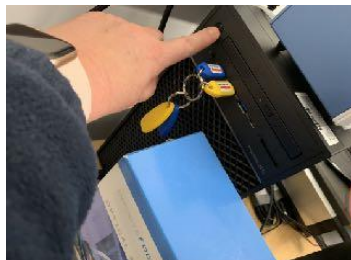# Proscan: Getting Started

Powering up:

1. Turn on Sensor Module
2. Turn on PSU module – at back where power cable goes into module
3. Turn on PC
4. Raspberry Pi (Tablet) will turn on with PSU

Sensor Module power button

Sensor input

Allow 15 minutes for warm-up before scanning – preliminary work can be conducted during this time

When the PC loads into windows Artemis Bridge will automatically start-up, this software is the backbone to measurement software and errors within the system are shown here.

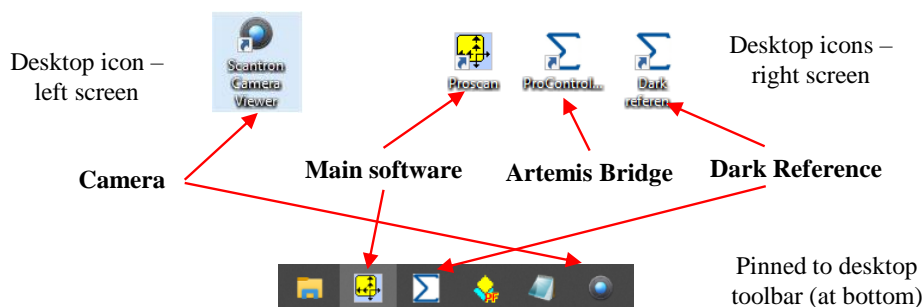If the program (Proscan) freezes or the machine stops functioning restart both Proscan and Artemis Bridge.

Desktop icon – left screen

Desktop icons – right screen

Camera   **Main software**   **Artemis Bridge**   **Dark Reference**

Pinned to desktop toolbar (at bottom)

Figure 1   Important program icons both on the desktop and pinned to toolbar at bottom of screen.

5. Select appropriate sensor for work (see Table below)
   a. If needed unplug current sensor at sensor input and replace with desired sensor (see below)

Sensor ID	Other designation**	Nominal Measuring Range	Working Distance	Lateral Resolution
S3/0150*	CL1	150µm	3.3 mm	1.1 µm
S11/0400	CL2	400µm	10.8 mm	1.8 µm
S12/1400	CL3	1400µm	12.2 mm	2.6 µm

* for flat surfaces only ** All the sensors are chromatic confocal from STIL

**Changing sensors:**

I.   Turn power of the sensor module OFF
II. Lift flat on module and extract sensor fibre optic cable by depressing green clip

III. Detach sensor with knob (anti-clockwise)
IV. Place sensor in black case (under machine) – do not bend the fibre optic cable, loop in large radii only
 V. Insert sensor cable into sensor module (ensure the cable is full inserted, if the sensor does not appear to be working this will be the likely cause)
VI. Place sensor on XY table and turn on sensor module (perform dark reference see step 6)
VII. Check the sensor (put white card under sensor and observe spot)
VIII. Affix desired sensor (DO NOT cross-thread) to instrument

6. Next perform a Dark Reference
    a. Open dark reference software ∑
    b. Start *Dark reference sensors and collect information*
    c. Select sensor from the list
    d. Ensure the sensor is not in focal range of any surface
        i. When the sensor assembly is on the XY table
        ii. This could be in the home position of the Z position (home Z in Key Move Stage from scan window in Proscan software)
   e. Sensor will return a report check the working frequency which should be 100 Hz
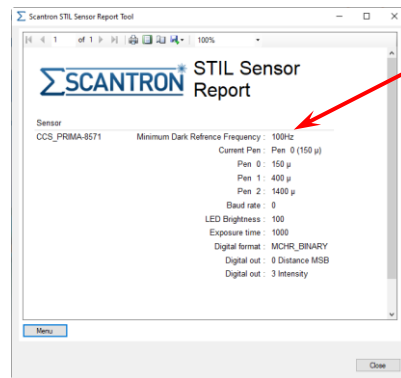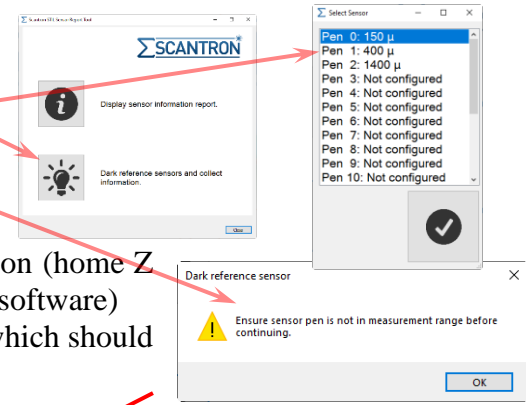
7. Open Proscan software
8. Click on tools and select *Sensor Selection*
9. Select current sensor
10. You are now ready to begin scanning.
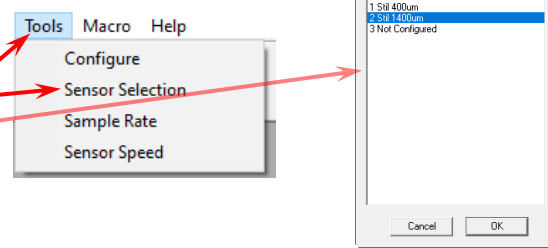
Shutting Down the Equipment:
1. Turn off the Raspberry Pi (Tablet) – bottom left quit button
2. Close all programs and turn off PC
3. LEAVE AT LEAST 10 seconds before going to 4.
4. Turn on Sensor Module
5. Turn on PSU module – at back where power cable goes into module
6. Removal all samples

Sensor Module power button

Sensor input
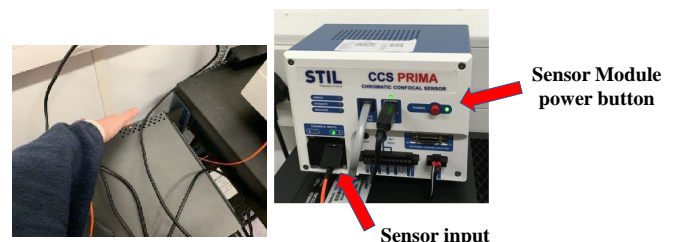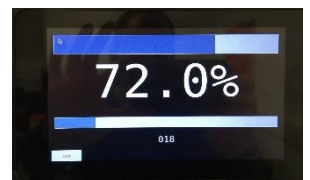
Setting up the system prior to scanning:

