Toho Technology

Toho
FP Series

Operation Manual

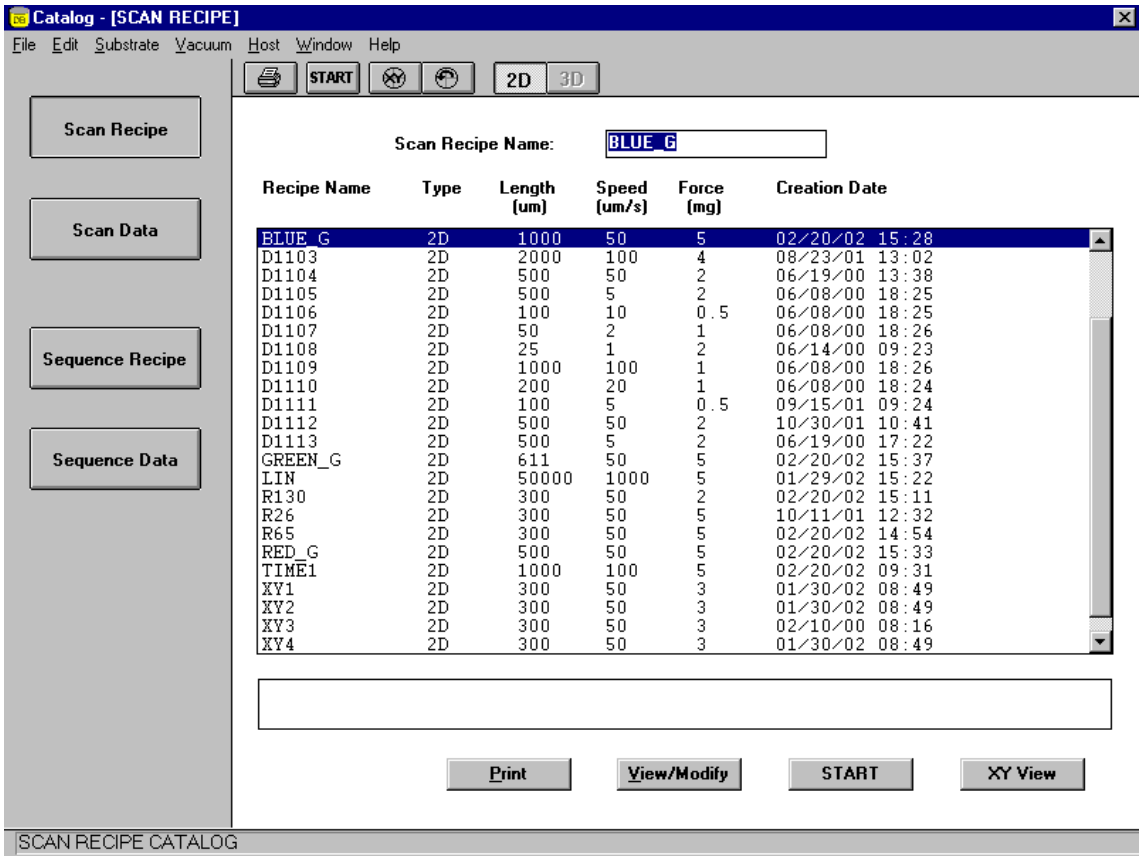
Toho Technology Corporation.

1. Top Level Menu

- Scan: Set, select a recipe and a sequence, and measure
- Calibration: Adjust including step height calibration and others
- Configuration: Set including password and others
- Database File Manager: Import, export and delete data and recipe
- Stress: Stress measurement.
- GEM+SECS: Not used.
- Diagnostics Tools: Not used.
- Log Off: Log off Profiler by (SHIFT + double click)

1.1. Scan

Select Scan Recipe



Use Scan Recipe to measure samples. Determine how to move on the stage during measurement with Scan Recipe. You can set such parameters as scan length, scan speed, stylus forth and so on. The parameters includes those associated with scan data such as cursor position.

