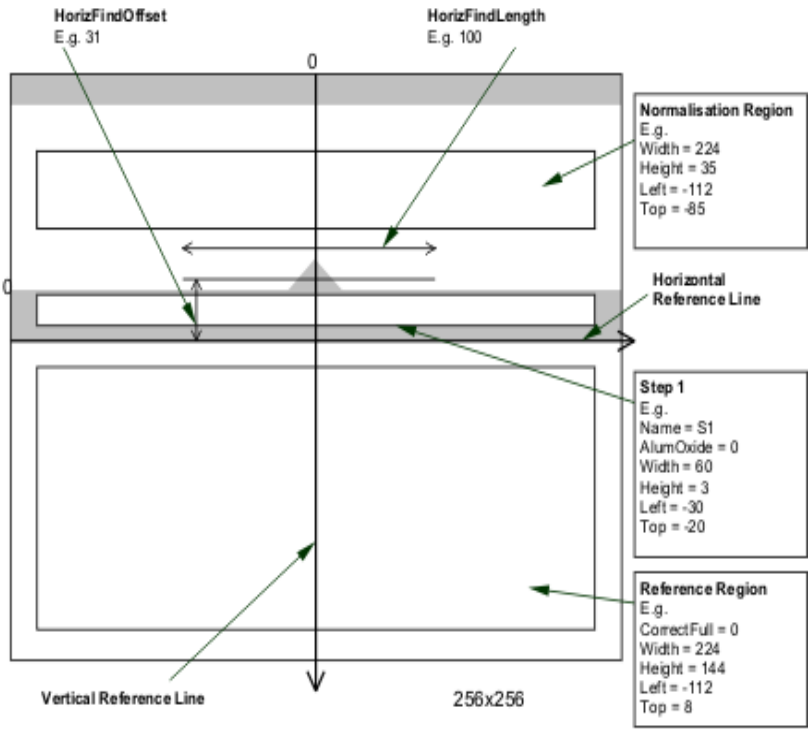
These parameters are provided in pixels. The image area is 256 x 256.

The 'left' and 'top' parameters are with respect to the reference point. Note that the value is negative to the left of and above the reference point.

2. Reference point definition

A search is made from the top to locate the rough position of the magnetic area lower edge followed by a refined search at different angles until the horizontal reference line is found. The X,Y reference point is then found by moving up a distance of HorizFindOffset normal to the reference line and searching along a profile of length HorizFindLength until a defined landmark on the slider is found.

An example slider image with rectangular areas is provided in the following Figure.



Slider Results File

An example results file is shown below.

All values are in mm.

For each 'step' defined in the definition file there will be a corresponding step height value and a roughness value (RMS) in the results file.

There is one row of results for each slider.

File Name	Slider	Slider Type	Batch ID	User Info	Oper-ator	S1 RMS	S1 Height	ALR RMS	ALR Height
C:\HDD001.SUR	00 00	Typ1	A034	-	U1	2.87 E-06	1.29E -05	6.31E-06	-2.1E-05

Lenses

Objective Lens	Field of View/mm	Working Distance/mm	Lateral sampling resolution/μm	Maximum component slope/°
10x	1.26 x 1.26	7.4	1.2	+/- 8
20x	0.63 x 0.63	4.7	0.62	+/- 14.5
50x	0.25 x 0.25	3.4	0.25	+/- 22

Power lead

The power lead K509/1527 on the interconnection diagram on p.3-24 of the User Guide is replaced by K509/1539.

Chapter 5
Maintenance Procedures and Service Support

Cleaning and Routine maintenance

General Cleaning

Caution:

Cleaning of the instrument using inappropriate cleaning materials may lead to damage being caused to the instrument. The cleaning of the instrument is to be limited to cleaning of the instrument covers and the tabletop only

1. The covers should be cleaned using a soft cloth moistened with water or if required a mild detergent solution. No cleaning solvents or abrasive cleaners of any kind should be used on the covers as these may damage the surface of the covers.
2. The tabletop can be cleaned with a soft cloth moistened with Isopropyl Alcohol if required.

Lens Cleaning

Caution:

UNDER NO CIRCUMSTANCES are you to attempt to clean any of the lenses with anything other than lens cleaning tissue, eg Whatman lens cleaning tissues cat no. 2105841. Also use either Isopropyl alcohol or Ethanol to moisten the tissue, DO NOT use Methylated Spirit, Acetone,Water or any Aerosol cleaner.