The machine basically operates in two modes and this can **only** be set with **no open** scans/files. In the main software (Proscan), go to *Tools* and then *Configure* as shown below. ALWAYS WORTH CHECKING WHAT MODE IT IS IN WHEN YOU START. For roughness measurement also check all analysis functions required are selected.
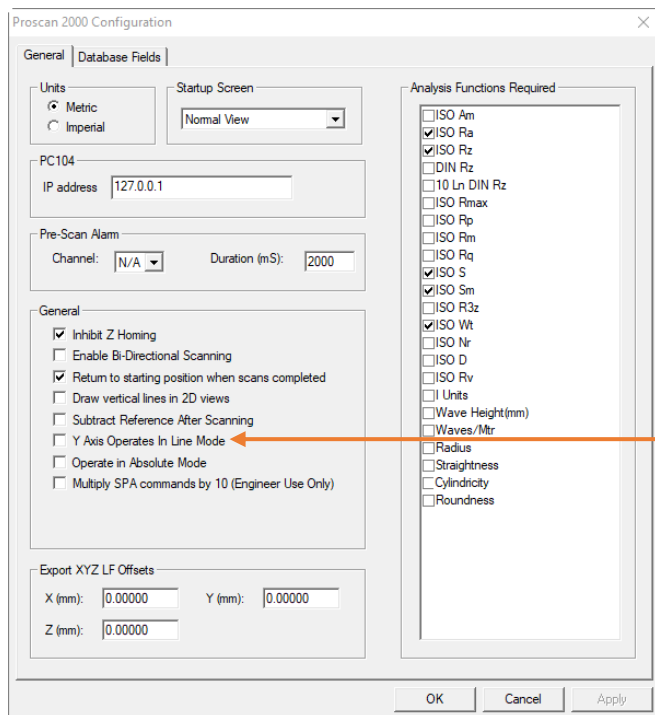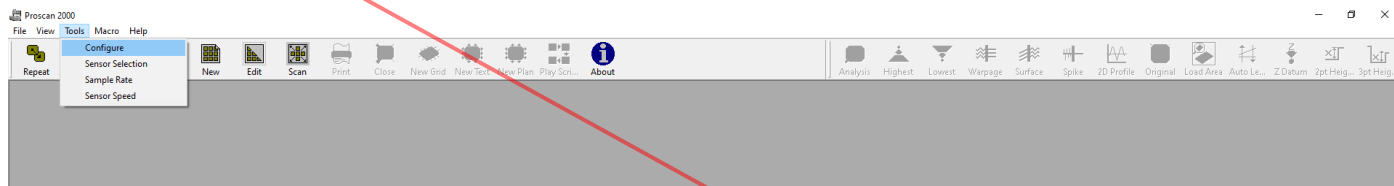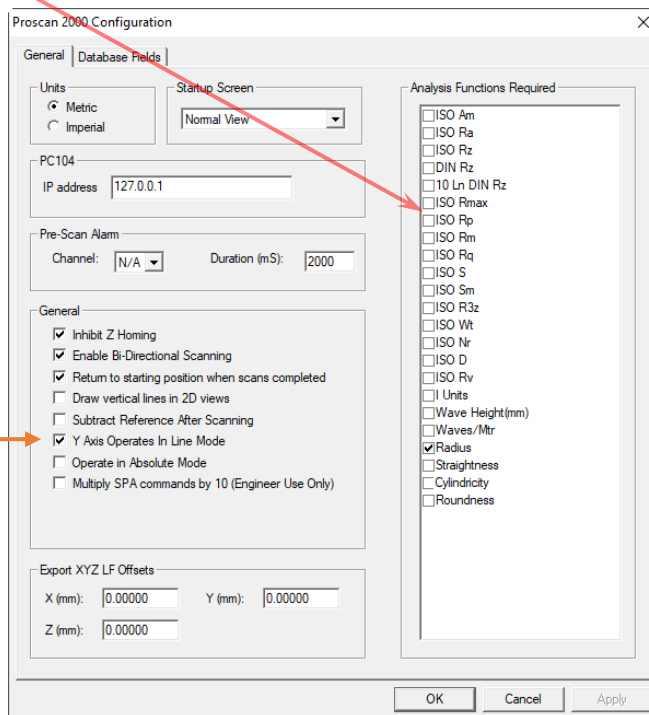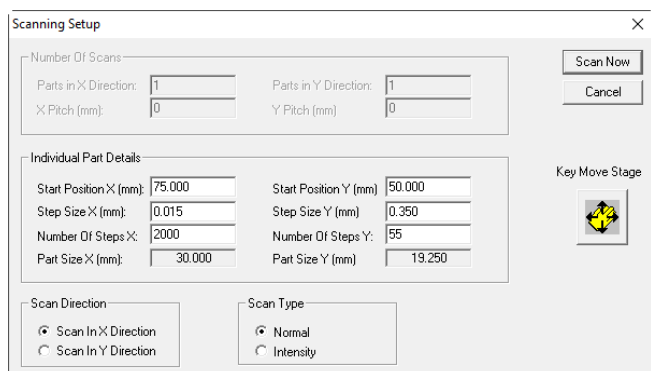

(a) General scanning   (b) Roughness measurements

You can also setup the *Analysis Functions Required* (right panel), again do this at the start (or close all windows is you missed).

Click on the *Scan* button [Scan] and depending on the mode one of the following windows will show.
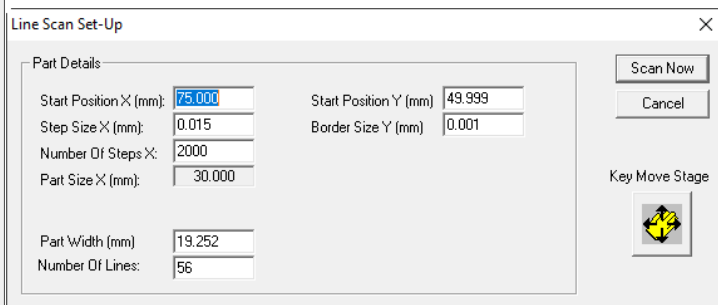
(a) General scanning   (b) Roughness measurements

The reason for the two modes is the way the system works; the image below shows that scans starts in the top left position, also called the *Starts Position* (which becomes important when setting up a scan) and moves (rasters) in the X-direction performing a series of measurements in a 'line', it will then move to the same

starting X position but move down the step size in Y and repeat the line measurement and will continue this until the scan is complete, but what this means is it is very quick at measurements in X direction but a lot slower in the Y direction, thus **roughness measurements are always conducted in the X direction** and general scanning can have more data points in the X-direction to increase density of points without a major increase in time.
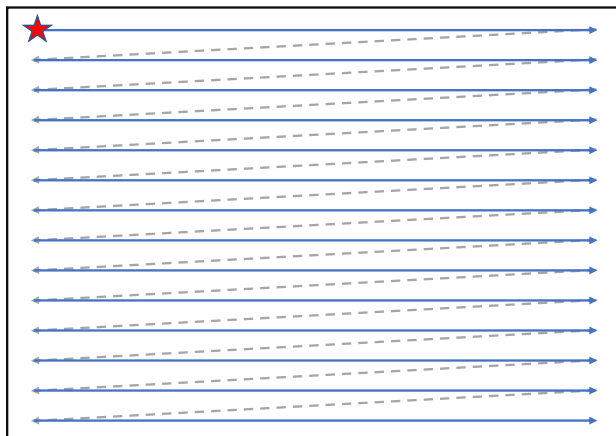

Figure 2   Scanning start from top left and only scans from left to right (blue arrows) record data, the repositioning shown by grey lines does not record data.

Loading sample

Once the system is set up and the correct sensor installed and checked that it is working and then the right mode is selected. Click on *Scan* icon ( ), either the 'Scanning Setup' or 'Line Scan Set-up' window will appear depending on mode, next click on *Key Move Stage* ( ) and the following window will pop up that control the position of the XY table and sensor height/position.
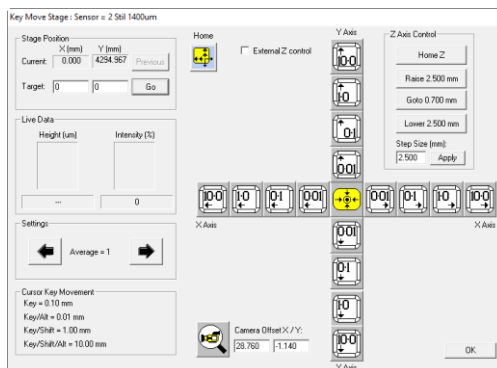
Next click *Home* ( ) and XY stage will move to the 'home' position, which move the stage forward and right as shown in the image below.
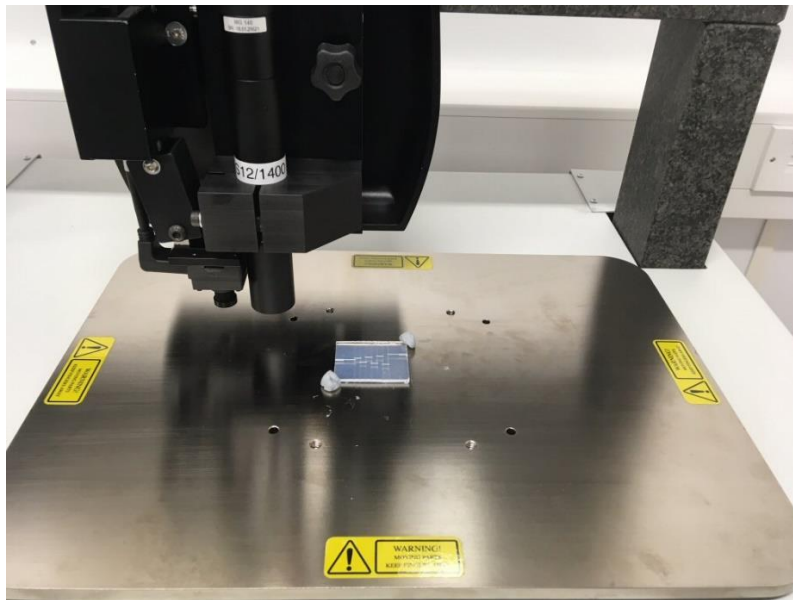
Fix the sample to roughly in the middle, using blue tack for light sample, as shown in the image above. Note the system is setup for better accuracy in the X-direction and roughness measurements are performed in this manner. Now measure (flexible ruler provided) the height of the sample or any fixations whichever is highest, and the distance between the bottom of the sensor and the XY stage. It might seem obvious, but the sensor must be higher up than the sample and any fixations to avoid it crashing into the sensor when it is moved around. ENSURE there is sufficient distance below the sensor that it will not hit the sample (or any fixations), initially this should be at least 20 mm above if not much more (use flexible ruler), see the section *Approaching the Sample* to move the sensor up if necessary. Once the sample is fixed in position use the stage controls to move the centre over the sample, if you have positioned the sample in the centre just press *Centre* (⊕).