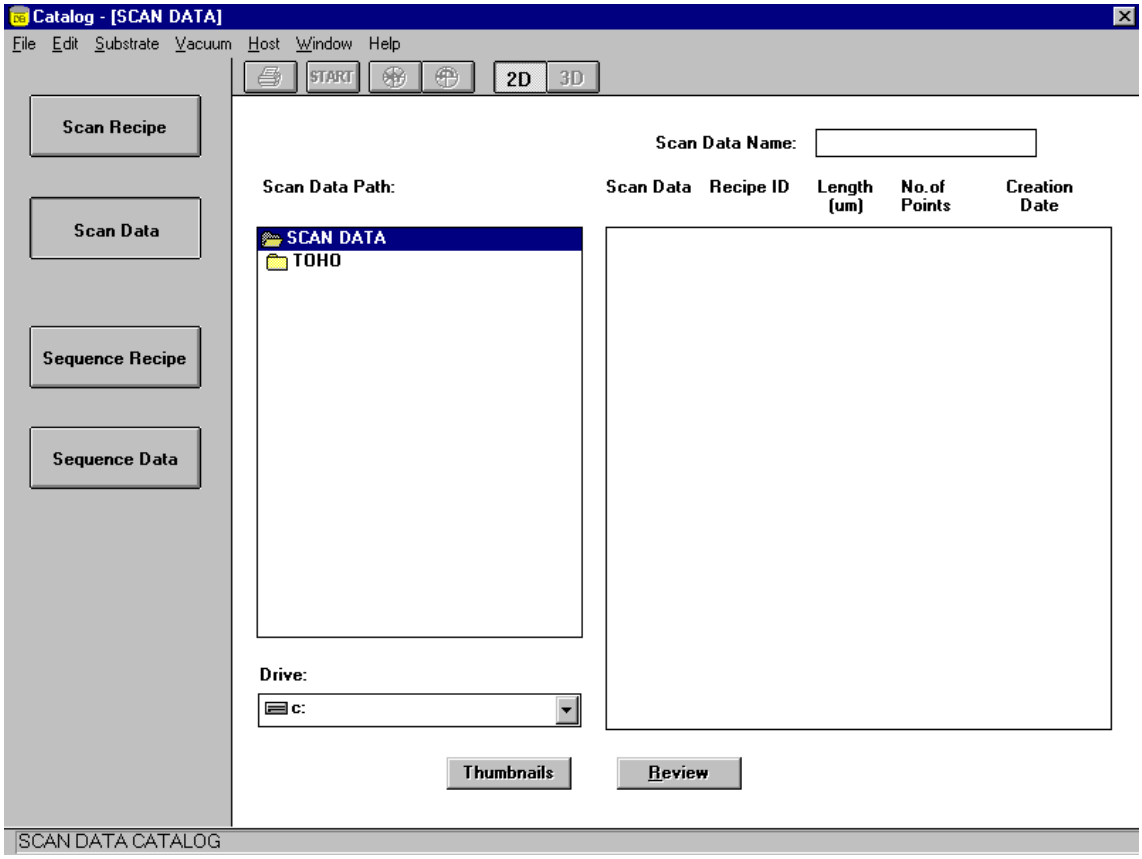
Print a recipe selected.

Display a recipe selected

Measure with the selected recipe.

Load and display a sample for review.

