Optimap™ PSD 2

A revolution in surface measurement
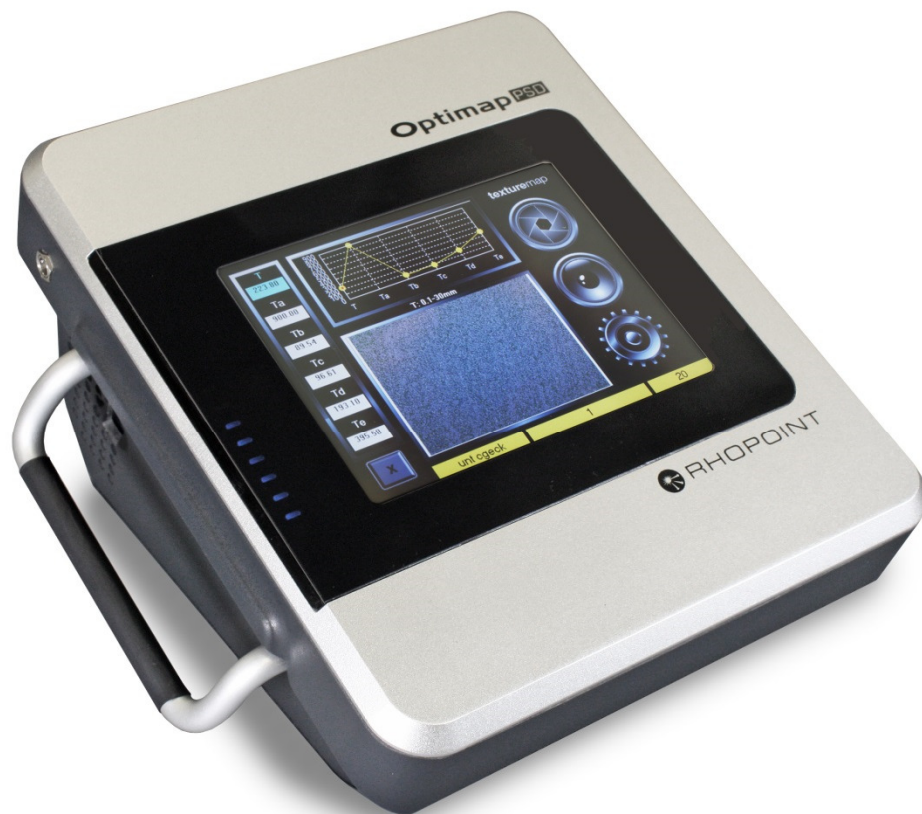
Operating Instructions

English

RHOPOINT
INSTRUMENTS

This instruction manual contains important information about the setup and use of the Optimap™. It is therefore essential that the contents be read before powering up and using the instrument.

If this instrument is passed to other users you must ensure that the instruction manual is supplied with the instrument. If you have any questions or require additional information about the Optimap™ please contact the Rhopoint Authorised Distributor for your region.

The technology and components used in the device are based on state-of-the art optic and electronics. As part of Rhopoint Instruments commitment to continually improving the technologies used in their products, they reserve the right to change information included in this document without prior notice.

Contents

Storage and Handling

- This instrument contains precision optics and electronics. You should therefore avoid knocking or dropping the device as the resulting impact could cause serious damage.

- In some circumstances the optical components in the instrument could become misted as a consequence of temperature change. It is recommended that the instrument is not used until it has stabilised to ambient temperature.

- Ensure that the instrument is not exposed to moisture, chemicals or to any corrosive vapours.

- Do not hold the instrument by the measurement aperture, no objects should be placed inside the aperture as damage to the measuring system may occur.

- The instrument housing and sample area locator are resistant to a variety of solvents however it is not possible to guarantee resistance to all chemicals, therefore the surfaces of the instrument should only be cleaned using a soft, moist cloth.

- Prevent exposure of the instrument to direct sunlight for prolonged periods and to continuous humidity and condensation.

About the Optimap™ PSD

Optimap™ PSD – The technology

Optimap™ PSD is an advanced portable handheld instrument capable of performing fast, full field 3D surface measurements.

Using an optical measurement technique known as Phase Stepped Deflectometry (PSD) it objectively measures and characterises many aspects of surface quality including texture, waviness and local defects including orange peel, inclusions, dents and scratches.

The instrument has a large area of measurement (95mm x 70mm) allowing the instrument to analyse larger structure sizes that are visible from longer distances. A lateral resolution of 75µm and fixed reference plane also allows the device to detect surface defects that are invisible to the naked eye.

Optimap requires no movement over the surface as all measurements are made optically therefore preventing any damage during operation. Although surface contact is required, the devices measurement port is rubberised to protect it during operation. Measurement results are displayed in graphical, image map and numeric format according to the measurement scale selected.

A wide range of surface finishes can be measured from low gloss (2.0GU@60°) to mirror finish allowing the complete characterisation of manufacturing processes from machining, moulding and forming, through to surface preparation and final coating.

Further technical information about PSD can be found later in this manual.

Accessories

The instrument is supplied as a standard package complete with all accessories required to calibrate and recharge the unit including:-

Optimap™ PSD Instrument

Reference check standard

Mains charger

USB Data stick

USB Data transfer cable, Software and Dongle

Protective instrument carry case

Functional overview

Label No.	Function
1	Battery Indicator
2	Touch screen display
3	Power button
4	Battery charger connector
5	USB connector
6	Measurement Port
7	Carry Handle

Power

The Optimap™ PSD is powered by an integrated high capacity lithium ion battery.

Fully charged the instrument will operate for 4 - 5 hours depending on use.

A mains powered battery charger is provided with the unit allowing it to be fully charged, when connected to the units charger input (4), in under 3 hours. The instrument can also be operated with the charger plugged in. The charging time will be longer if the instrument is operated during charging. Battery status is shown by the indicator on the front screen (1).

Lithium ION cells do not suffer from "memory effects" so it will not reduce the life of the battery if the charger is used top up the battery between readings.

Switching on the unit

To switch Optimap on press and hold the Power button located on the lower right hand side of the instrument until two audible beeps have been sounded, the second of which being longer than the first, and then release the button.

The instrument will power up and when ready will display the main measurement screen as displayed in the next section. A further beep will be heard to indicate the instrument is ready to make measurements. The operation of the device is detailed in the next section.

To power the instrument off press the Power button until two audible beeps are heard. The instrument will then safely enter into its power on / down cycle

Operation

Texture Main
Measurement Screen
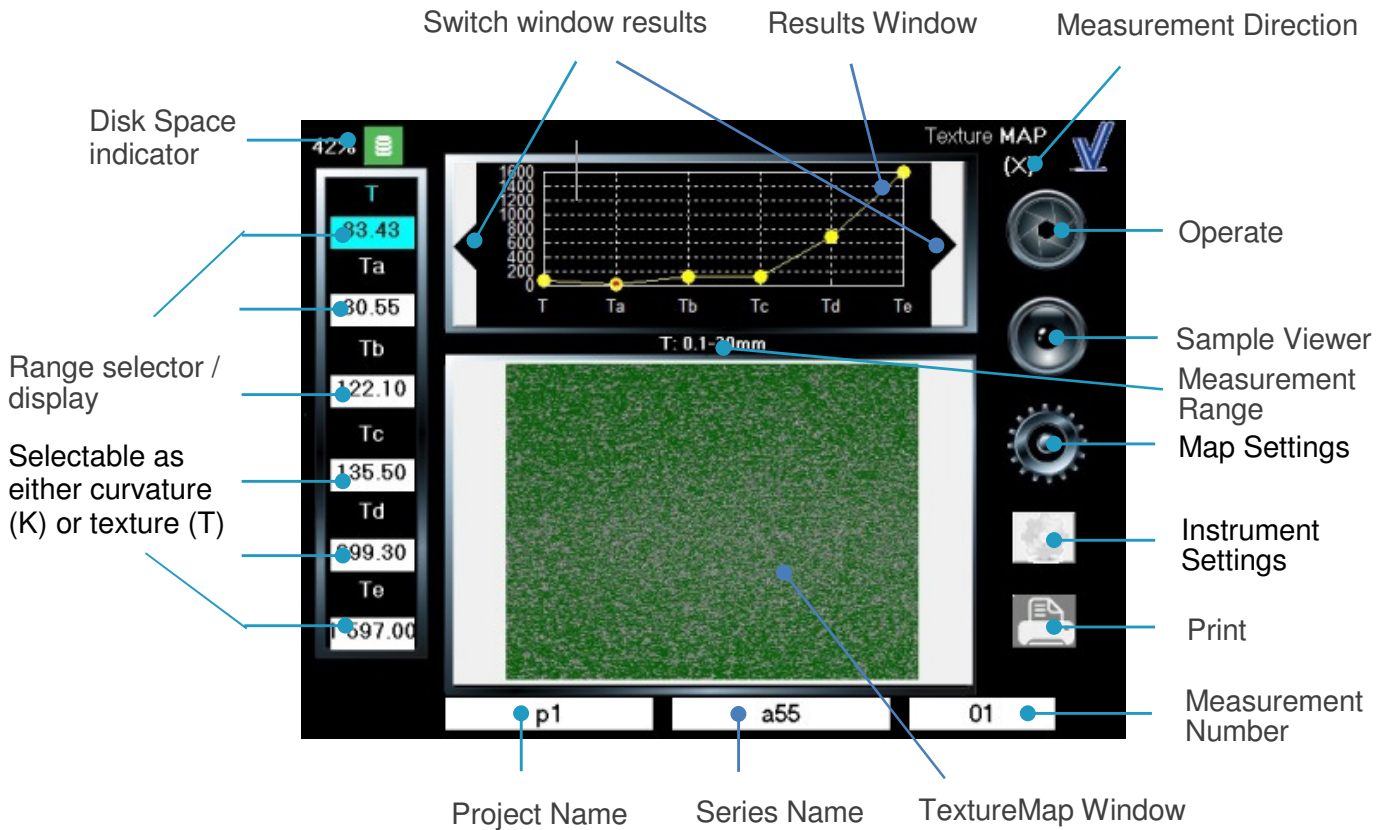
The touch sensitive icon based measurement screen provides operation and setup of the device.

By pressing each of the icons or active areas shown on the screen the instrument responds in a different way according to the function.

To the left of the texture main screen there are six white range selector indicators displayed showing the measurement scale selected.
Measurement data is displayed in each of these indicators according to the range selected which is shown above the texturemap window.

In the example screen above the 0.1 – 30mm range has been selected in curvature mode K. The 3D texturemap screen displays an image of the surface according to this range.