ALTERNATELY, use the *Centre* (⊕) and then slide the sample underneath the sensor, adjust sensor height (see the section on *Approaching the Sample*) as necessary, this approach is easier with the turret cover off and is recommended for samples or sample fixation devices that are not flat or you are uncertain about the other approach. It is still best to have a large distance away from the sensor and this can be achieved by Z home (see section *Approaching the Sample*).

Once the is sample positioned and sensor move over use the Y Axis and Y Axis 'nudge' controls (10 mm to 0.01 mm) to move to the area of interest on the sample, note this is moving the stage and thus maybe opposite to what you think (if you have used the Alicona a lot). But fine tuning of the scan area will be done after the sensor is in working range and thus the camera is in focus.
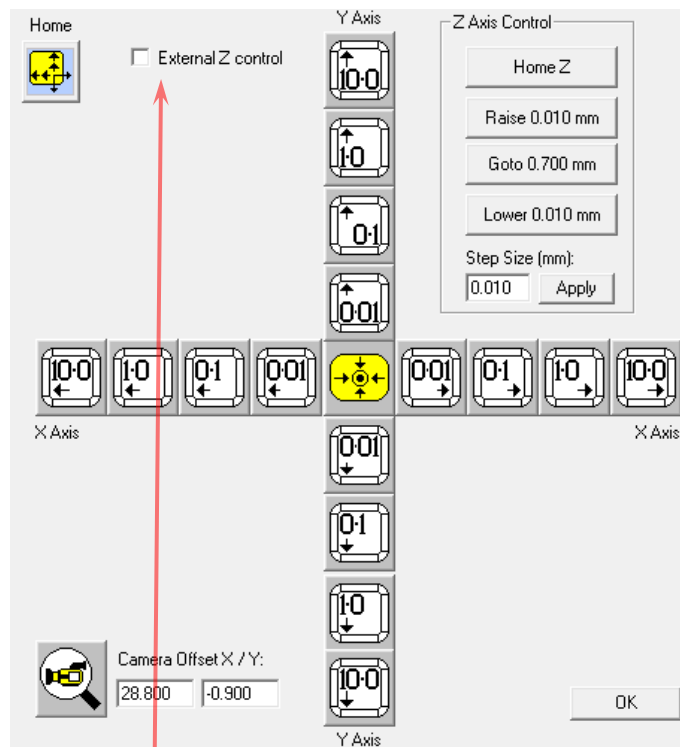
Approaching the sample

Great care must be done when moving the sensor towards the surface of the sample to avoid collision and potentially damaging the sensor.

Note the working distance and range for the sensor you are using (table on page 1), this is very important during the approach.

Click on the *External Z controls* (External Z control) to make active (box ticked). Now use the manual controls on the front of the machine. See image below, the right button is Z home and takes the sensor all the way up. Can be useful when changing samples. The middle two buttons are up and down and both will move the Z stage slowly when depressed. To speed the up and down motion, simultaneous hold the left button and it will quickly descend/ascend.
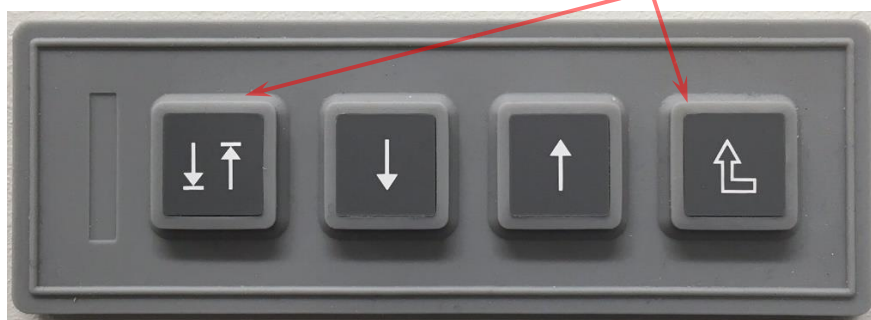
Watch the raspberry pi display (see below for image) for the sensor to come in range, note for the most sensitive sensor it easy to quick go through the measurement range and thus it is necessary to both watch the raspberry pi display and the sensor-sample gap. There is a flexible ruler (fridge magnet style) to check the gap.
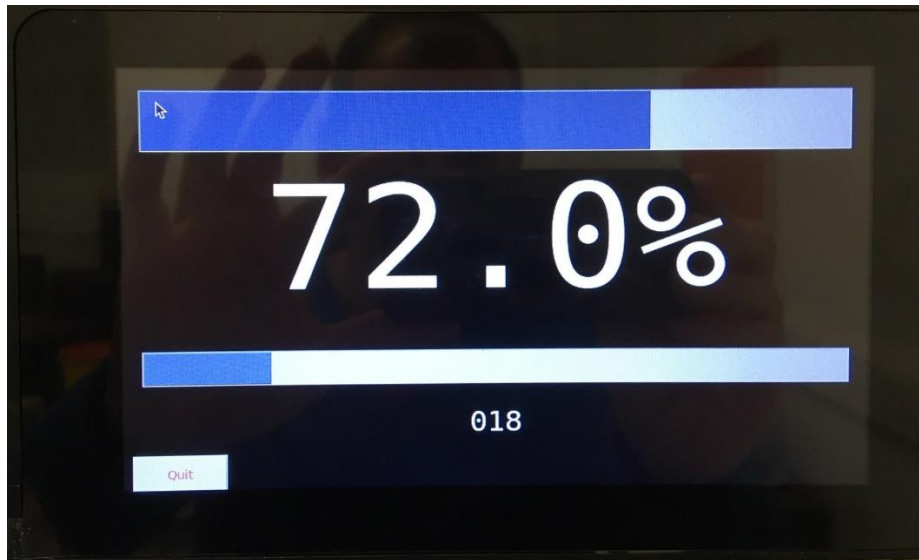
Once the sensor comes into range a percentage will appear on the raspberry pi display, for flat samples aim for around 50% to be in the middle of the range. If the sample is not flat or has a significant variation in height you may need to move around the sample and test that all of the area of interest is in range, but initial scans are quick and this can also be evaluate there. But this can be done later.

Now turn on the camera (if not already on), there is a desktop icon and in bottom task bar.

In the Proscan software on the *Key Move Stage* (from *Scan* window) check the *Camera Offset X/Y* is correct for the sensor used, note the offset is slightly different for each sensor. Click on camera icon and the stage will be so the camera is over the same spot as the sensor used to be.

Sensor ID	Camera Offset
S12/1400	X = 28.76 Y = -1.140
S3/0150*	X = 28.78 Y = -1.280
S11/0400	X = 28.70 Y = -0.840

The next two things to determine is the initial start position (in X and Y) and the area to be scanned. Use the camera to find the top left position. **Note the coordinates (in notepad or similar)** if you intend to move around, you can return by entering the values into the Stage Position. If you go OK on the Key Move Stage it will automatically enter current position as your Start Position, thus if this is not correct and you have noted where you want to start you can enter manually. Note if the scan is aborted (user stop or software crash) it is very easy to lose your start point.
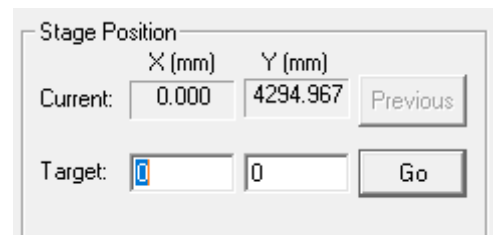
Users can use the *Key Move Stage* to move around the area of interest easily and accurately with the X and Y nudges (note you are moving the stage, thus this maybe in opposite direction to what you would think when using the camera). Alternately, low resolution scan can be performed very quickly and are recommended to check you have the right position and height (no data drop out)

General Scanning

Ensure that the *Scan In X Direction* (bottom left) is selected. Check the Start Position (X and Y) and manually alter or go back into the Key Move Stage and set up.