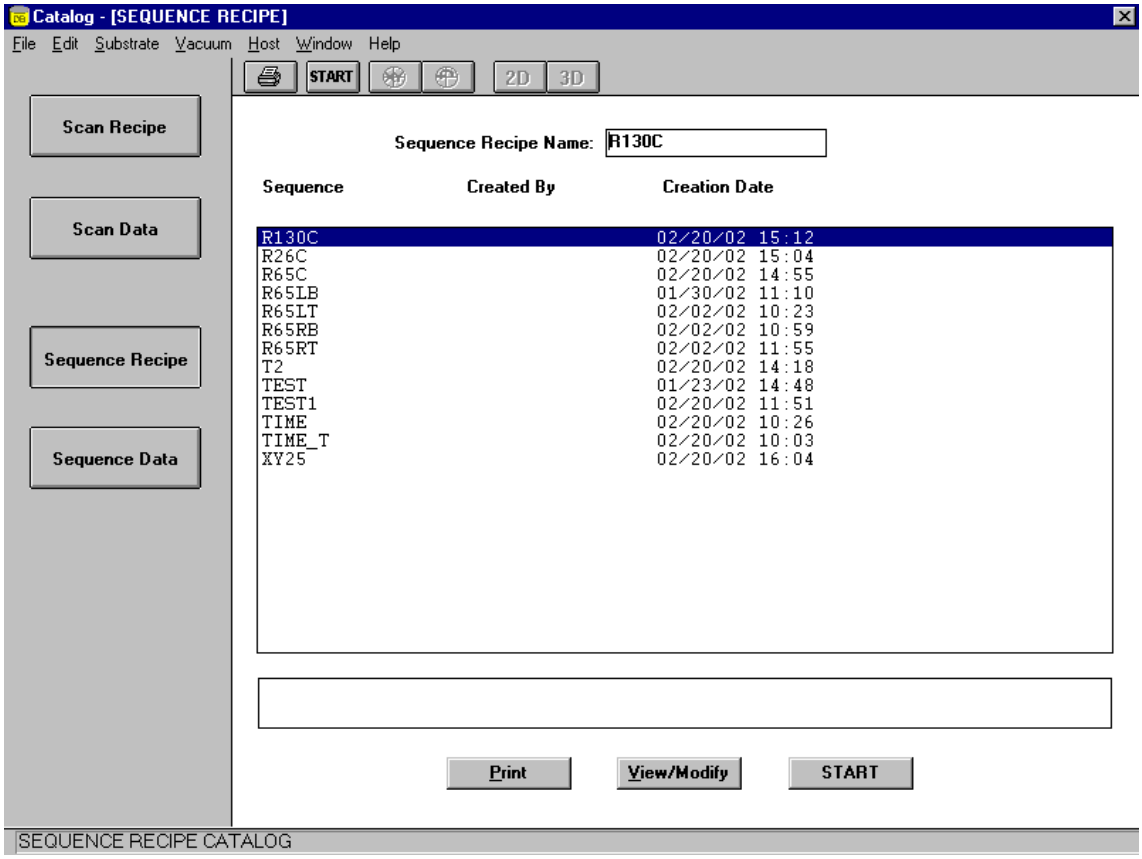
1.2. Selecting Scan Data



This is the area the data measured with a scan recipe is stored. You can review the data here.

Display scan data selected.

1.3. Selecting Sequence Recipe



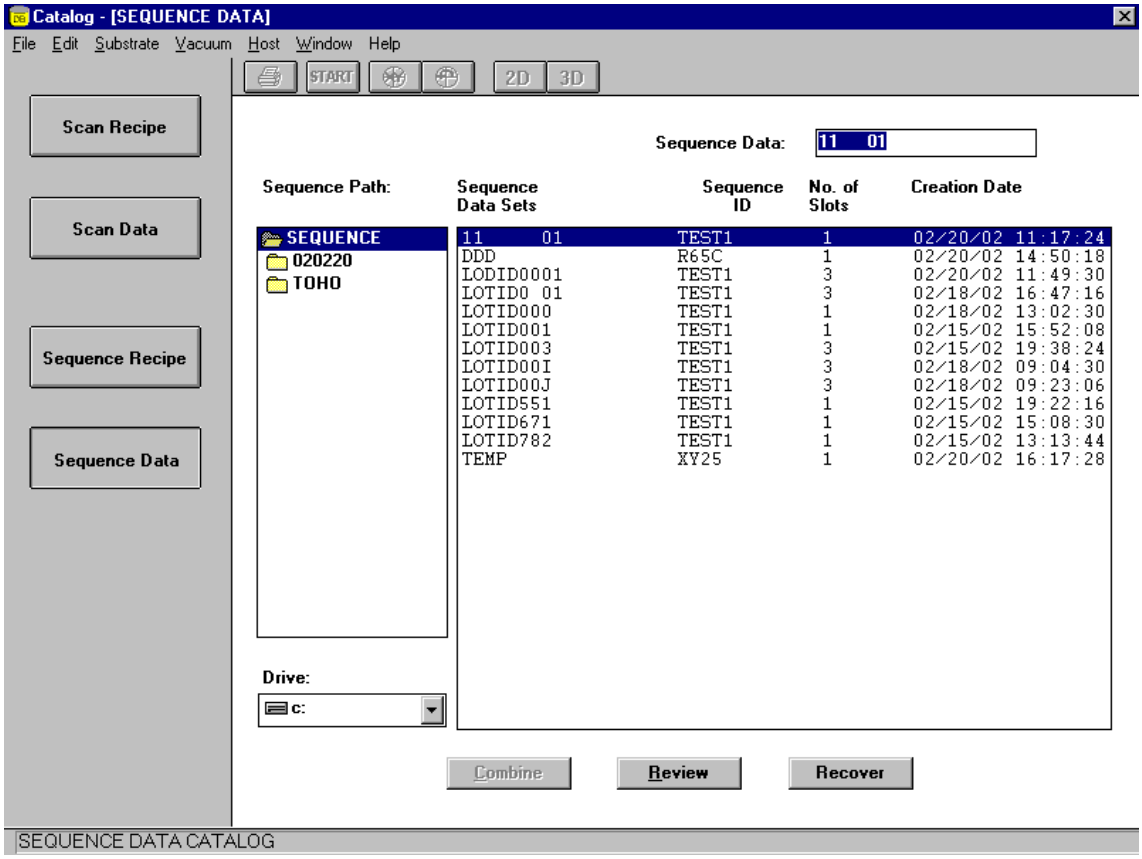
Multiple points on a sample can be automatically measured using FP20 sequence program. Sequence programs consist of and are a combination of recipes for each measurement point and measurement axis. Automated measurement of multiple points helps improve system performance.