By pressing each of the indicators in turn the texturemap window changes to display the image according to the range selected allowing the analysis of any structures present on the surface in that range. Above the range selector / display there is a disk space indicator to show how much memory has been used.

Results are also displayed in graphical or statistical format in the results window at the top of the screen. By pressing the right or left buttons on the results window different result types can be displayed.

The measurement direction indicator at the upper right corner of the screen indicates the axis in which the measurement data, including texturemap image, is displayed. This indicator is not touch sensitive and is there only for indication purposes.

The Optimap can be configured to display the image in single (X or Y) or dual axis (X+Y) directions. Single axis texturemap images are very useful for analysing surfaces effects that may occur due to directionality.

At the bottom of the screen below the texturemap image, Project Name, Series and Measurement Number indicators allow the storage and management of measurement results. Measurements are saved by the Optimap in a logical sequence allowing clear identification of the surface being measured.

The naming method used for these will differ according to application however it is the Project name that is the key field holding all measurement data for each series.

Therefore as an example a typical naming setup for an automotive measurement would be to use the vehicle name or model number as the project and the surface to be measured, left door, right door etc as the series. Measurements can then be made according to requirement with each being stored as a separate measurement number over the surface.

Altitude Main

Measurement Screen
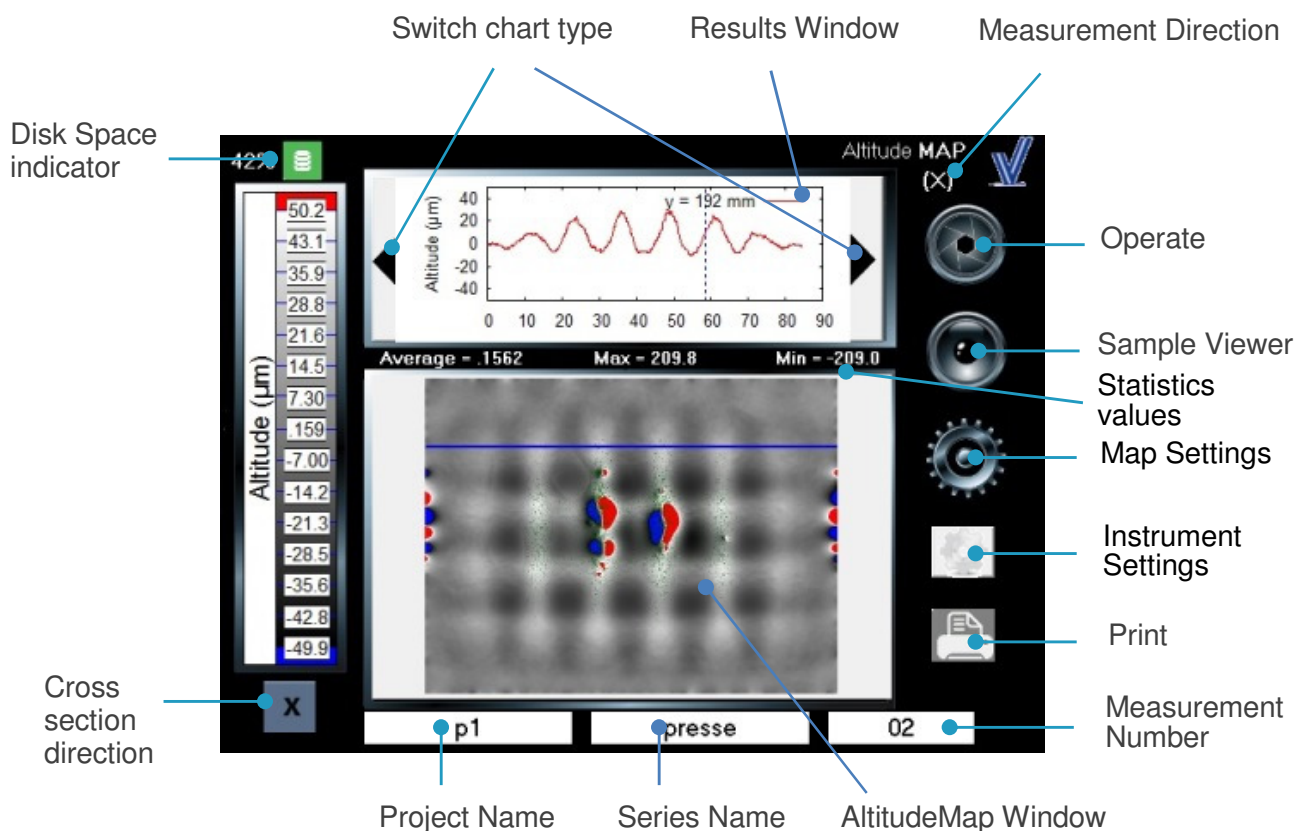
To the left of the altitude main screen a scale is displayed corresponding to the image displayed in the AltitudeMap window. The cross section direction button underneath the scale allows the switching of the cross section view, either X, Y or X/Y, that is displayed in the results window.

Statistics values of the displayed image are shown between then AltitudeMap Window and results window.

The switch chart type button allows switching between statistics curvature results, graph curvature results, statistics texture results, graph texture results and cross section.

Project Screen

A new project can be created by pressing the Project name indicator.

The display will change as shown below :-
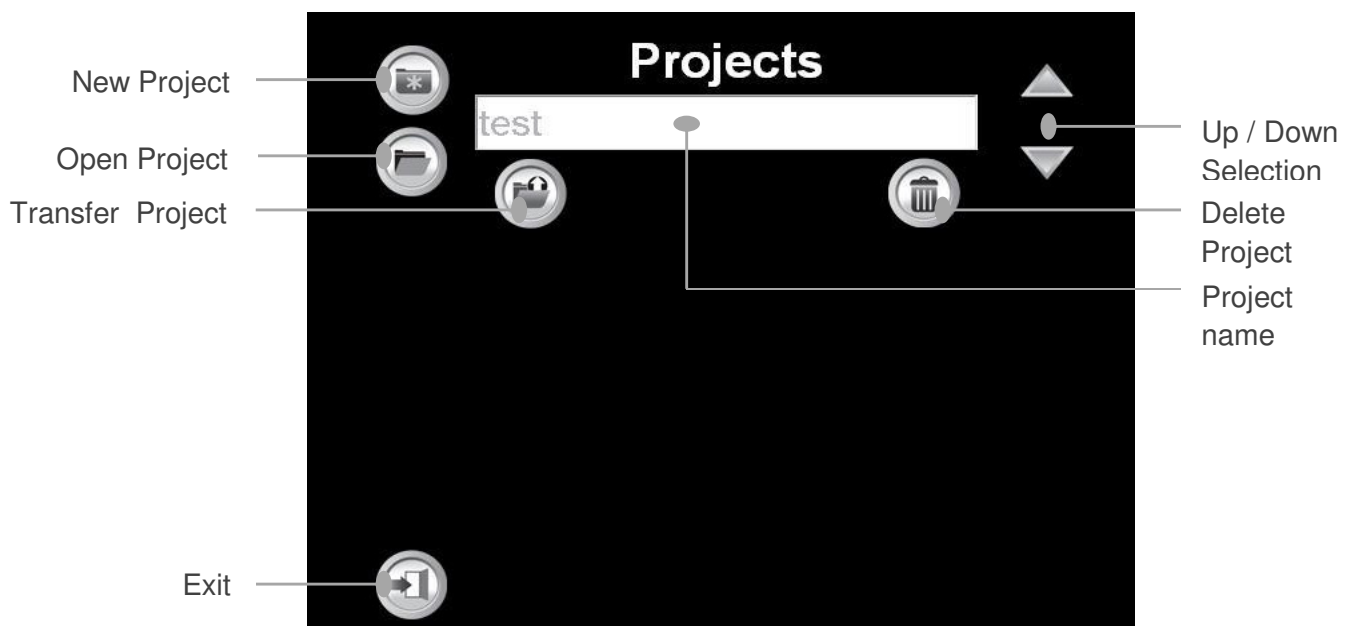
To allow the measurement of a wide range of surface finishes the Optimap has three optical configurations (models) available for selection – Reflective, Dull and Extra Dull.

The device achieves this by varying the amount of light projected onto the surface. A reflective model is suitable for surfaces with a mid to high gloss finish (>30GU) e.g. automotive topcoats, clearcoats etc., metals, by default the Optimap will automatically select this setting.

A dull model is suitable for surfaces with a mid to low gloss finish (10-30 GU) e.g. e-coats.

An extra dull model is suitable for surfaces with a very low gloss finish (<10GU) e.g. primers

Incorrect model selection normally results in the texturemap of the Optimap displaying a green screen after measurement. This is caused by insufficient light being reflected from the surface being measured to the sensing system. A reflective model used on too dull a surface will usually cause this effect.

This can normally be overcome by selecting a dull model (to increase the light intensity) and repeating the process, if not by then selecting extra dull.

To create a new project, press the New Project icon.

The screen will change to -
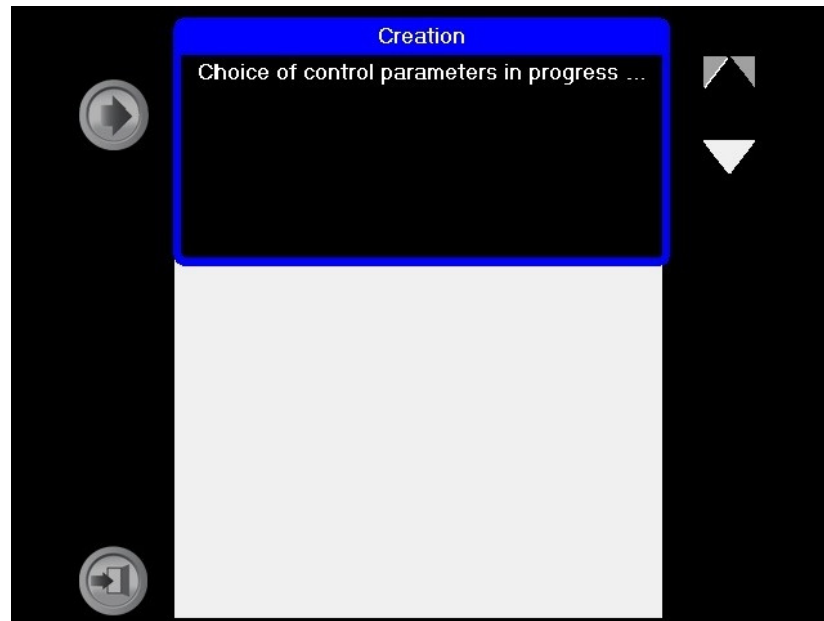
During this process the Optimap will automatically set itself by default to a reflective model.