For initial scanning, it is recommended to use a low number of points, such as 100 × 100 steps, which is usually sufficient to get an idea of the area being scanned and allow for quick alterations. Adjust the Step Size (in X and Y) to the desired and *Scan Now*.
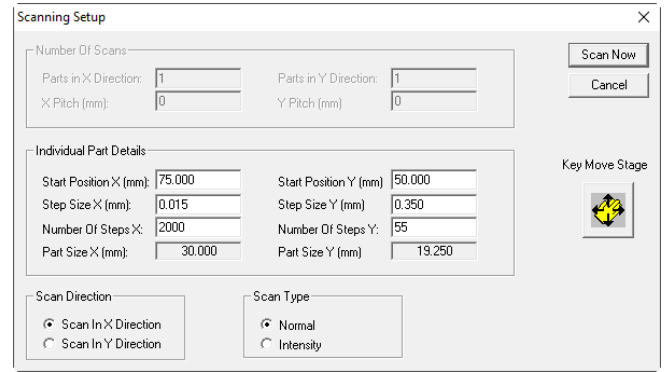
The stage should start moving and the Scanning in Progress window will appear and will start building line by line.
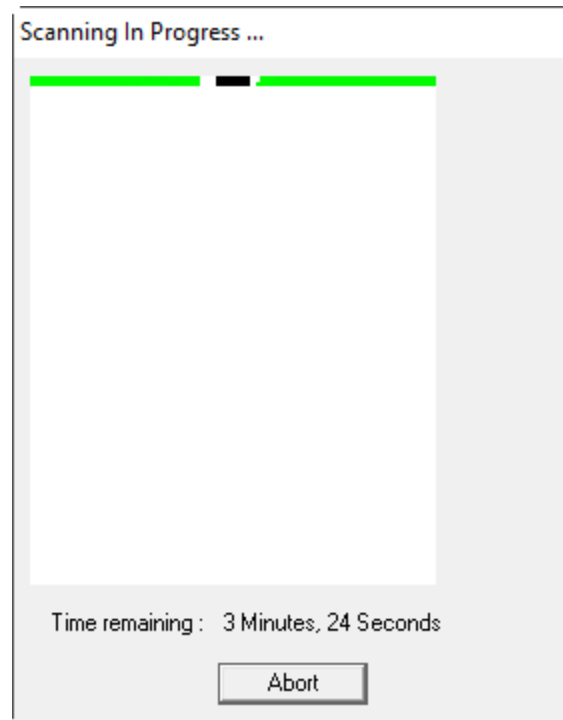
Once you are happy it is in the right place and are ready for a full resolution scan, now adjust the step sizes (resolution) in X and Y. NOTE DO NOT GO LOWER THAN 0.001 mm (1 µm) – THIS WILL CRASH THE SOFTWARE. Also adjust the number of points accordingly to be same area (or change area size as necessary). Note it is far quicker to have a large(r) number of points in X than Y, so 10,000 points in X and 100 points in Y, will be almost 10 times quicker than 1,000 by 1,000.

Post Scan Optimizations

The analysis tool bar is shown below, Analysis, Surface (filter) and 2D profile are used in roughness measurements.

All the optimisation steps and the later analysis steps can be reset by clicking on *Original*, this will go back to the original data, so remember to save it if the optimisation/analysis steps work. You can also work on smaller portion of the data by holding the shift key, use the mouse to draw a box, then click on *Load Area*.

Levelling

One the first things you will likely do is levelling and, in most cases, this can be achieved this can be achieved by Auto Level ⊞ Auto Le… . Note this uses all the data points, thus there are a few other options, go to the *Function* and choose between the *Datum Plane Levelling* or *Three Point Levelling*.

Function	Tools	Macro	Script	Window
Datum Plane Leveling				F6
Three Point Leveling				Shift+F6
Auto Leveling				Ctrl+A
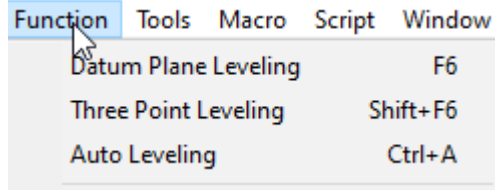
Visualisation

In terms of visualisation, the plots may have contour lines or be shown *Lines Mode*, the latter is shown below
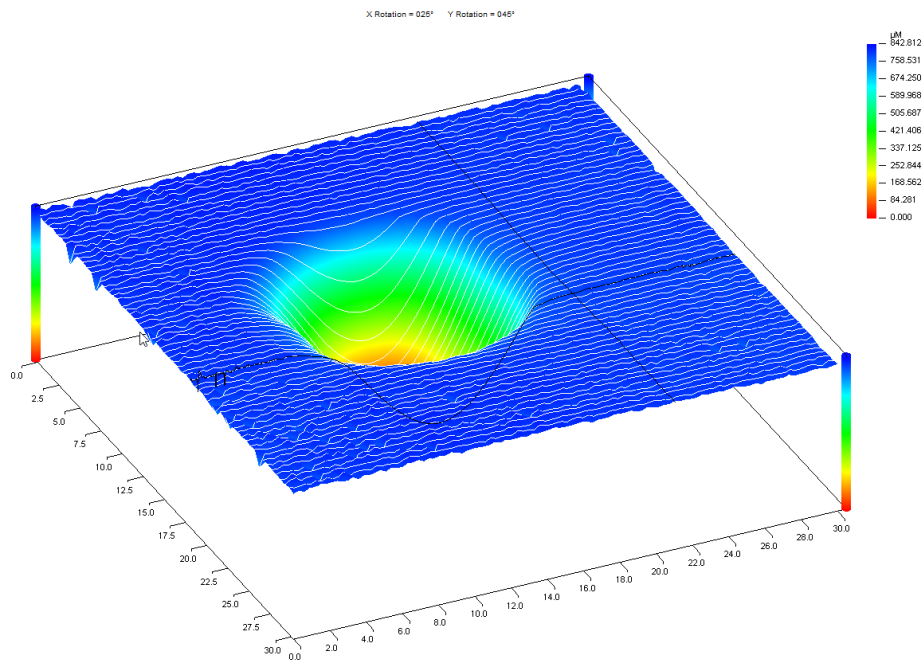
To remove contour lines and change from *Lines Mode*, go to *Tools* and *Options*.
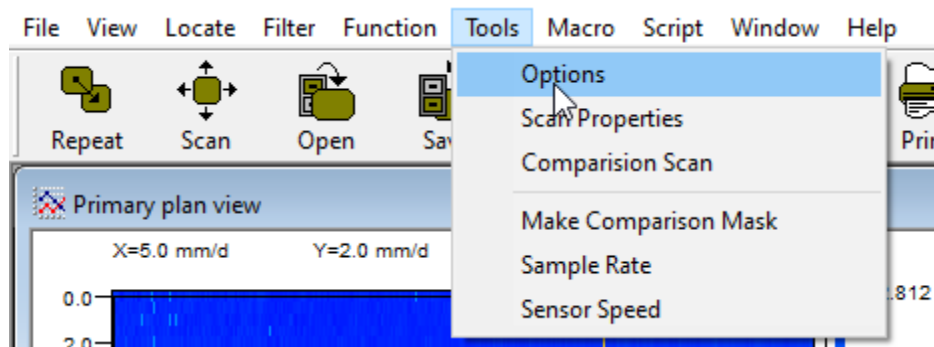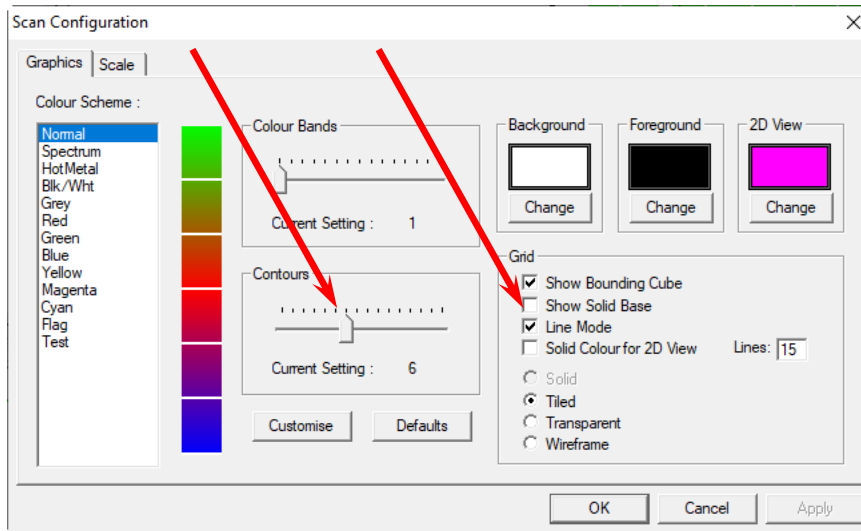
Uncheck *Line Mode* and select *Solid*, also set the *Contours* to zero.
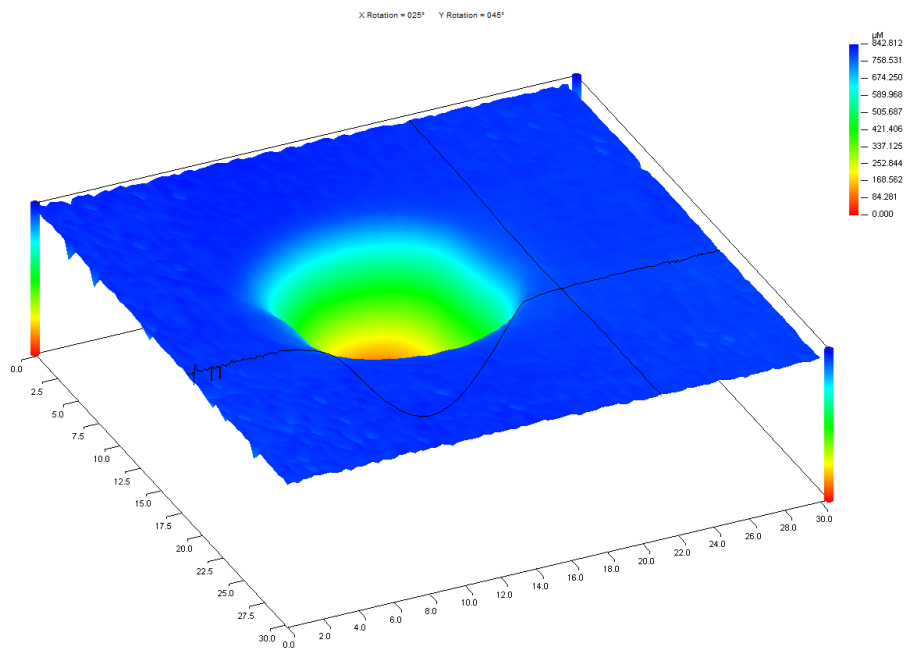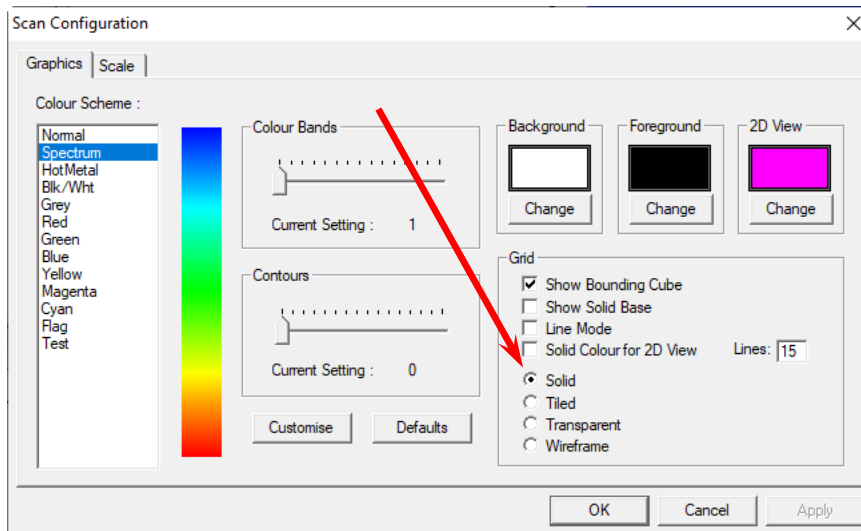
Removing bad data