PC Anywhere

The PC has PC Anywhere software installed. This is for use by the Service Engineers for remote fault diagnostics of the system. If the Service Department need to use this facility you will need to connect the computer to the telephone line using the cable supplied and then run PC Anywhere. Instructions will be supplied from the Service Engineer as to what other actions you will need to take. No attempt should be made by the User to change any of the settings associated with this software.

Service support and Spares

If you should need to contact the Taylor Hobson Service department, please use the following contact numbers.

- Telephone: +44 116 2463135
- Fax: +44 116 2460325
- e- mail: service@taylor- hobson.com

Spares

The following is a list of spares that you should maintain.

- 112-3348-01 - Projector Lamp For Illuminator
- You should maintain a set of replacement fuses for the instrument and its associated equipment. (Not supplied by Taylor Hobson)

Chapter 6
Fault Analysis

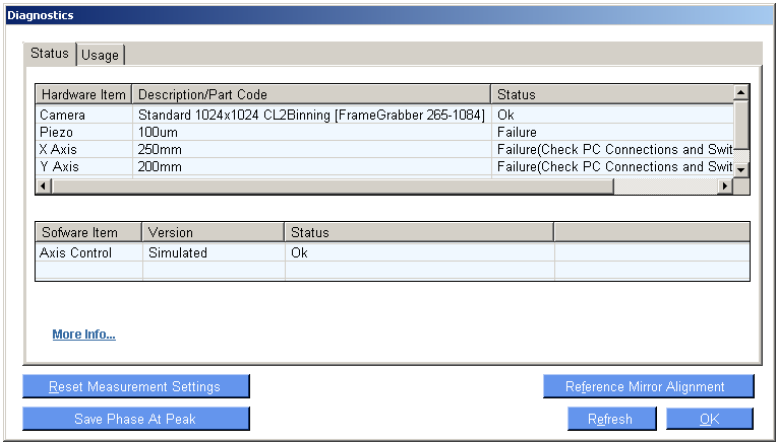
Fault analysis and repair

This Instrument and its Software have been carefully designed and tested. However, we accept that, despite this testing, faults, or apparent faults, may occur.

Software diagnostics

The software diagnostics facility automatically runs when the software starts up to check if everything is functioning correctly. To run the facility at any other time during use of the instrument, you must be logged on as an Admin or Service user. Click on the Diagnostics button to run the facility.

The diagnostics facility lists the main components of the system and their status.



Fault table

The following table shows the type of fault and the suggested repair that may occur from time to time.

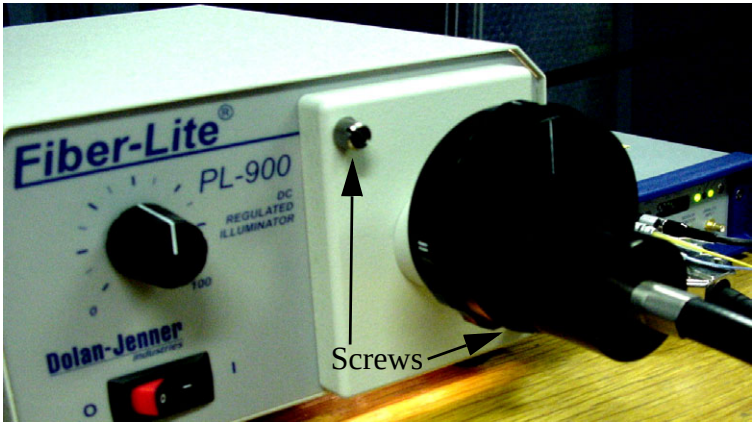
Table 6-1: Simple Fault Analysis and Repair

Description of Fault	Possible cause	Suggested action
Computer ON/ OFF Switch LED not lit.	Mains voltage not present.	Check mains connections.
	Blown fuse in computer.	Check fuses.
Keyboard not working.	Connection.	Check connection.
Mouse not present.	Mouse not plugged in.	Check connection.
Random errors generated.	Noisy mains.	Use a mains filter on the mains input.
	System not earthed.	Correctly earth the system
No light from light unit	Blown fuse in light unit or power distribution Unit.	Check fuses.
	Light bulb blown.	Replace bulb, see page 6-3.