If an alternative model is required press the Up / Down selection icon to select the one required. The Optimap will then display the screen above and reconfigure itself to the model selected.

Once set the display will change to -

Select — (icon)
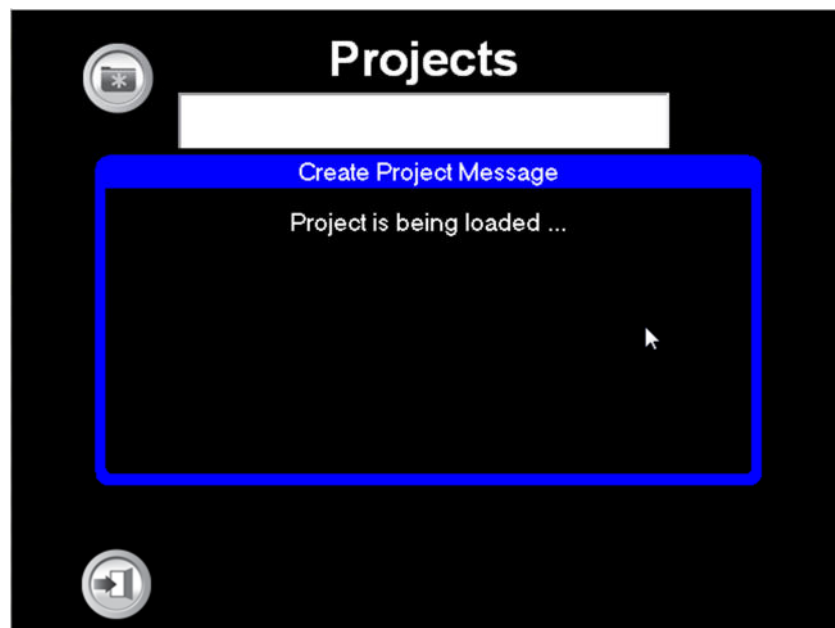
Up / Down Selection

Exit — (icon)
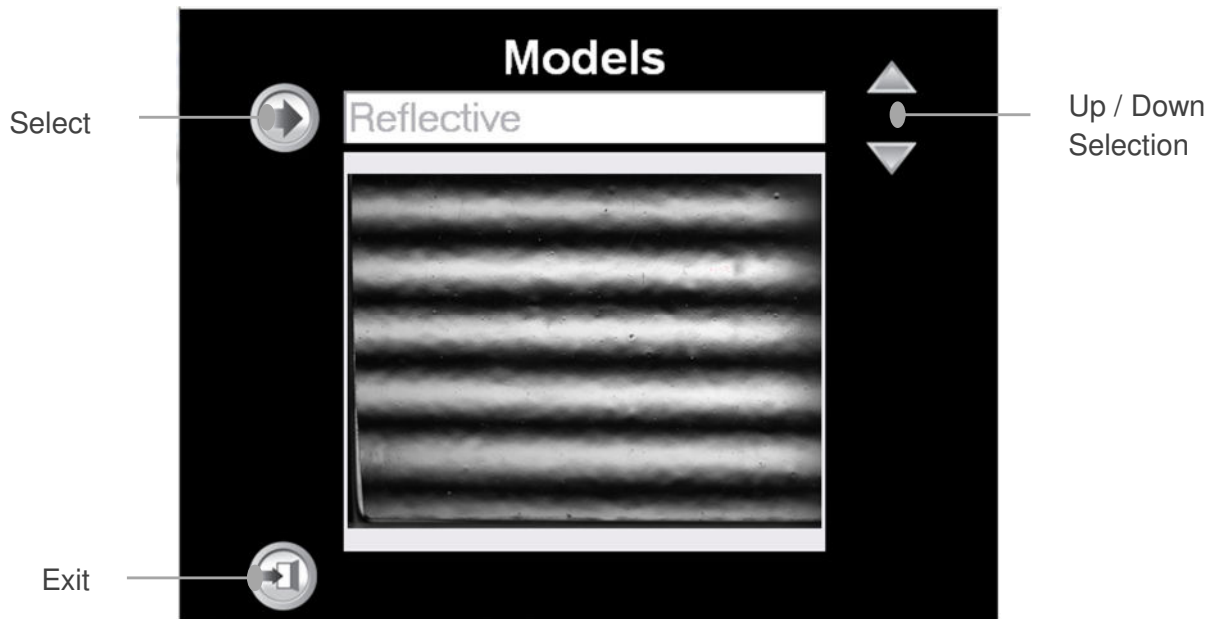
A reflective model is shown, alternatively Extra Dull or Dull will be displayed if selected.

Press the Select icon, the display will change to -
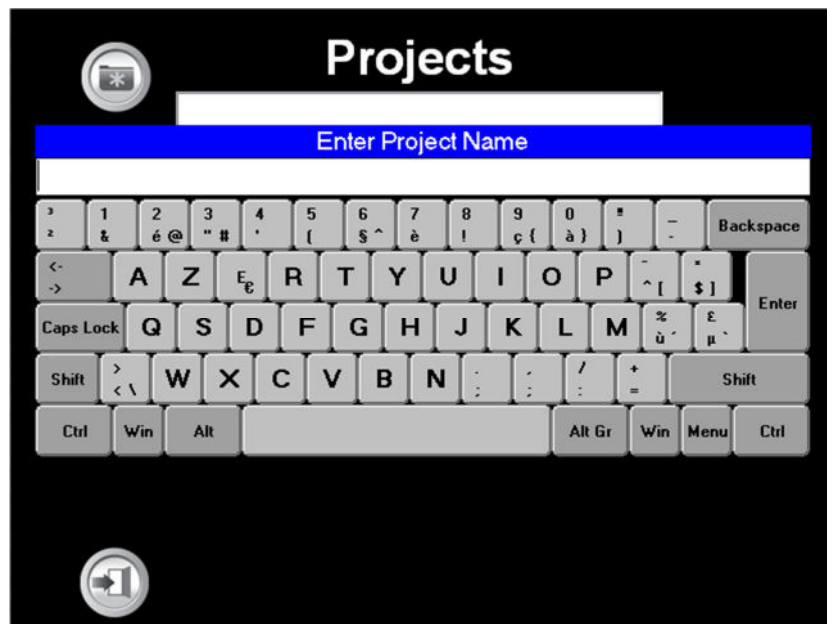
Use the keyboard to enter the name of the project, press Enter to save.

The display will change to -

During this step it is essential that the Optimap is left on the surface being measured as it optimises the optical configuration using the reflected light from the surface. Failure to observe this will result in the Optimap making incorrect measurements.

Once completed the screen will return to the main measurement screen with the project name entered being displayed in the Project Name indicator.

Returning to the Project Screen other functions can be performed -
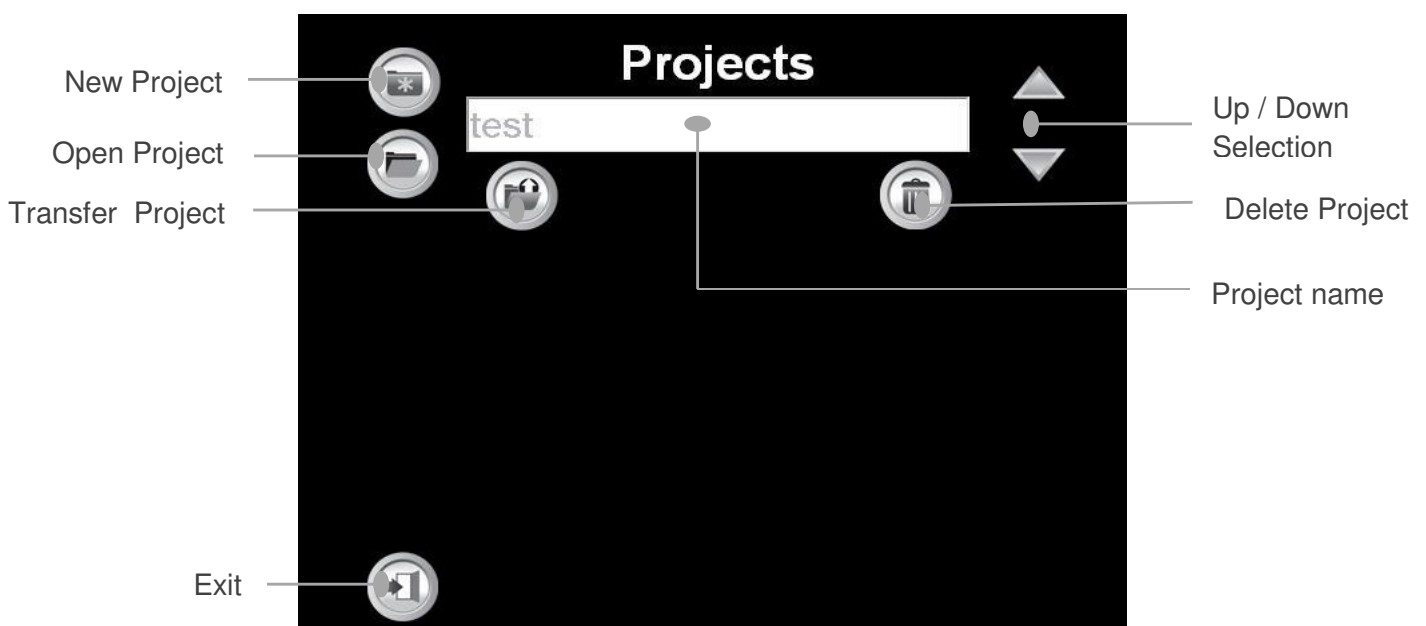
Open Project – By pressing this icon previously stored projects can be selected and recalled for display using the Up / Down selection icons.
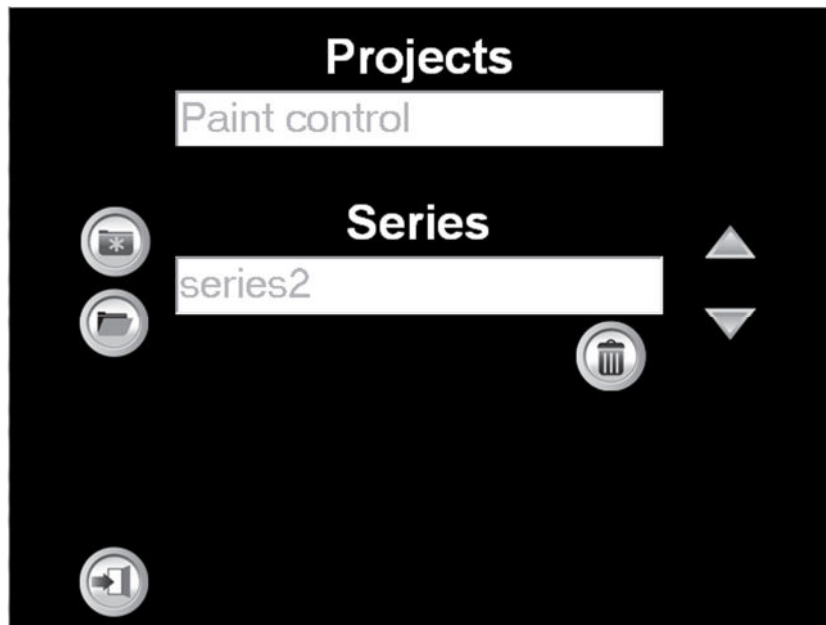
Transfer Project - Results can be transferred to a USB memory device when inserted in the instrument. Pressing the icon transfers the data. if no memory device is present an error message will be displayed.