Bad data can appear as either blank/empty or unrealistic spikes, a scan below shows the former (better shown by top left panel). The sample had sharp (square) channels and the system could not determine height as it transition from high (green) to low (blue or purple) and the white is effectively missing data. This is an extreme case and the missing patches on the green are much more likely in most scans, but careful preparation in scanning even these are quite rare.
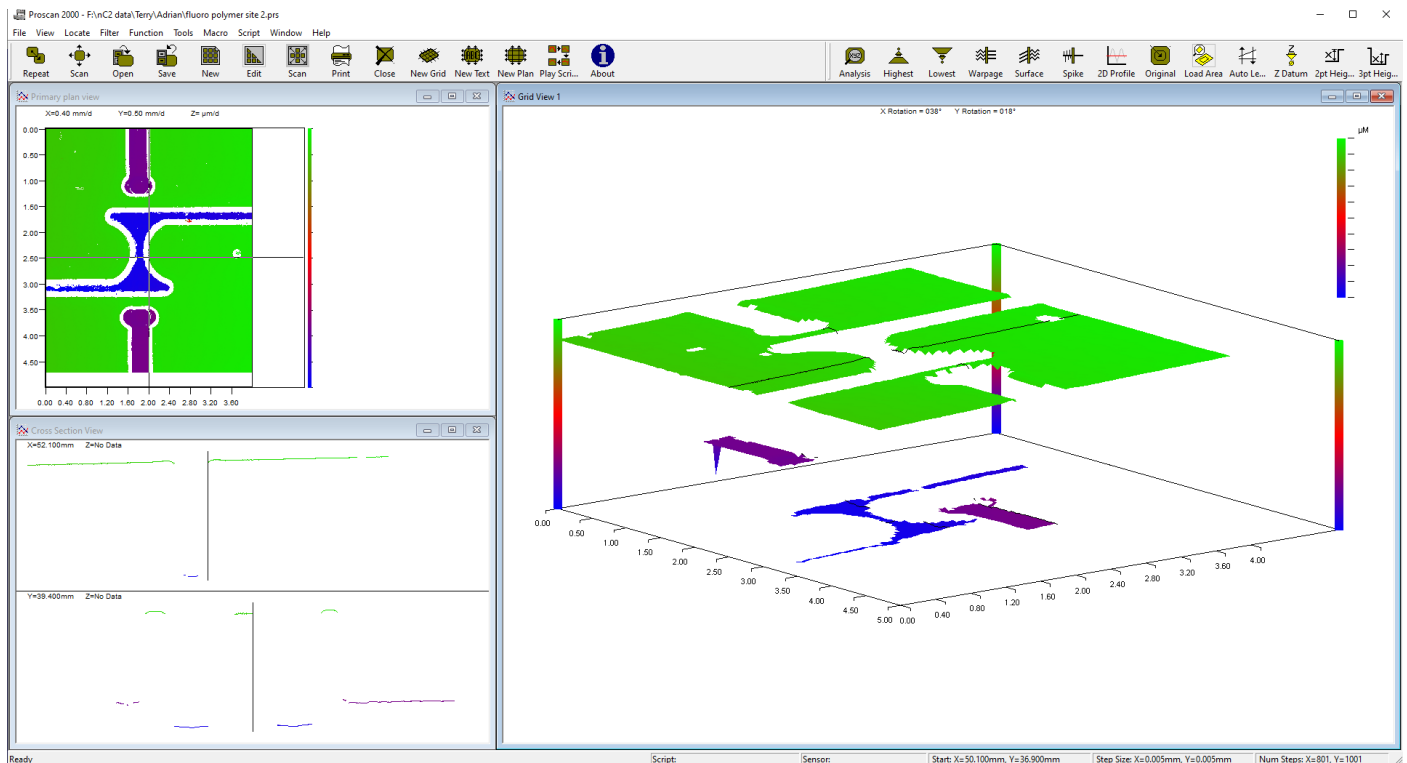
These can be filled by an interpolation method and it is best to try the three methods and see which best does the job.
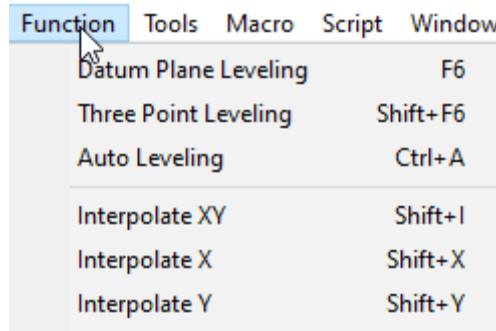
As mentioned the other data that may need is spikes and these can be remove with the spike filter which is found on the Analysis part of the tool bar ( ), again it seems that playing around until it seems to get the best results is the way to go.

Analysis of General Scans

Most people will be likely be using the system to measure wear and this is best done by inverting the data in height (after all the optimisation steps are done). Go to *Function* and then *Flip Height*.
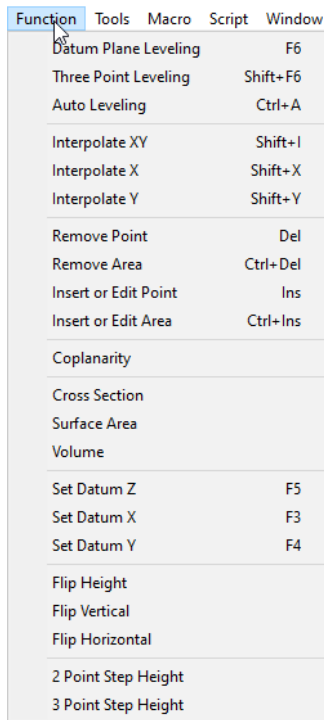
To determine the volume go to *Function* and then *Volume*, adjust the lower datum with the cursor keys (up and down) then press enter, adjust upper datum (DO NOT PRESS ENTER) with cursor keys. Note the volume. Shown below is the inverted (CORRECT) data and the non-inverted data (INCORRECT) data, the non-inverted is more than 10× larger as it effectively takes the wear data from the from the total scan volume.