Table 6-1: Simple Fault Analysis and Repair

Description of Fault	Possible cause	Suggested action
Poor image quality.	Dirty objective lens.	Clean lens, see page 5-1
	Vibration affecting the system	Remove vibration source or isolate from vibration (check AV mounts are correctly functioning
No measured data	Incorrect light level	Adjust light level
Noisy result	Incorrect filter setting	Select correct filter.
No image	Camera not switched on.	Switch on camera
	Light Unit not switched on.	Switch on light unit.
Image does not change when fringe settings slider is adjusted	Piezo unit not switched on.	Switch on piezo drive unit.
Motorised /Automatic axes fail to move		Check all connections
		Use diagnostics to check for faults.

Bulb replacement procedure



Warning.

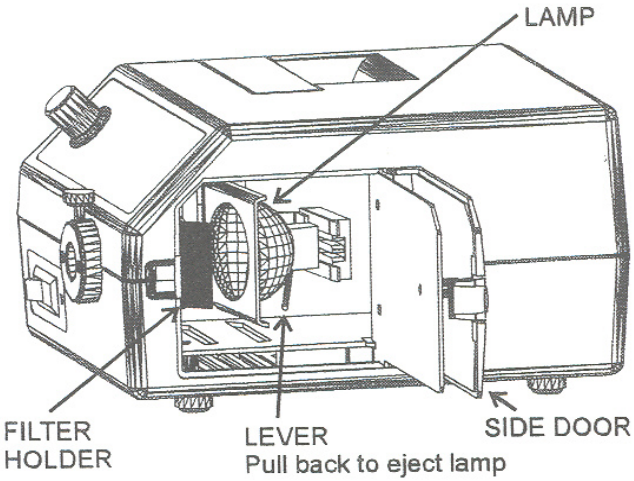
Ensure that the power is removed from the light unit and allow a short time after removal of the power for the bulb to cool down before attempting to change the bulb.

- Unscrew the two screws securing the front plate to the light unit and withdraw the plate and attached lamp holder chassis from the light unit.
- Remove the connector from the back of the bulb and slide the bulb out of the holder.
- Replace with new bulb and re-attach connector. DO NOT touch the bulb with uncovered fingers.
- Slide lamp holder chassis back into the light unit and secure with the two screws.
- Order replacement bulb, 112-3348-01 - Projector Lamp.

Lamp replacement for alternative illuminator type

WARNING.

Risk of electrical shock. Remove power plug before lamp replacement and wait for hot lamp to cool



1. Turn the illuminator intensity control fully counterclockwise (the 0 position) and run the illuminator with the fan for several minutes. Wait until the nosepiece is cool to the touch.

2. Press the ON(1)/OFF(O) rocker switch to the OFF(O) position.

3. Remove the AC power cord from the AC power receptacle.

4. Open the lamp access door by depressing the small clip toward the rear of the illuminator with your thumb or finger. Once the clip disengages from the illuminator housing the lamp access will spring open several inches. The lamp access door will open slightly more than 90^{o} to allow easy access to the lamp and lamp socket.

Do not pry open the door with a tool. This may result in damage to the illuminator housing or the lamp access door.

5. Check the lamp assembly to verify that the lamp and socket are cool before proceeding. Caution: The lamp runs at very high temperatures and contact with a hot lamp may result in severe injury.

6. Pull the lamp eject lever to remove the lamp from the socket.

7. Lift and remove the lamp from the lamp socket by grasping the rear of the lamp adjacent to the lamp power pins.

8. Remove the lamp from the socket.

9. Discard the old lamp.

10. Insert the replacement lamp into the lamp socket by aligning the lamp power pins with the slots in the lamp socket. CAUTION: Do not touch the interior of the lamp reflector, the lamp envelope or the lamp pins with your fingers. Touching the interior of the lamp reflector, the lamp envelope or the lamp pins will result in significant shortening of the lamp life. Handle the lamp only by the exterior of the reflector or the area adjacent to the pins.

11. Push the lamp gently into the socket to seat the lamp in the socket and lampholder.

12. Rotate the lamp access door toward the illuminator housing and gently press the lamp access door to cause the door clip to seat into the housing and secure the door.