Delete Project – Pressing this icon deletes the active project displayed in the project name window. Stored projects can be selected using the Up/Down selection icons.

Exit – Returns to the main measurement screen
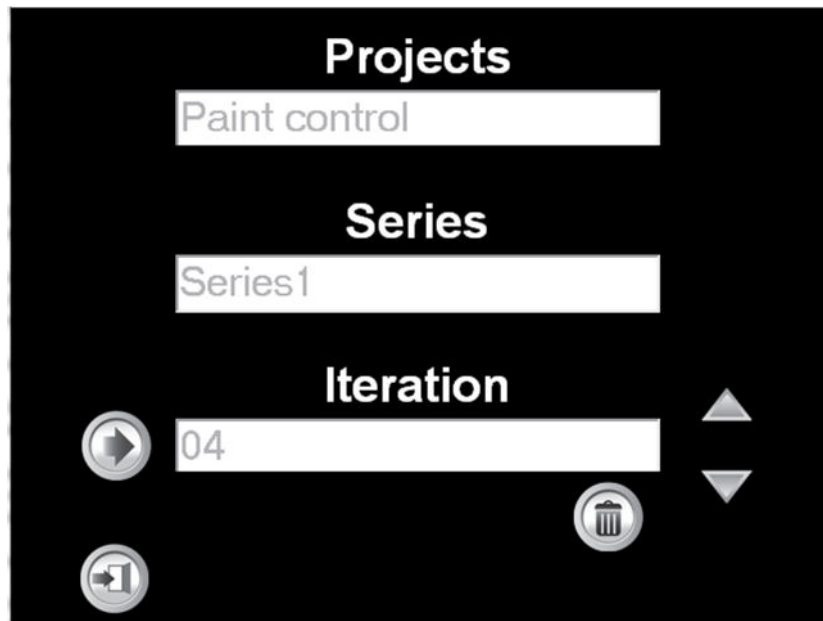
Series Screen

A new measurement series can be created by pressing the Series name indicator.

Operation of this screen is the essentially the same as the Projects screen except there is no file transfer function. Screens change in the same way as shown previously.
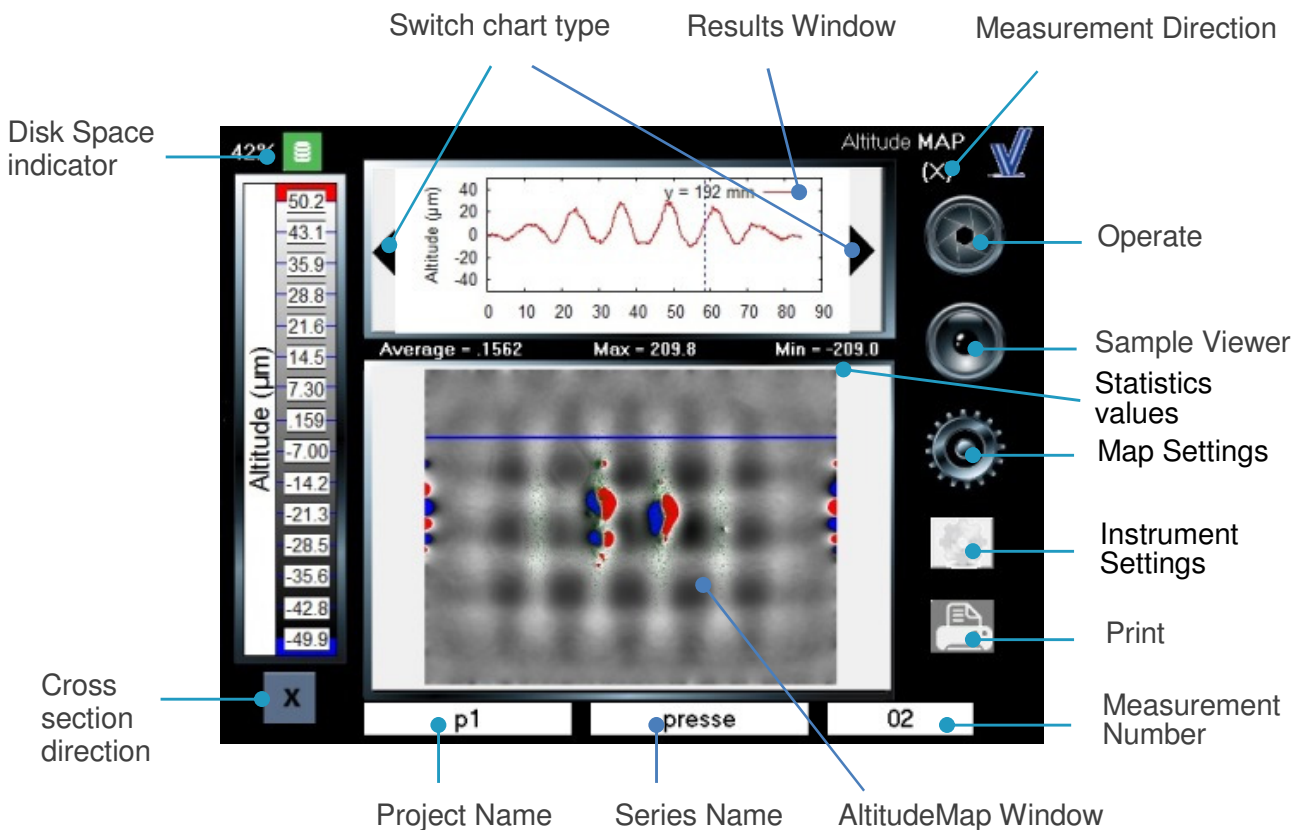
Iteration Screen

Previously stored results can be opened or deleted by pressing the Measurement Name indicator on the Main Measurement Screen

Operation of this screen is the same as the Project and Series screens. Screens change in the same way as shown previously

Returning to the Main Measurement Screen:

To the right of the screen there are three icons, Operate, Sample Viewer and Instrument Settings.

Operate

To make a measurement, press the Operate icon. Measurement time takes approx. 9 seconds following which measurement data is displayed.
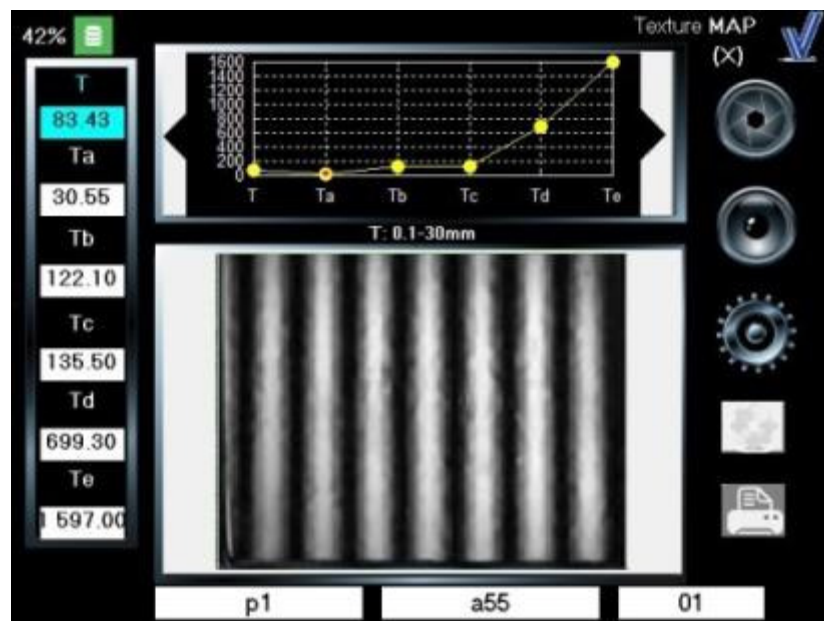
The measurement number indicator will increment by one as each measurement is made.