Page 12
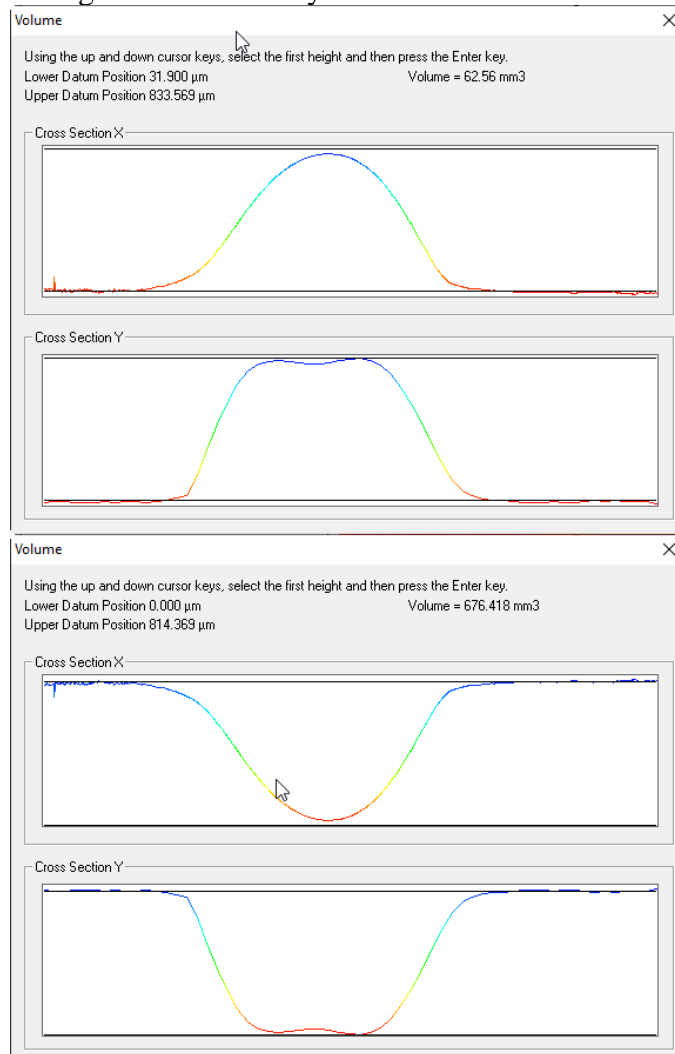
Roughness Scans

If you do not see the Line Scan Set-up after clicking *Scan*, close all any open scans and follow the procedure on Page 4.
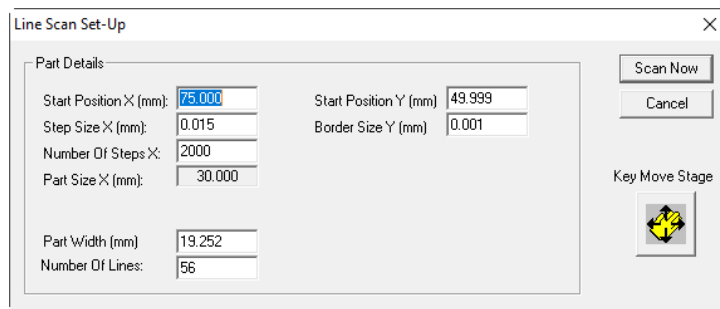
Roughness scans are similar to general scans except the user needs to set the step size relating to the roughness to be measured. But first how is roughness measured. Below is an image of a measurement length, inside this length there is an allowance for filter (data that is distorted and needs to be discarded), then the evaluation length is made of a number of sample lengths, typical five or more.
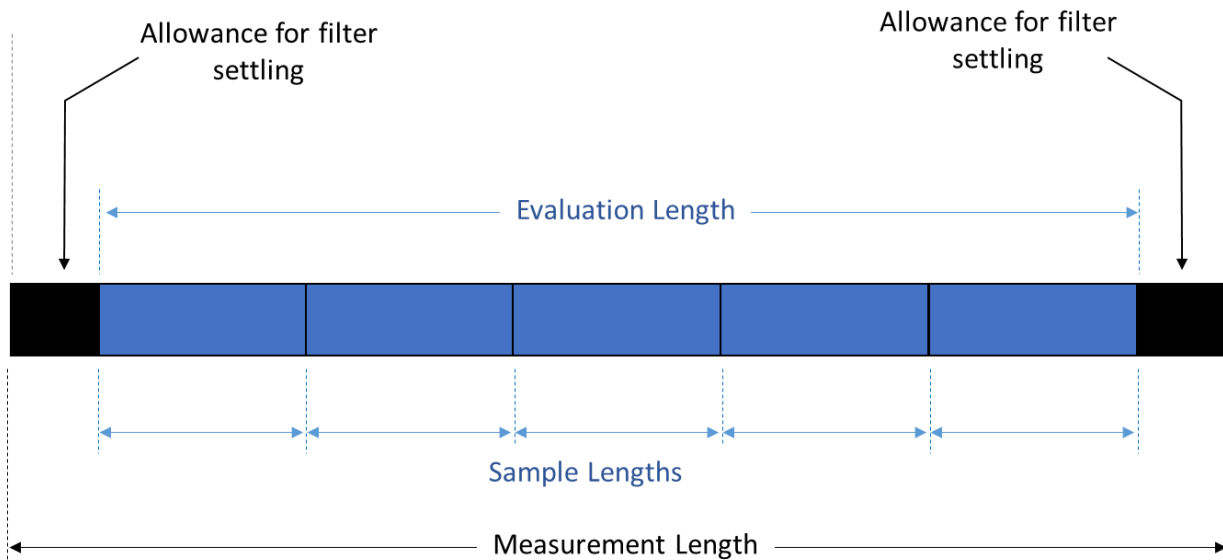
These sample lengths are also called 'cut-offs' and are defined by ISO4288-1996 and this has been adapted in the table below. This sort of means you need to have an estimate of the roughness and may have to adjust and rescan after the initial assessment. Alternately you can scan at the highest resolution (0.001 mm / 1 µm *Step in X*) and do longer scan lengths.

Periodic Profiles	Non-periodic profiles		Cut-off	Minimum Spacing*	Evaluation Length	Measurement Length
Spacing Distance RSm (mm)	R_z (µm)	R_a (µm)	λ_c (mm)	(300:1) µm (mm)	L_{eval} (mm)	L_{tot} (mm)
>0.013 to 0.04	To 0.1	To 0.02	0.08	1 (0.001)	0.4	0.48
>0.04 to 0.13	>0.1 to 0.5	>0.02 to 0.1	0.25	1 (0.001)	1.25	1.5
>0.13 to 0.4	>0.5 to 10	>0.1 to 2	0.8	2 (0.002)	4	4.8
>0.4 to 1.3	>10 to 50	>2 to 10	2.5	5 (0.005)	12.5	15
>1.3 to 4.0	>50	>10	8	20 (0.020)	40	48

Recommended Cut-off (ISO 4288 and DIN EN ISO 3274) – Proscan

* - the lowest spacing is 1 µm/0.001 mm, lower will crash the system, the higher values have been rounded down to nearest sensible number.

The *Minimum Spacing* in the table above are what should be used in each of the ranges as the X-direction step size. These have been calculated for you but to show you how to do it the following example is given. If we have a sample with expect Ra of 0.2 µm, the ISO recommendation is to use 0.8 mm *cut-off*, with a sampling length/evaluation length of 0.8/4.0 mm. The general rule within ISO is that we use a default bandwidth of 300:1 for calculations, therefore the step size that we should apply is 0.8 mm / 300 = 0.02666' or 2.666 µm. As you can see in the table this is rounded down to 2 µm.

The *Measurement Length* needs to be 10% larger on both sides than the *Evaluation Length*, with our 0.2 µm Ra surface, this means a 4 mm becomes 4.8 mm and this is reflected in the table above.

Non-periodic profiles		Cut-off	Step Size X	Measurement Length	Number of Steps X*	Sensor
Rz (µm)	Ra (µm)	λ_c (mm)	(mm)	(mm)		
To 0.1	To 0.02	0.08	0.001	0.48	480	CL1
>0.1 to 0.5	>0.02 to 0.1	0.25	0.001	1.5	1500	CL1
>0.5 to 10	>0.1 to 2	0.8	0.002	4.8	2400	CL1 & CL2
>10 to 50	>2 to 10	2.5	0.005	15	3000	All
>50	>10	8	0.020	48	2400	All

* This just *Measurement Length* / *Step Size X*.