13. Reattach AC line cord and the illuminator is ready for service.

Fault reporting

This Instrument and its Software have been carefully designed and tested. However, we accept that, despite this testing, faults, or apparent faults, may occur. In the first instance please report all faults to the Service Department at Taylor Hobson.

- Telephone: +44 116 2463135
- Fax: +44 116 2460325
- e- mail: service@ taylor- hobson.com

If you believe you have found a fault with the instrument, the software, with this user guide or with the "On- Line" Help text, please contact the help desk by e- mail with a description of your fault:

E mail address: helpdesk@taylor-hobson.com

To aid us evaluate the symptoms, please give the following: -

- The Licence Registration No. (TayMap only)
- The Software Version.
- The Instrument configuration.
- The P. C. and Printer type.
- The area of software in which the fault resides.
- A full description of the problems with print-outs (if possible).
- The measurement data (if possible).

Taylor Hobson would also appreciate any comments you may have about improving this software.

Many thanks for your co- operation.

Chapter 7
Accessories

112-3350-02 - Instrument Desk

Dimensions. Height: 750mm to 760mm (by adjustment) to table top. **Width**: 900mm. **Depth**: 890mm.

K505-71 - CCI User Manual For Clean Rooms

This is an identical manual to this one printed on material suitable for use within a clean room environment.

K505-72 - CCI Quick Reference Guide For Clean Rooms

The Quick Reference Guide for Clean Rooms consists of a number of encapsulated instruction sheets that instructs the user in the main instrument operations. Essentially the Quick Reference Guides act as reminders on the sequence of operations to achieve the required action.

112-3348-01 - Projector Lamp For Illuminator

112-3323-01 - Lateral Calibration Standard

Description. This calibration standard is used to calibrate and verify gain in X and Y directions by measuring the diameter of concentric circles. It consists of a grid to verify distortion (linearity) in the X-Y plane by measuring the distortions of the straight lines.

Specification:

- 5 concentric circles, used for lateral calibration of X and Y gain for 2.5x, 5x, 10x, 20x and 50x lenses.

- 3 grid patterns (one for each objective lens);
- Each grid pattern covers an area of $10mm^2$; the grid line pitch and line width is

  10um wide @ 100um pitch for the 10x objective.
  5um wide @ 50um pitch for the 20x objective.
  2um wide @ 20um pitch for the 50x objective.
- Each grid patch has the corresponding objective magnification value and pitch value displayed below the patch in 2mm high lettering.

112-3498-01 - Lateral Calibration Standard with traceable calibration

112-3298-01 - Step Height Calibration Standard 5μm

Description. This standard is used to calibrate and verify the gain of Z direction data. It consists of three steps of nominally 5μm.

112-3499-01 - Step Height Calibration Standard 50μm with traceable calibration

Description. This standard is used to calibrate and verify the gain of Z direction data. It consists of three steps of nominally 50μm.

112-3297-01 - Calibration Flat

Description. The mirror is used to remove (through calibration) any out of flatness of the system. It is used to verify the flatness and linearity measuring performance of the system.

Specification:

- nominally λ/50 flatness (13nm), 3Å rms roughness.

112-2902-01 - HP Deskjet Printer

Description. The Hewlett Packard Deskjet 950C printer can be supplied as an optional accessory. Results printouts are output to fit on A4 or Letter size paper. Details of operation and specification are provided in the manufacturer's handbooks.

Versions are supplied appropriate to the country in which it is to be operated:

- 112/2902 E for use in the U.K.
- 112/2902 F for use in France
- 112/2902 G for use in Germany
- 112/2902 I for use in Italy
- 112/2902 S for use in Spain
- 112/2902 U for use in the U.S.A. and Canada.

Important.

Use only the lead supplied with the Taylor Hobson equipment to connect the printer to the USB port of the computer. Do not use the lead supplied with the printer.

For further details on the printer, refer to the manufacturer's handbook supplied.