Sample Viewer

Pressing the Sample Viewer icon allows viewing of the surface under different conditions.
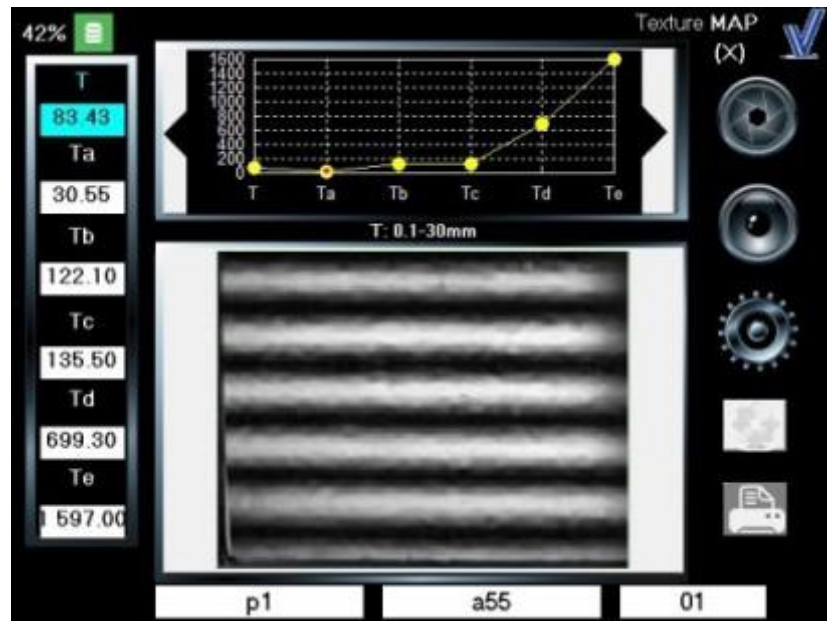
There are four modes of operation of the viewer each one activating sequentially after each press of the icon:-
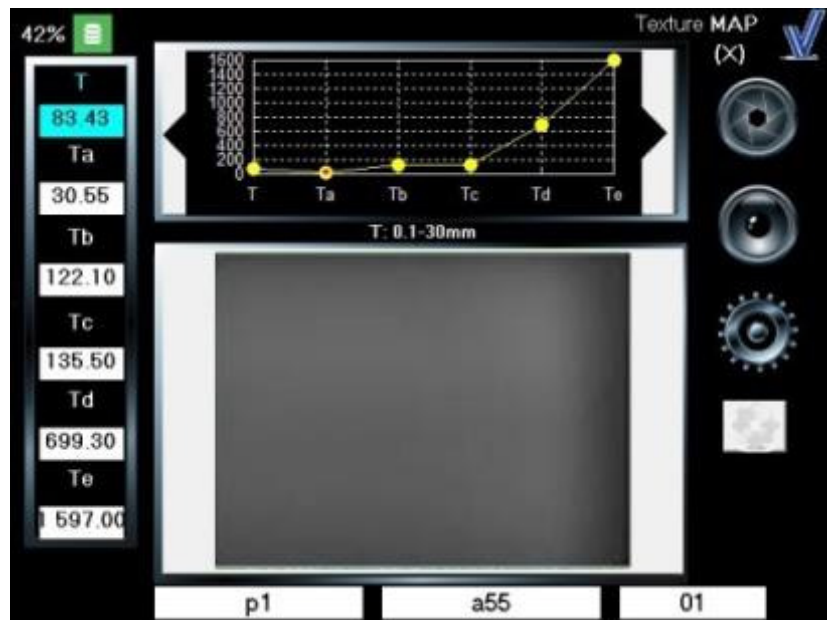
Sample viewer - X Sweep

Projects a fringe pattern onto the surface in the X direction. Useful for pre - measurement directional analysis of texture and / or defects.
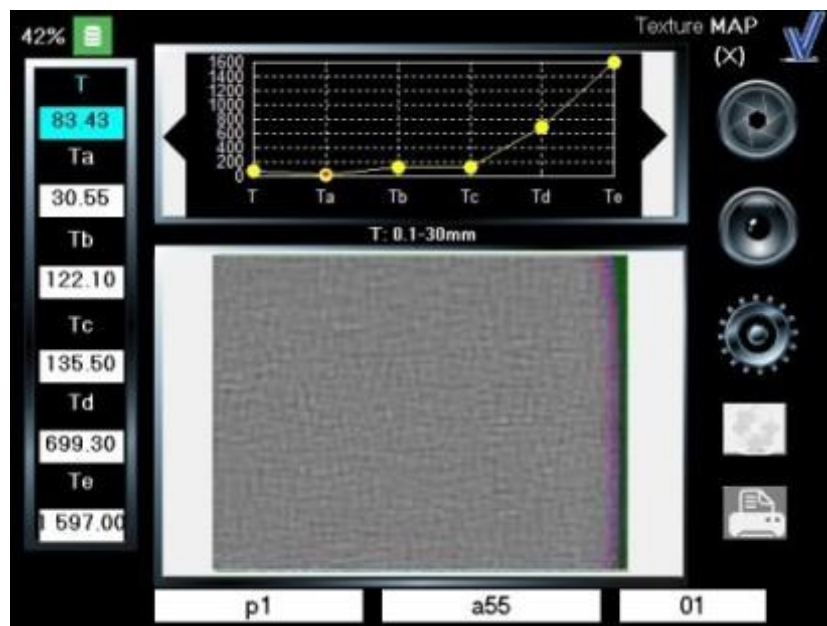
Sample Viewer – Y Sweep

Projects a fringe pattern onto the surface in the Y direction. Useful for pre - measurement directional analysis of texture and / or defects.

White screen

Illuminates the entire surface.

Sample viewer – Live View

Provides a live view of the sample surface allowing the Optimap to be accurately positioned on the area of interest.

Pressing the Map Settings icon accesses the Optimap Main Measurement Screen:

By pressing each of the blue title areas the configuration can be changed as follows:

Display Mode – Used to change the measurement units displayed on the Optimap. Three options are available, Curvature (K), Texture (T) or Altitude.

Band Select – Data can be displayed in either dual band or multi band format.

Chart Type – Data in the results window can be displayed in either Graph or Statistical format with Curvature and Texture mode or Curvature Graph format, Curvature Statistical format, Texture Graph format, Texture Statistical format or Cross Section.

Display Selection – Data can be displayed in either X, Y or X+Y directions.

Image Type – available with altitude display mode, image can be displayed in color or grey mode.

Exit – Returns to the main measurement screen

Instrument Settings

Pressing the Instrument Settings icon accesses the Settings Menu for configuration of the Optimap. There are five icons in this menu.

Pressing the Language button allows different languages to be selected. The Optimap has four languages available – English, German, French and Spanish. Languages are sequentially selected and displayed after each press.

Pressing the Date button allows the date to be set

Press the date required in the calendar and Exit to save.

Pressing the Time icon allows the time to be set

Use Up / Down icons to adjust the date as required then Exit to save.

Pressing the Update button allows the Altitude licence to be set:
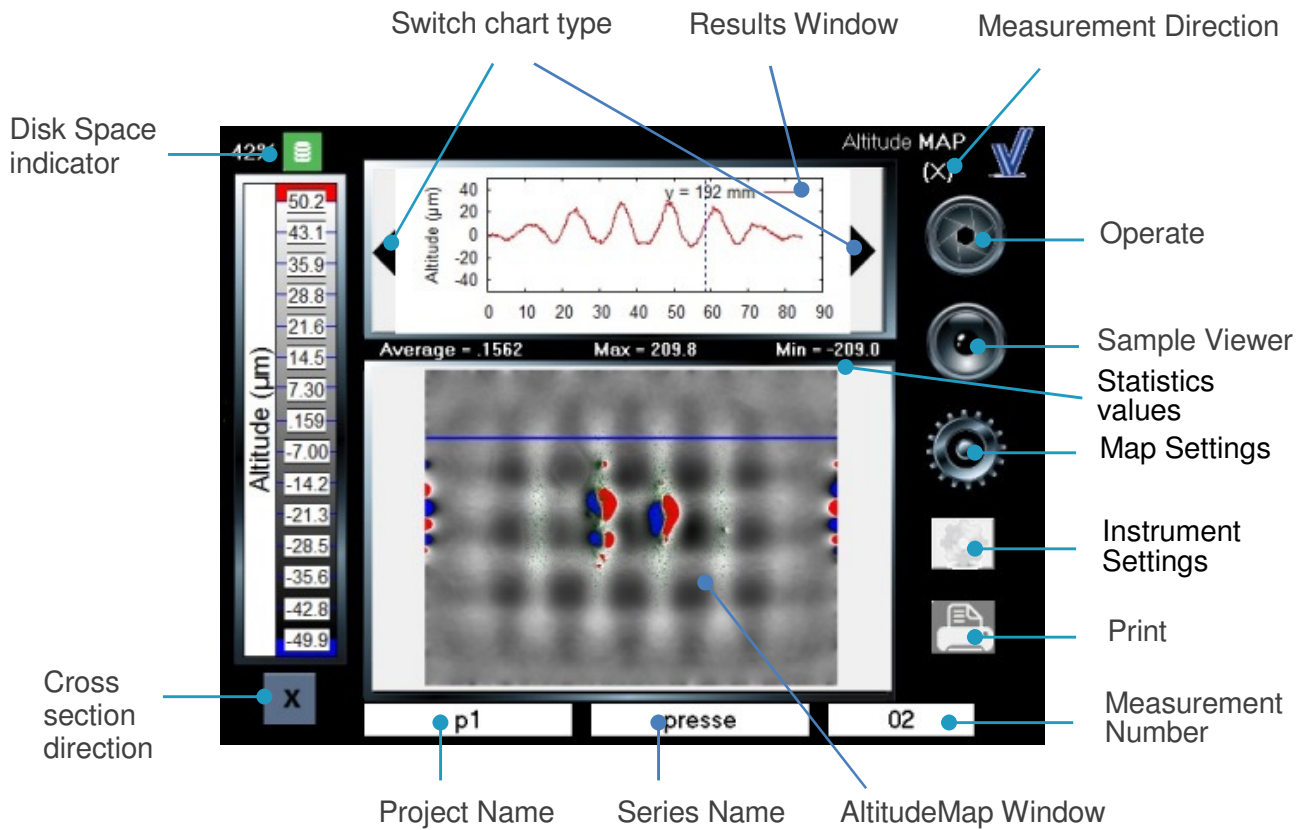

A message is displayed when the licence update has been completed successfully.

And an error message is displayed when the licence update has failed.

Sample Viewer

Returning to the Main Measurement Screen -

Switch chart type   Results Window   Measurement Direction

Disk Space indicator

Operate

Sample Viewer

Statistics values

Map Settings

Instrument Settings

Print

Cross section direction

Measurement Number

Project Name   Series Name   AltitudeMap Window

By double tapping the Texturemap window it allows full screen viewing of the sample surface –

Viewer toolbar

Measurement Units

Texturemap window
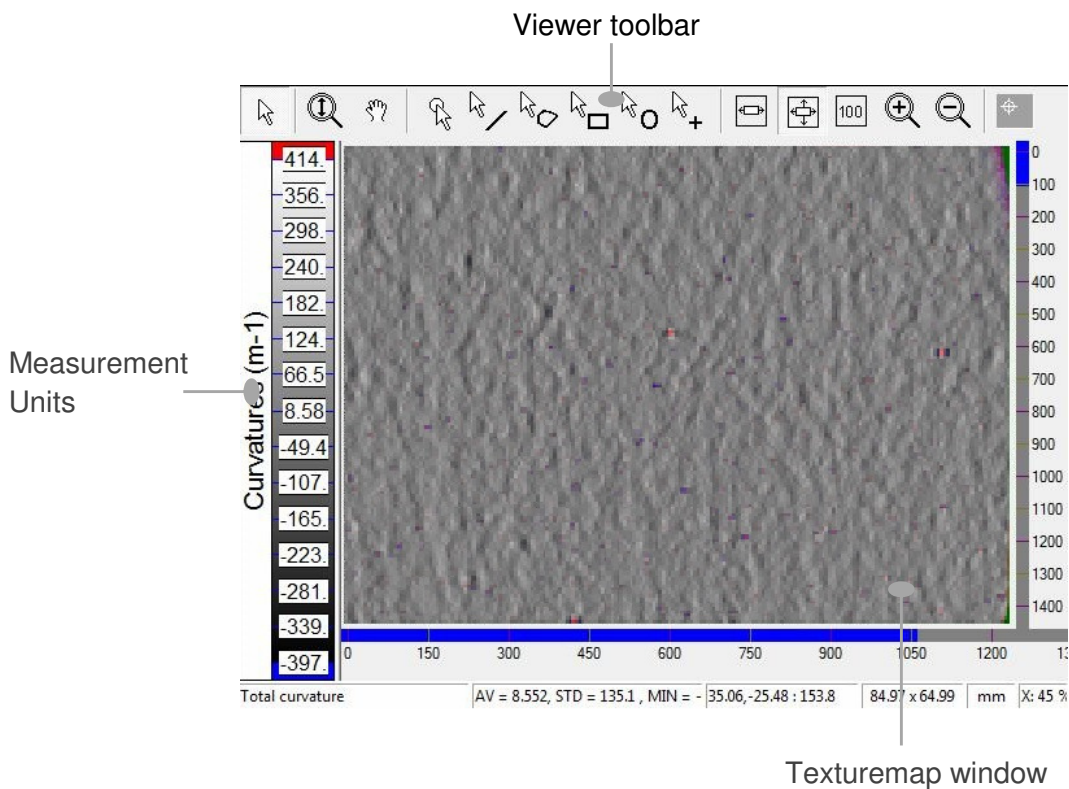
Functions of each of the individual viewer icons are as follows-