The table above is a distillation of the ISO table and adapted for inputs into the 'Line Scan Set-up' window, these are minimum size/numbers. Use the *Step Size X* (do not go lower than 0.001 it will crash the software and machine) and enter the *Number of Steps X*, check that the measurement length, *Part Size X (mm)*, is correct and is at least the measurement length in the table above.
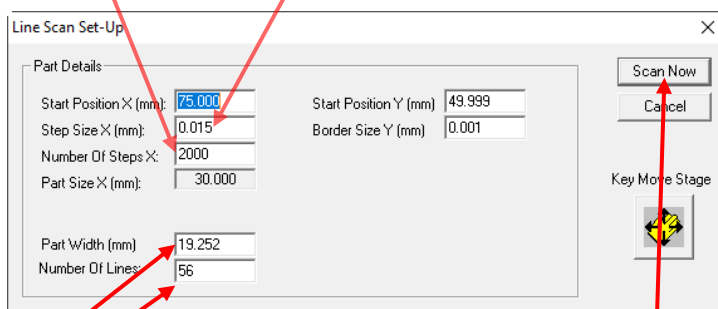
Next enter the *Part Width (mm)*, this defines the area the scan will cover in Y (from the starting position), then enter the *Number Of Lines*, this determines the number of individual 'roughness lines', dividing one by the other will determine the spacing between the lines. Once all set up press *Scan Now*.
This should produce something like that shown below.
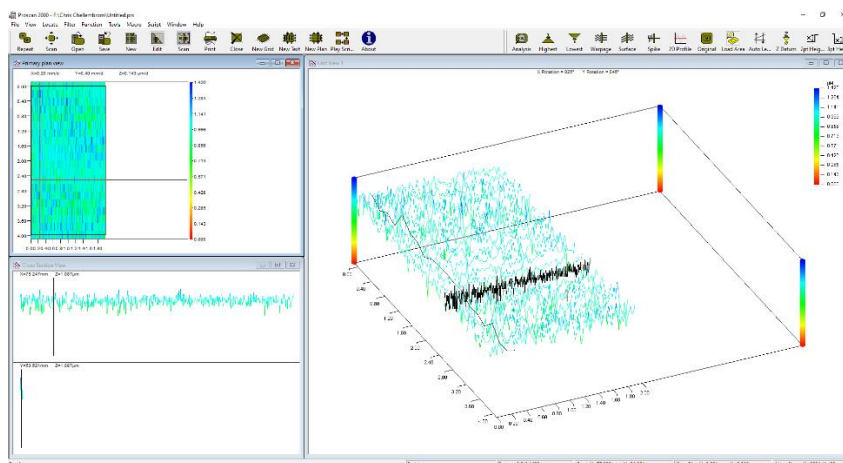
If you are happy with the scan save it now, otherwise rescan.

The software allows a quick check for roughness measurements, from the analysis tool bar select *2D profile*.
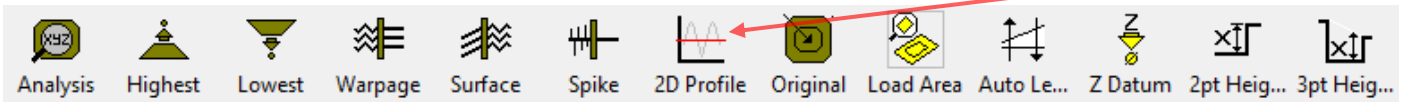
Draw a horizontal line in Primary plan view (when the below pops up).
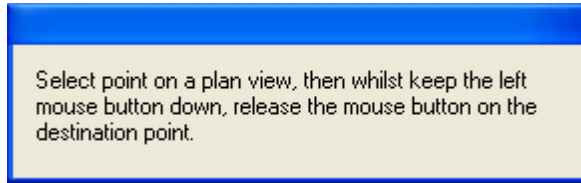
A new panel will open, something like below. *Auto Level* the data and then enter the *cut-off* value in the *Roughness* and click *Apply*. Check the *Ra* and *Rz* match the range for the cut-off used. You can use a difference cut-off but may need to rescan if the step size and measurement length are incorrect for the cut-off.
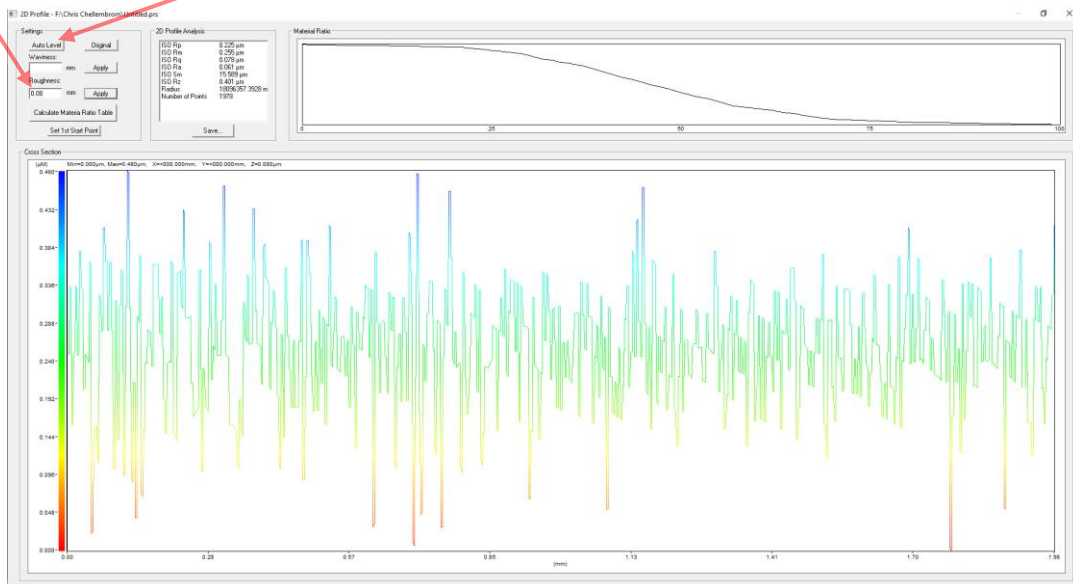
Once the cut-off and measurement lengths are appropriate the data can be properly analysed. But it needs be Auto Levelled and a surface filter applied

The surface filter ranges from 1 to 99, and can be calculated using:

$$\text{Surface Filter} \ = \ \frac{\left(\lambda_c/2\right)}{\text{step size}}$$

Thus, if we use the example above (Ra = 0.2 µm) with cut-off (λ_c) of 0.8 mm and step size of 0.002 mm, this gives:

$$\text{Surface Filter} = (0.8/2)/0.002 = 200$$

So, we apply the closest value, which is 99. The values have been tabulated below for each cut-off.

Non-periodic profiles		Cut-off	Step Size X	Surface Filter
Rz (µm)	Ra (µm)	λc (mm)	(mm)	
To 0.1	To 0.02	0.08	0.001	40
>0.1 to 0.5	>0.02 to 0.1	0.25	0.001	125
>0.5 to 10	>0.1 to 2	0.8	0.002	200
>10 to 50	>2 to 10	2.5	0.005	250
>50	>10	8	0.020	200

Now that a filter has been applied, we need to remove 10% from on each side, which has been adversely affected by the filtering. Do this in the Primary plan view. Holding the shift key, use the mouse to draw a box excluding 10% on each side (see example below), so for our example the measurement length would have been at least 4.8 mm, so going from 0.4 mm to 4.4 mm (on bottom axis), try to include all vertical lines. Once the box is drawn, now click on *Load Area*. You can save the filter data and it is suggested to do a *Save As* to keep the raw data.
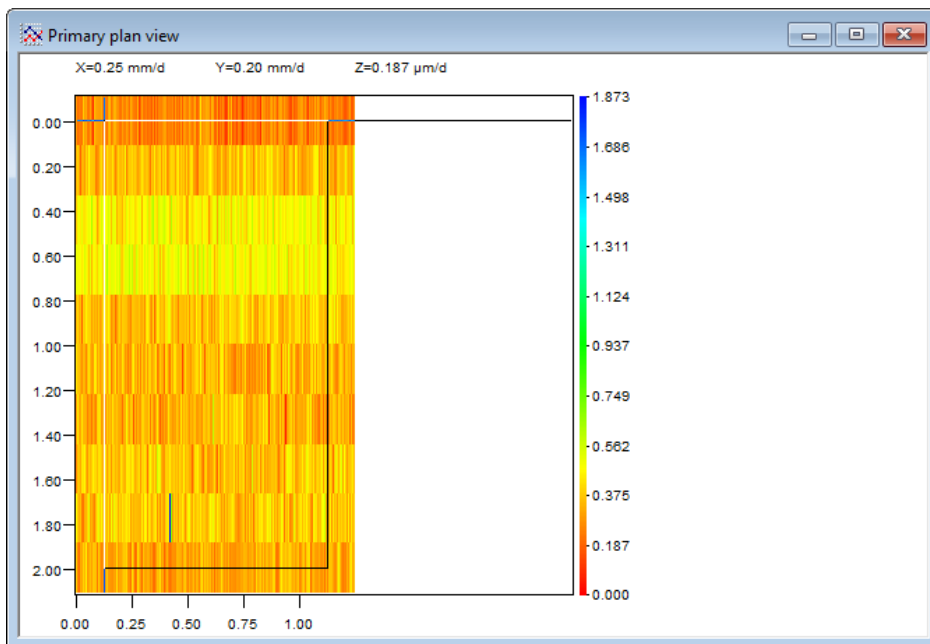
Now click *Analysis* ( ), there are a few options, note if you have lots of lines the *Zoomed Area* will take a considerable amount of time and seem like that the software has crashed (it is just working very hard). Note the last used option used will appear for the next user!