112/2696-01 - LaserJet Printer

112-3217-01 - HP Business Inkjet Printer 2000

112-3290-01 - Objective lens

Magnification: 2.5X

Numerical Aperture: 0.075

Working Distance: 10.3mm

Max field Of View: 7.0mm x 7.0mm

112-3291-01 - Objective lens

Magnification: 5X

Numerical Aperture: 0.13

Working Distance: 9.3mm

Max field Of View: 3.6mm x 3.6mm

112-3292-01 - Objective lens

Magnification: 10X

Numerical Aperture: 0.3

Working Distance: 7.4mm

Max field Of View: 2mm x 2mm

112-3293-01 - Objective lens

Magnification: 20X

Numerical Aperture: 0.4

Working Distance: 4.7mm

Max field Of View: 1mm x 1mm

112-3294-01 - Objective lens

Magnification: 50X

Numerical Aperture: 0.55

Working Distance: 3.4mm

Max field Of View: 0.4mm x 0.4mm

Chapter 8
Glossary of terms

On this page, you can look up terms associated with precision surfaces and surface measurement using Interferometers.

3D

3D Analysis

Analyse a 3D Surface Measurement to determine form and/or surface finish by a process of alignments, form removal and filtering and parameter calculating algorithms.

3D Processing

Mathematically generate a 3D surface map from a number of images.

3D Surface Map

3D representation of a measured surface area. Comprising of a 2D array (X-Y) of Z Heights.

A

Accuracy

The amount by which a measured value adheres to a standard.

Ångstrom

Equal to 0.0000000001metres, or 0.1 nanometres.

Area of interest

The area of the component that is of interest to you.

B

Binning

Combining points of information to reduce amount of data to process. E.g. x2 binning combines information from 4 points, 2 in the X direction and 2 in the Y direction.

C

CCI

Coherence Correlation Interferometer.

CCI 3000

Product providing 3D Surface Measurement with manual set up.

Coherence Length

The distance over which interference will occur. Coherence length of an optical source is affected by the size of the source, spatial coherence, the phase purity of the source, temporal coherence, and the spectral bandwidth of the light.

Coherent Light Source

A light source that is capable of producing radiation with all the waves vibrating in phase.

D

E

F

Field of view

The maximum area of the component in X and Y that can be viewed by the camera with a defined optical configuration (different for different objective lens).

Form

The general shape of a surface or low frequency surface characteristics.

Fringe (Fringe pattern)

The light and dark band caused by interference.

On a scanning broadband interferometer this represents the contours of the component that are the same distance from the objective as the reference for any given frame.

Fringe pattern zone

The zone through which fringes appear on a scanning broadband interferometer.

G

GUI

Graphical User Interface, Software interface.

H

HDD

Hard Disk Drive

I

Image

A 2D array of light intensities at a particular height from the measured area. A set of images taken at height intervals along the Z Scan Length is used to form a 3D Surface Map.

Interference

The constructive and destructive superposition of two wavefronts that have different phases. In an interferometer the two wavefronts are produced by the reference surface and the test sample surface.

Interferometer

An instrument that employs the interference of light waves to measure the wavefront.

Interferometric Objective

An optical component that gathers light from the object, and from a reference surface. Creates an image with an interference pattern.

J

K

L

Lateral Resolution

The smallest linear separable and measurable feature on the imaged surface. Lateral resolution of an interferometric microscope objective is a function of the numerical aperture. and the Spatial Sampling Interval. See Vertical Resolution and Sparrow.

M

Magnification

The amount of lateral enlarging produced by an interferometric microscope objective.

Measure/Measurement

Encompasses steps from capturing images to 3D processing, does not include aligning component or 3D analysis.

MEMS

Micro Electro-Mechanical System

Microroughness

Fine irregularities of a surface.

Mirau interferometer

An interferometer with a beam splitter and reference mirror in line with the main optical path.

N

Neutral Filter

A filter that has attenuation independent of wavelength and therefore does not affect the bandwidth of light. Also termed 'broadband'.

Noise

Any random or periodic non-data signal in the measurement.

Nominal Surface

The intended surface contour, exclusive of any intended surface roughness. numerical aperture.

Numerical Aperture (N.A.)

The sine of the vertex angle of the largest cone of meridional rays that can enter or leave an objective, multiplied by the refractive index of the medium in which the vertex is located. In air the N.A. must be less than 1.

Nyquist

If the original signal is bandwidth limited, in that there is a shortest wavelength present (highest harmonic) in the signal, then the Nyquist theorem imposes a limitation on the maximum sampling interval possible. The Nyquist theorem states:

If it is known that an infinitely long signal contains no wavelengths shorter than a specified wavelength then the signal can be recon-

structed from the values of the signal at regularly spaced intervals provided that the interval is smaller than half of the specified wavelength.