Print sequence selected.

Display sequence selected.

Start Sequence selected.

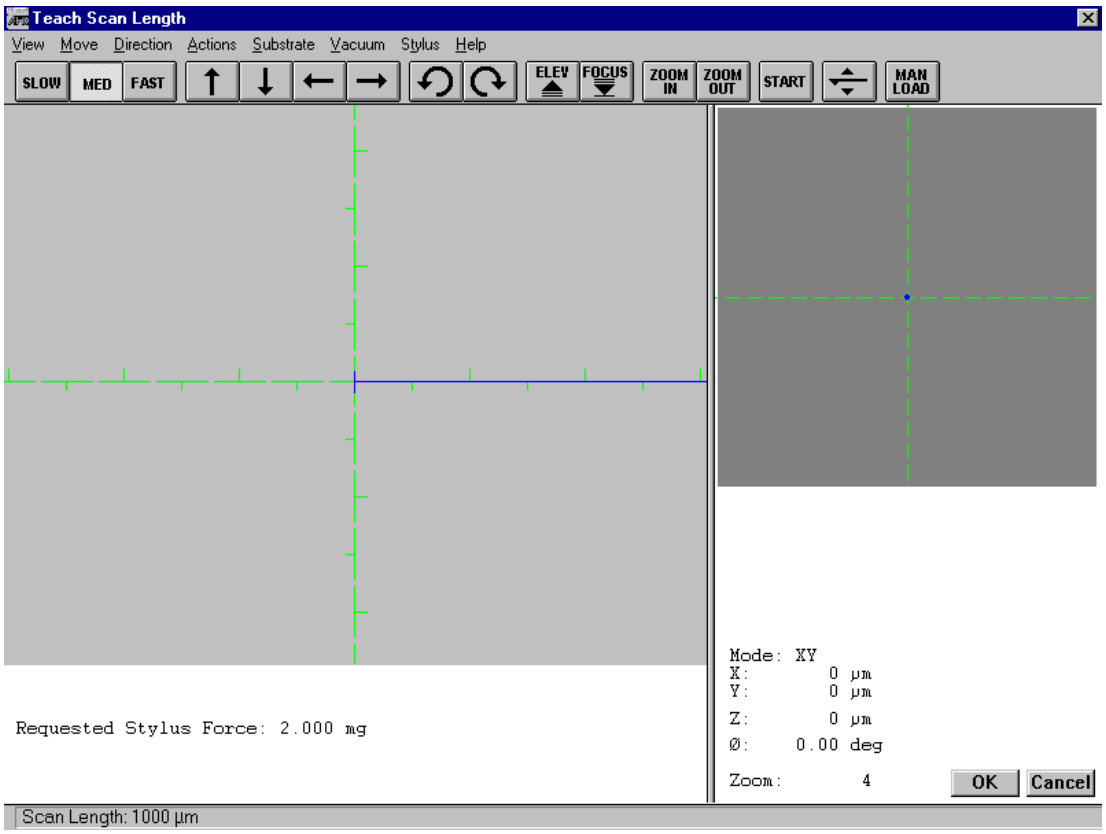
1.4. Selecting Sequence Data



This is the area where the data measured with sequence data is stored. You can review the data here.