At the bottom left of the analysis window is the type of analysis performed.
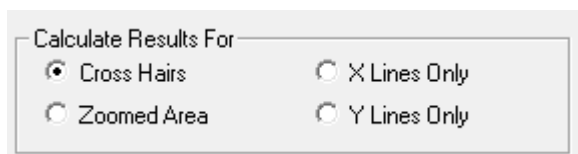
Cross Hairs is a single measurement where the cross hairs…only helpful for checking the other analysis and as a quick answer.
Zoomed Area which will average all the lines and give you the parameters.
X Lines only will give individual analysis results for each line. This is recommended as you can perform your own analysis (statistics) on them.
Examples are shown on the next page.

Profile Analysis

Calculation	X	Y	Units
ISO Ra	0.054	0.055	µm
ISO Rz	0.327	0.106	µm
ISO Rp	0.183	0.167	µm
ISO Rm	0.195	0.185	µm
ISO Rq	0.067	0.085	µm
ISO Sm	35.667	-	µm
Radius	15.0094	1040.6589	mm
Straightness	-1.000	-1.000	mm

Calculate Results For: ● Cross Hairs ○ X Lines Only ○ Zoomed Area ○ Y Lines Only

Save to Database... | Print | Save to File... | OK

Profile Analysis

Calculation	Mean X	Min X	Max X	Count X	Mean Y	Min Y	Max Y	Count Y	Units
ISO Ra	0.052	0.047	0.063	1251	0.071	0.026	0.273	10	µm
ISO Rz	0.355	0.285	0.619	1251	0.099	0.032	0.508	10	µm
ISO Rp	0.324	0.153	1.491	1251	0.148	0.047	1.367	10	µm
ISO Rm	0.235	0.177	0.373	1251	0.145	0.048	0.340	10	µm
ISO Rq	0.069	0.060	0.105	1251	0.088	0.033	0.468	10	µm
ISO Sm	30.280	23.423	35.667	1251	-	-	-	10	µm
Radius	7472075...	15.0094	7472013...	1251	1.#INF	30.0476	1.#INF	10	mm
Straightness	---	---	---	1251	---	---	---	10	mm

Calculate Results For: ○ Cross Hairs ○ X Lines Only ● Zoomed Area ○ Y Lines Only

Save to Database... | Print | Save to File... | OK

Profile Analysis

Line No	ISO Ra	ISO Rz	ISO Rp	ISO Rm	ISO Rq	ISO Sm
1	0.054	0.327	0.183	0.195	0.067	35.667
2	0.053	0.351	0.262	0.328	0.069	34.971
3	0.051	0.349	0.209	0.278	0.066	30.590
4	0.063	0.619	1.491	0.211	0.105	23.423
5	0.049	0.285	0.183	0.177	0.060	28.186
6	No Lines					
7	No Lines					
8	No Lines					
9	No Lines					
10	No Lines					
11	No Lines					
12	No Lines					
13	No Lines					
14	No Lines					
15	No Lines					

Calculate Results For: ○ Cross Hairs ● X Lines Only ○ Zoomed Area ○ Y Lines Only

Save to Database... | Print | Save to File... | OK

Routine Maintenance

Part	Description	Period
Z axis leadscrew	Apply THK multipurpose lithium EP grease to lead-screw	Every 12 months
X and Y rails	Apply ISO68 Slide-way oil to rails	Every 12 months
Sensor measuring head optics	Make sure laser optics are clean and free from dust. Clean using a lint free wipe and a small amount of methanol	Every 3 months \after handling \if data quality falls
X and Y axis linear encoder strip and read-head	Use a clean dry lint free cloth. Use only the following solvents sparingly with a wetted lint free cloth - Propan-2-ol (iso propyl alcohol) CH3CHOHCH3 - N Heptane CH3(CH2)5CH3 DO NOT use the following aggressive solvents to clean the scale - Acetone CH3COCH3 - Chlorinated solvents - Benzene - Methylated spirits	Every 12 months \if read-head shows red
Cables	Check for wear\breakages	Every 12 months\as necessary

Troubleshooting

Fault	Possible reason	Action
On double clicking software icon, splash screen showing 'Scantron Proscan 2000' remains on screen and stage does not move	Electronics enclosure not plugged in/switched on	Plug in and switch on
	Stand emergency stop pushed in	Pull Emergency stop firmly to out position, press 'Esc' key to enter software, closedown and restart
	PSU module booting indicator is not lit	Wait for embedded PC to finish booting (< 10 secs) *Next* Turn off the PSU module, wait for 10 secs and then turn on again, waiting until the booting light is green *Next* Contact Scantron
	Networking problem	Check network cable from controlling PC to Stand back panel *Next* When splash screen showing, press escape to enter main software. Go to Tools/Configure and check the IP address which should read 172.16.0.70
	Cable connection problem	Check the power cable running from PSU module to stand
Power to the stand does not appear to be active	Power lead not plugged in	Ensure all leads are plugged in and switched on
	Fuse blown	Check fuse on back panel, and in power lead
	Internal PSU fault	Check all indicators on front of PSU module. If any of the indicators are not lit, contact Scantron
Software displays message: "The scan only contains invalid data and cannot be displayed"	Wrong sensor selected (i.e. sensor on system is not selected in software)	Go to Tools/Sensor Selection and chose the correct sensor. Also ensure sensor is selected on the S-type controller (if applicable)
	Sensor controller not switched on (S-type)	Turn sensor controller on
	Sensor out of range.	Go to Key Move Stage screen, ensure sensor is in range. Also ensure the sensor being used has enough range for the required task
	Scan was aborted	If a scan is aborted early there may be no data displayed. Allow scan to complete
No laser light from L-type sensor (or indicator on the top not illuminated)	Sensor not selected in software	Go to Tools/Sensor Selection and choose the relevant sensor. *Next* Check sensor is plugged in securely and to the correct control unit *Next* Contact Scantron
System does not complete a scan	PC Energy saving settings. If the Dell PC is allowed to	As a factory default setting at Scantron, the PC energy saving settings are all turned off.

	hibernate or enter standby mode whilst the system is scanning, then the scan will not complete	Please check these settings in Windows to see if they have been changed. To do this right click on the desktop and go to properties. Screen savers do not affect operation
	Emergency stop activated	Check and pull emergency stop button out. Close Proscan software, power cycle the embedded PC, and re-start Proscan software
Z drive does not go home when software is started	Inhibit z drive set in software	In Tools/Configure there is a setting 'inhibit Z homing'. With this checked Z will not go home on start-up. This is sometimes useful to save time
Stage 'clunks' near the beginning or the end of a scan line	If a scan is being done near the limits of the table, stage could possibly hit the limit of travel if travelling at speed	Try to set scans up near the centre of the table
Software seems to freeze when doing analysis	The mathematics involved in such analysis can be very involved and may take a long time to complete	Avoid scans with over 8,000,000 data points. Try using a matrix scan if a large area scan is required
Error message "setup does not lie within stage area (100.00mm, 100.00mm). Please check your settings" in new scan mode	Stage has a fixed size so cannot scan areas larger than 100mm by 100mm	Check that your scan parameters are not going to take you outside of the stage range from your start position
No picture in camera software	Camera not in focus	Rotate focusing ring on camera to adjust focus
	Lens cover is still on the camera	Remove the Nose Cone lens cover and replace Nose Cone again
	Camera not plugged in.	Check camera connector on top of camera. If camera is still not working, contact Scantron
Poor measurements from S-type sensor.	Sensor head is dirty	To remove dust, use a pressurised can of pure dry gas To remove grease, carefully use a soft lint free cloth, with either methanol or trichloro-ethylene The sensors have a special coating with can be damaged by aggressive chemicals. Do not use solvents
	Sensor needs a dark reference	See appendix on dark referencing
	Sample rate too high	Lower sample rate