Pointer – Use to double tap into and out of full screen view

Scroll zoom – Zoom in and zoom out of image by double tapping screen

Pan – When zoomed press the screen to move the image in the screen

Region Select – use to mark regions of interest for later evaluation

Fit in window – tap to activate

Stretch to window – tap to activate

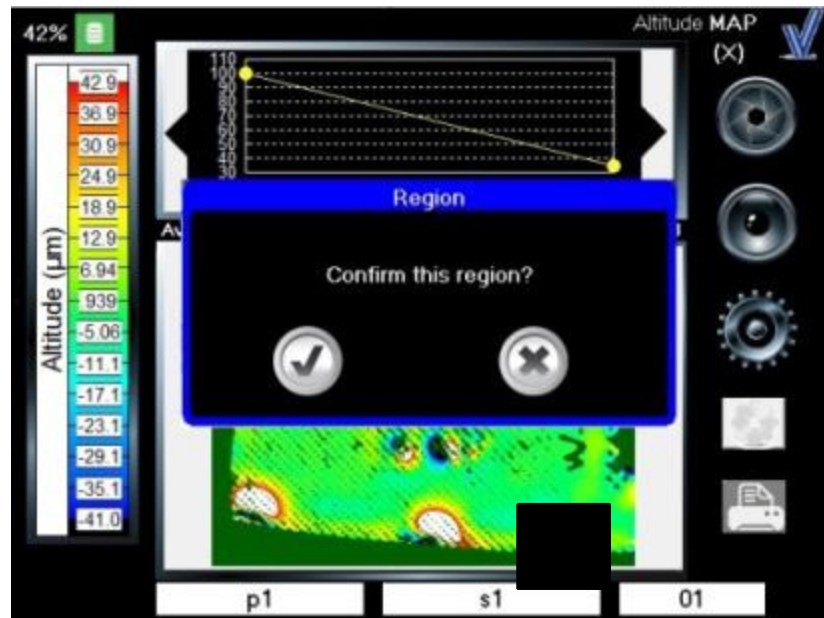Zoom to 100% - tap to activate, this must be selected in order to exit from full screen view
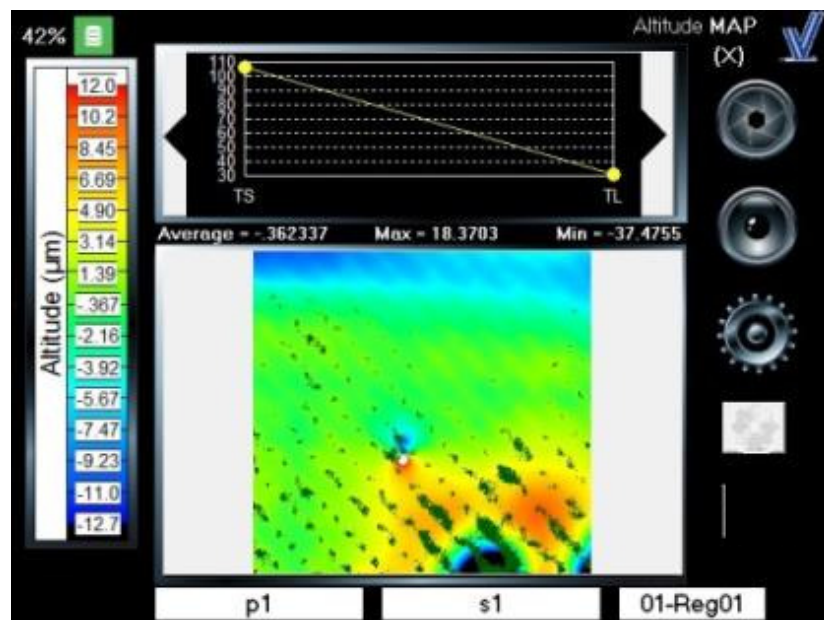
Zoom In – tap repeatedly to zoom into image

Zoom Out - tap repeatedly to zoom out of image

Region Creation

To create a region, double tapping the Map window then select a tool region select and create it.

A popup message is displayed to confirm or delete the region
The region is displayed in the main frame:

The Region feature is available for the Altitude/Curvature/Texture mode and dual/multi band and X, Y, X+Y directions. When a region is created the measurement number is renamed as 01-Reg01.

The name of region's measurement number is incremental. (i.e.. 01-Reg01, 01-Reg02, 01-Reg03, …, 01-RegXX) and specific to each measurement (e.g. 01-Reg01, 02-Reg01, 03-Reg01…).

Graphics and statistics charts are updated with data relevant to the new region.
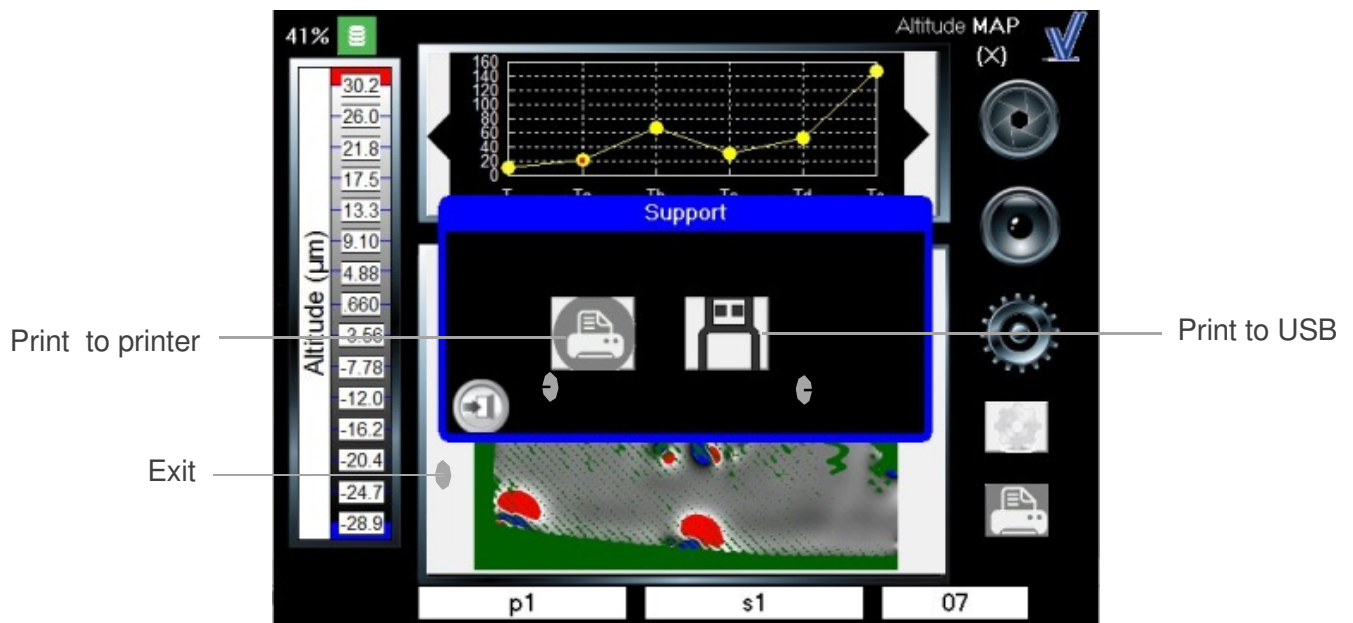
Print

Pressing the print button allows measurements to be printed :
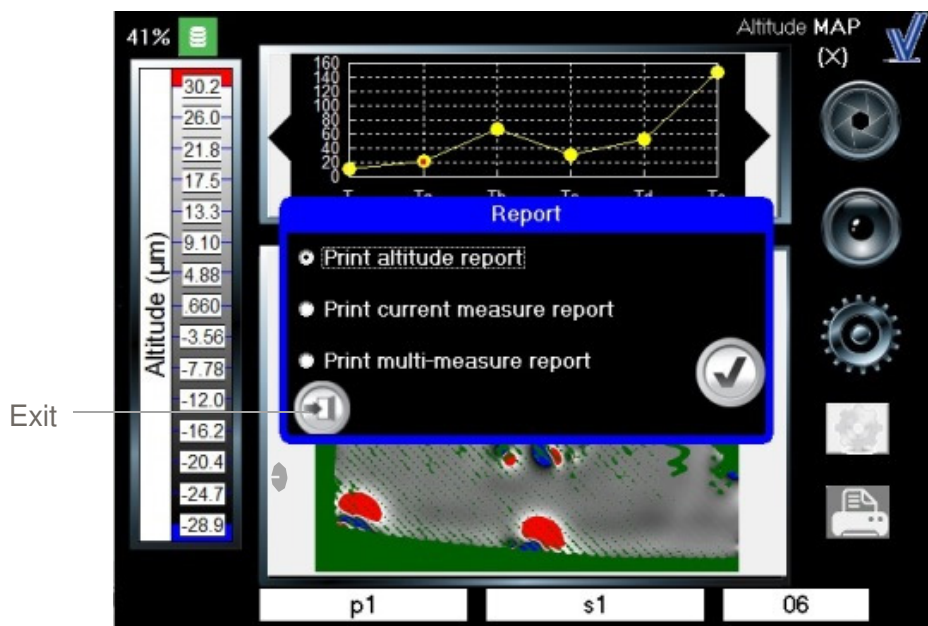
Three types of report are available:

- Print altitude report: this report includes, on the first page, Texture statistics series and curvature image. On the second page, altitude image and results window are displayed. Date, hour, project name, series name, iteration number, type of measurement, bands and direction are also included in the header of the report (please refer to Annex).