Strictly, the Nyquist theorem only applies to infinitely long signals. In practice the Nyquist criteria of sampling less than half of the shortest wavelength present is still useful even though signals are finite in length.

O

Objective lens drive unit

Unit that drives the objective lens along its axis to enable scanning.

Offline/Online

'Online' refers to software that communicates with the instrument hardware; 'Offline' refers to software that communicates with a simulation of the instrument hardware, and therefore does not need interface cards and their drivers or hardware to be present.

P

Persistent

Refers to Software Settings that are saved so that they can be recalled the next time the software is run.

Phase Discontinuity

A phase discontinuity occurs when the software algorithm for connecting the adjacent pixel phases in a continuous manner cannot determine the direction and height of a step. This is typically

caused by steep surface slopes. This slope limitation in the micro-scope is objective dependent.

Pixel

Shortened form of 'picture element'. The smallest element of the CCD detector used for imaging and data acquisition.

Points

The number of detector pixels in a particular data set. The number varies due to the use of the masks and zoom features which can alter the definable measurement area.

Position uncertainty

The uncertainty of the position feedback of an axis. E.g. if the position feedback displays a figure of X mm how close to the actual carriage position (relative to a defined datum) is value X likely to be?

Positioning uncertainty

The uncertainty to which the axis can be positioned to. E.g. if the command asks the axis to drive to X mm how close to X is the final position likely to be?

Precision

Mechanical or scientific exactness. The degree of refinement with which a measurement is stated.

Profile

The contour of the surface in a plane perpendicular to the surface. It is a two-dimensional plot of the data.

PZT

Abbreviation for piezoelectric transducer. This component modulates the phase of the interference pattern across the detector by moving the objective and hence the reference surface.

Q

R

Region Of Interest

Sub-area from the field of view.

Repeatability

The precision with which repeat measurements of the same sample give the same value with all conditions unchanged between measurements, except time.

Resolution

The smallest quantity that can be measured by a particular instrument.

RMS Thread

Royal Microscope Society Thread, (not Root Mean Squared)

Male thread = 20.274 - 20.198 EXT. DIA, 36 TPI, 55°, Whitworth form.

Female thread = 20.396 - 20.320 EXT. DIA, 36 TPI, 55°, Whitworth form.

Roughness

The finer irregularities of the surface texture; usually including irregularities resulting from the production process.

S

SBI

Scanning Broadband Interferometer

Sparrow Resolution

Describes the resolving power of an objective as 0.5λ/N.A.

Spatial Sampling Interval

The apparent size of a camera pixel (see "Points") that is projected on the test sample. Spatial Sampling Interval is a function of the interferometric microscope magnification.

Specular

1) an object that reflects light.

2) In the direction in which a mirror reflects incident light.

Special Options

A number of special configuration options available on the CCI instrument. They are Data Output Mode (Low Noise), Scan Type and Post Threshold. Full descriptions are given on page 4-7 of this handbook.

Surface Texture

The repetitive or random deviation from the nominal surface that forms the three dimensional surface topography. Includes lay,

waviness, roughness, and flaws. Any manufactured surface has irregularities due partly to the nature of the material but to a greater extent to the finishing operation used.

T

Talymap

Software Application that can calculate form and 3D surface finish. It is able to analyse data in a .SUR format file.

Turret

A rotating plate on a microscope that contains a number of objectives to provide for a rapid change of magnification.

U

User

Person using the system to take a measurement or process connected with taking a measurement.

V

W

Wavefront

A surface connecting all field points (of electromagnetic energy) that are equi-phased from the source.

Waviness

The component of surface texture upon which roughness is super-imposed. See "Form".

X

X axis

Horizontal or left and right direction. Can refer to left-to-right movement of a translation stage or to the left-to-right direction on the video monitor. Orthogonal to Y and Z.

Y

Y axis

Horizontal or back and forward direction, but 90 degrees to X. Can refer to the front-to-back movement of a translation stage or to the up-and-down direction on the video monitor. Orthogonal to X and Z.

Z

Z axis

Vertical direction of the microscope relative to the fixture stage. Refers to the up-and-down movement of the microscope head. Parallel to the optical axis and normal to the X-Y plane.

Zoom

Digital zoom that reduces the area of interest without changing the spatial sampling interval and hence reducing the amount of data.