- Print current measurement report: This report includes current image and current results. Date, hour, project name, series name, iteration number, type of measurement, bands and direction are included in the header of the report (please refer to Annex).

- Print multi-measure report: This report includes all measurement statistics of the iteration selected. Date, hour, project name, number of measurements are also included in the header of the report (please refer to Annex).

After selecting the type of report to print, a popup is displayed to select the printer type:

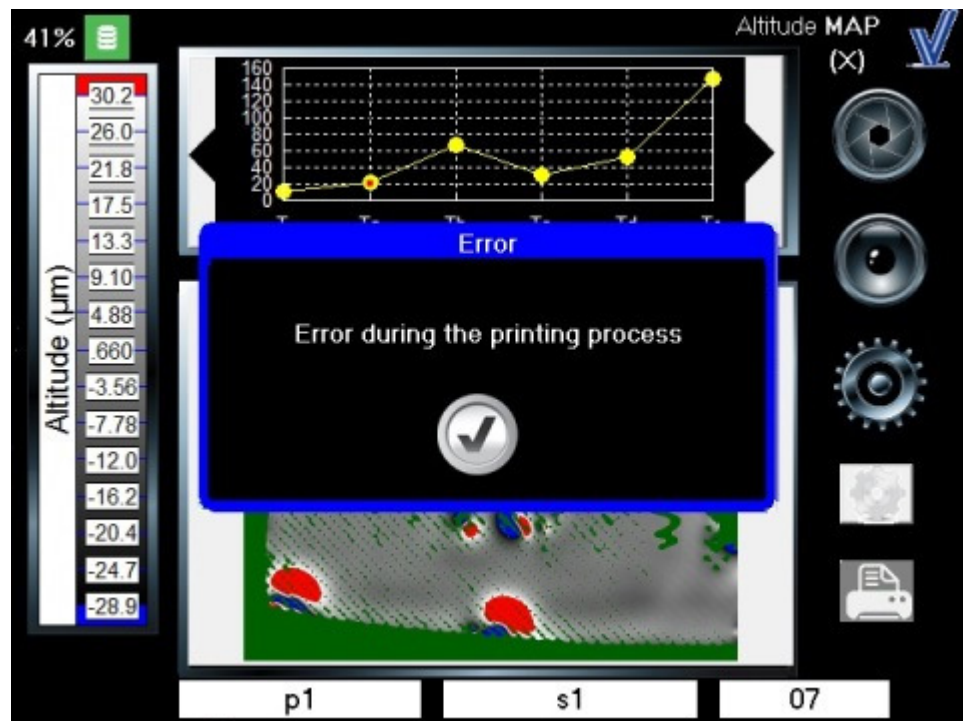Print to printer ———

Exit ———

——— Print to USB

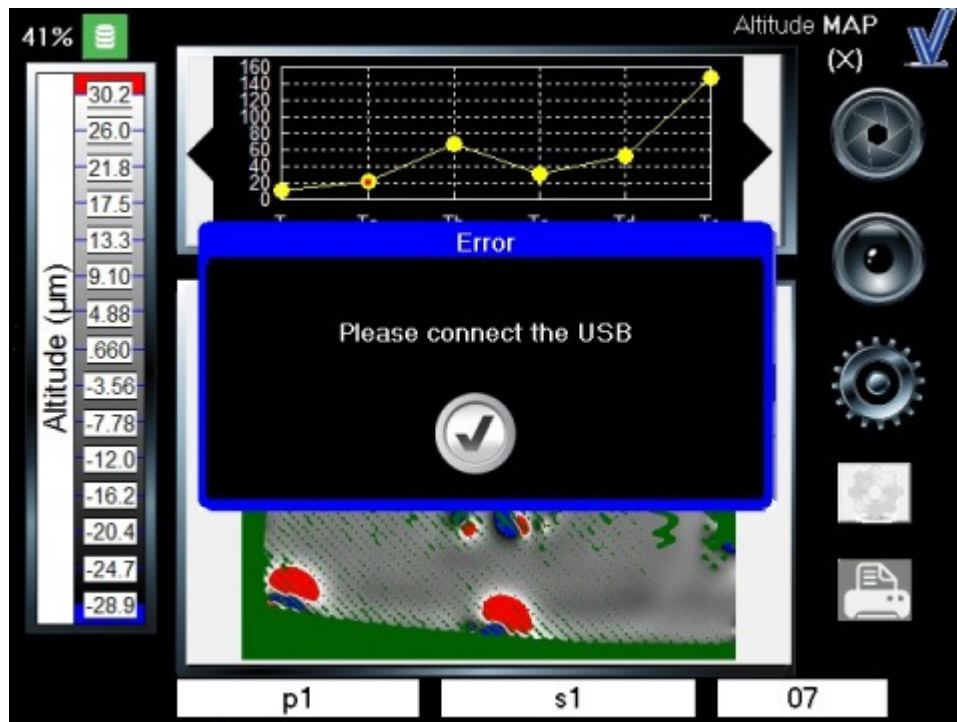When either option is selected a popup will be displayed:
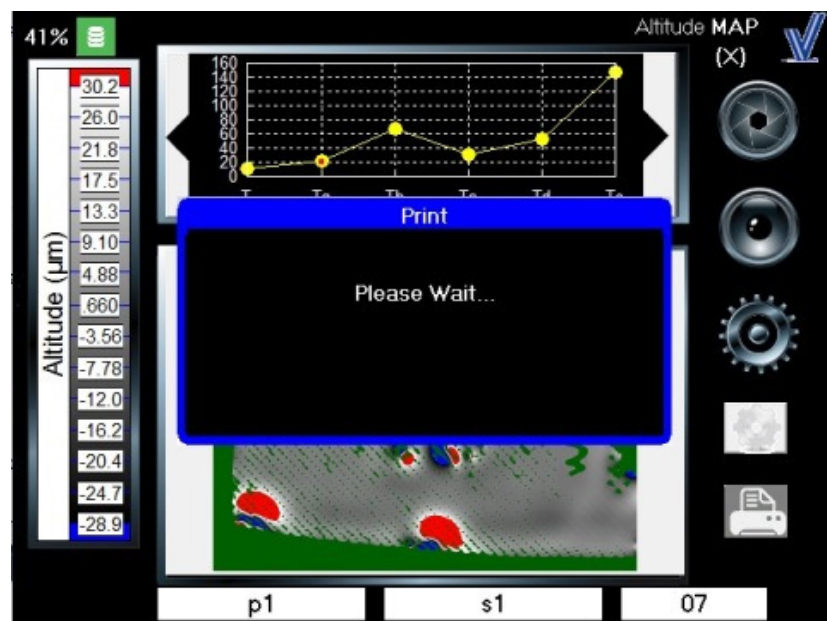
And a popup is displayed when the process is completed successfully:
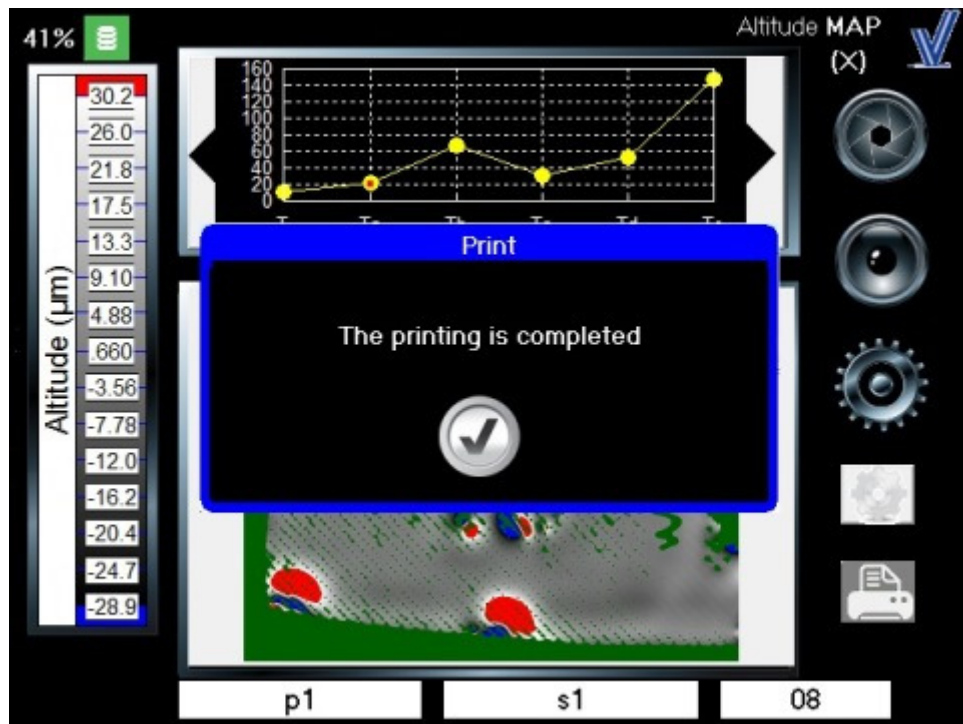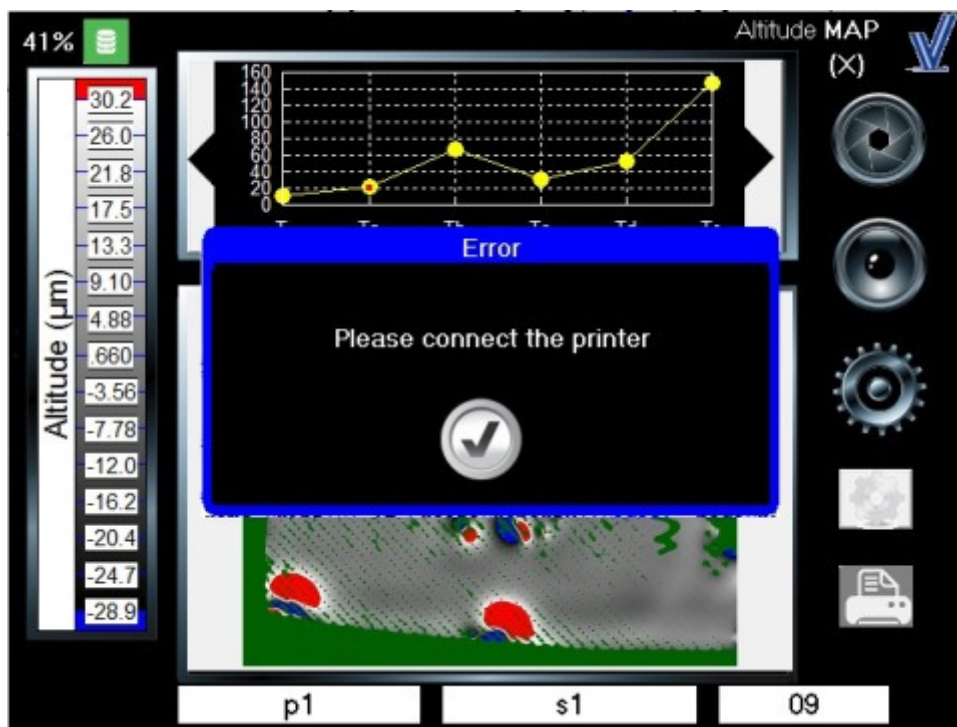

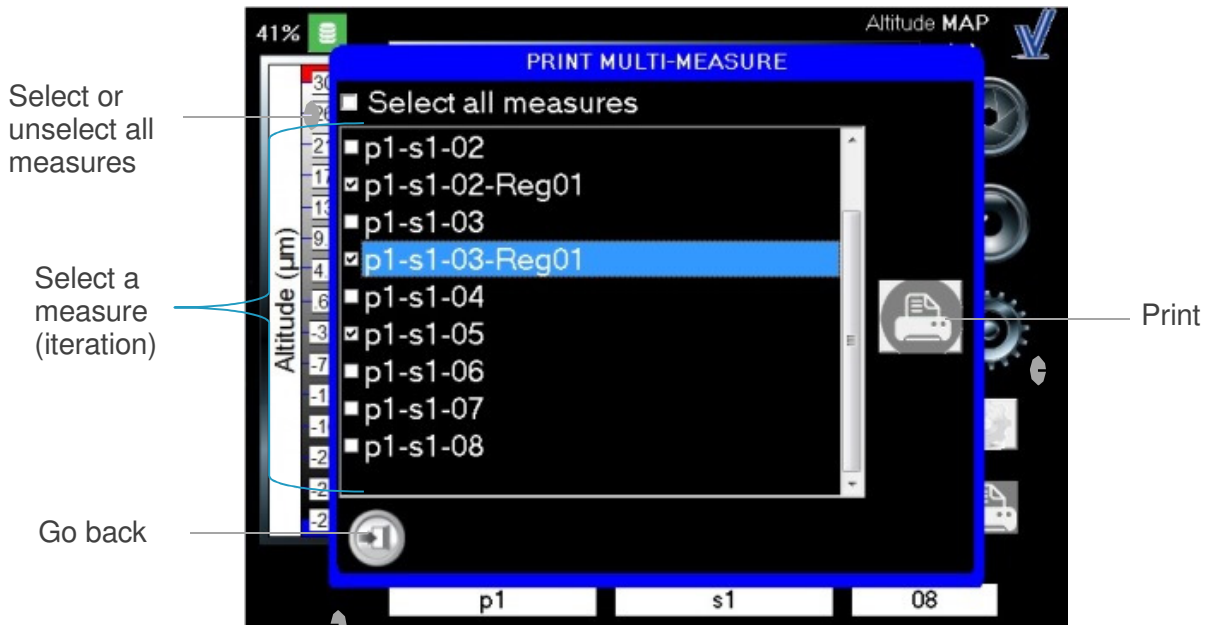Or if the process returns an error:

If the USB key is not connected a popup will be displayed:

And if the printer is not connected a popup will be displayed:

- Print Multi-measures report:

Select or
unselect all
measures

Select a
measure
(iteration)

Print

Go back

PRINT MULTI-MEASURE

☐ Select all measures

- ■ p1-s1-02
- ☑ p1-s1-02-Reg01
- ■ p1-s1-03
- ☑ p1-s1-03-Reg01
- ■ p1-s1-04
- ☑ p1-s1-05
- ■ p1-s1-06
- ■ p1-s1-07
- ■ p1-s1-08

41%   Altitude MAP

Altitude (µm)

p1   s1   08

Instrument verification

Due to the PSD measurement principle, the Optimap requires no calibration.
It is recommended however that a verification check is performed periodically (about
once every 3 months) using the reference tile included with the instrument.
Verification check is simple requiring one measurement to be made and comparing
the result obtained with the values indicated on the tile.
If the measured values are within the agreed tolerance then the instrument can be
used. If they are outside the tolerance please contact your nearest Rhopoint
Authorised Service Representative for advice.

Measurement Principle

Phase Stepped Deflectometry (PSD), a white light optical technique, uses a periodic pattern with a sinusoidal waveform to measure the profile or curvature (K) of a surface.

The waveform is presented to the surface using a high resolution display and the reflected pattern captured by a high resolution camera. This waveform acts as a ruler over the surface allowing the ordinates of the light source to be determined as they are proportional to the spatial phase of the sinusoidal pattern profile.

By "shifting" or stepping the waveform phase across the surface it allows an accurate measurement of each point from the corresponding point per pixel on the camera.

Using the known geometric relationship between the display, the object surface and camera, light rays reflected from the surface are spatially modelled to calculate the direction of the normal at each point across the surface thereby allowing the profile at that point to be obtained.

Displaying the sinusoidal waveform in horizontal and vertical directions across the surface allows slope information to be determined in both orthogonal directions.
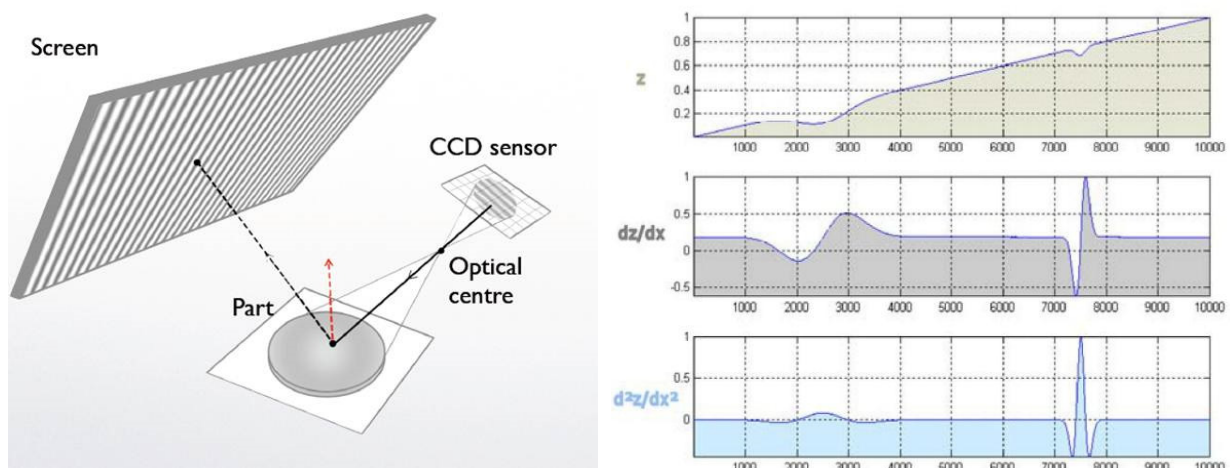

By differentiating the slope information curvature data can be produced allowing accurate characterisation of the surface profile.
As curvature is the first derivative of slope and second derivative of amplitude it combines both parameters to produce a more adapted quantity capable of being expressed in traceable SI units as m^{-1}.

Integration of this information allows the original 3D surface topology to be reconstructed.

By filtering the curvature data, in accordance with standardised wavelength ranges as shown in the table below, curvature bands Ka - Ke, KS - KL are then used to represent the SD (sigma) of surface curvatures for each wavelength range.

As an overall rating, Total curvature (K), is used to represent the SD (sigma) of curvatures falling within the range 0.1 – 30.0mm. As a totally flat surface would have no variation in curvature, higher curvature values indicate that there are more structures present on the surface at that particular wavelength range.

Resolution of the human eye
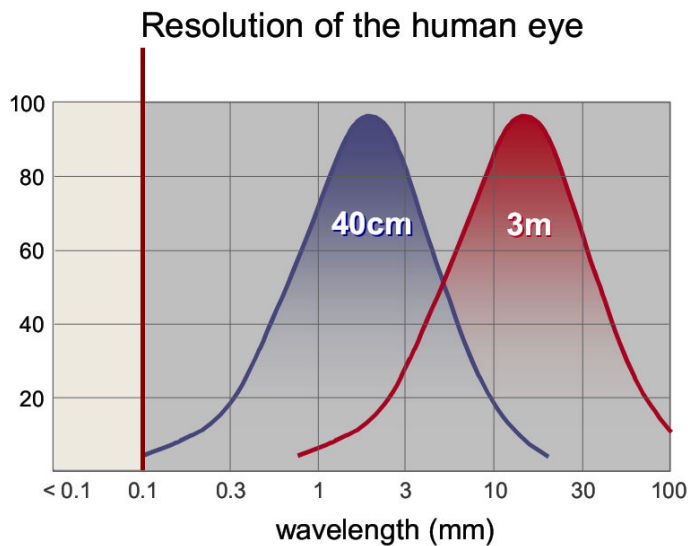
To

Value	Wavelength
Ka	0.1 – 0.3mm
Kb	0.3 – 1.0mm
Kc	1.0 – 3.0mm
Kd	3.0 – 10mm
Ke	10 – 30mm

correlate to the industry accepted Waviness scale regular equations are then applied to the filtered curvature data to produce a texture (T) scaling.

For this scale total texture (T), is used to represent the SD (sigma) of surface textures with the 7 additional texture bands Ta – Te, TS - TL used to represent the SD (sigma) of correlated surface textures Wa – We, WS – WL.

This correlation provides a best fit translation from the dimensionless, single or multiple scan waviness scale to a dimensioned, full field, texture scale

Instrument Specifications

Display

- 6.5 inch Colour VGA TFT Touch Screen

Camera

- 1.3 Megapixels, image resolution 1296 x 966

Measurement Area

- 95mm x 70mm

Lateral Resolution

- 75µm

Data storage

- 6GB Compact Flash
- 200 readings

Data Transfer

- USB Memory Stick
- Go Suite Data Transfer Software / Cable

Power

- Rechargeable Lithium Ion Battery 4800mAH
- 4-5 hours usage / charge

Weight

- 3.0 Kg

Dimensions

- H – 200mm, W – 218mm, D – 250mm