Display the sequence data to be selected.

1.5. Measurement Screen



Either click the XY View button or select XY View in the menu bar, and then the XY View in the above will appear.

SLOW MED FAST button: Select stage moving speed

↑ ↓ ← → button: Stage movement

↺ ↻ button: Stage rotation

ELEV FOCUS button: Elevator up-and-down

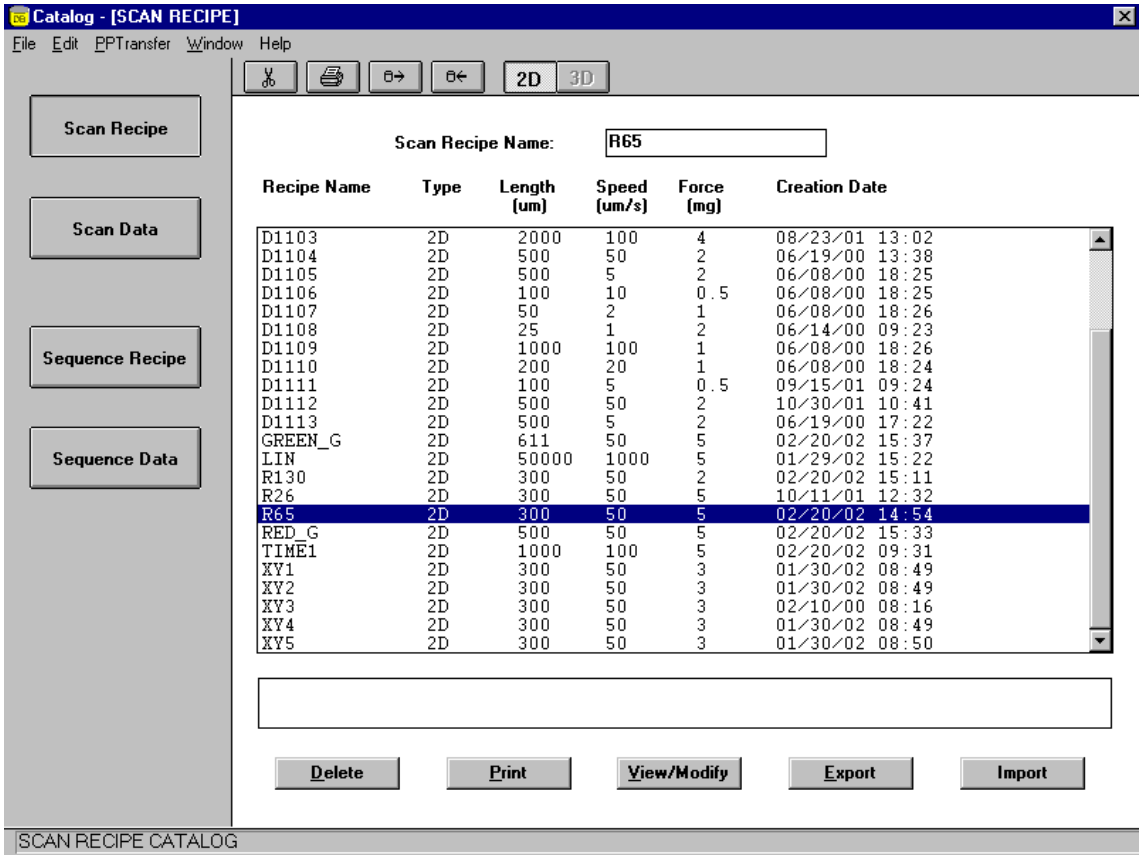
ZOOM IN ZOOM OUT button: Zoom-in and –out of screen

START button: Measurement Start

button: Stylus -up and -down

MAN LOAD button: Move to manual loading position

1.6. Database File Manager



It is possible to import, export, and/or delete the recipes and data selected. You can also check the data measured.

 button: Delete

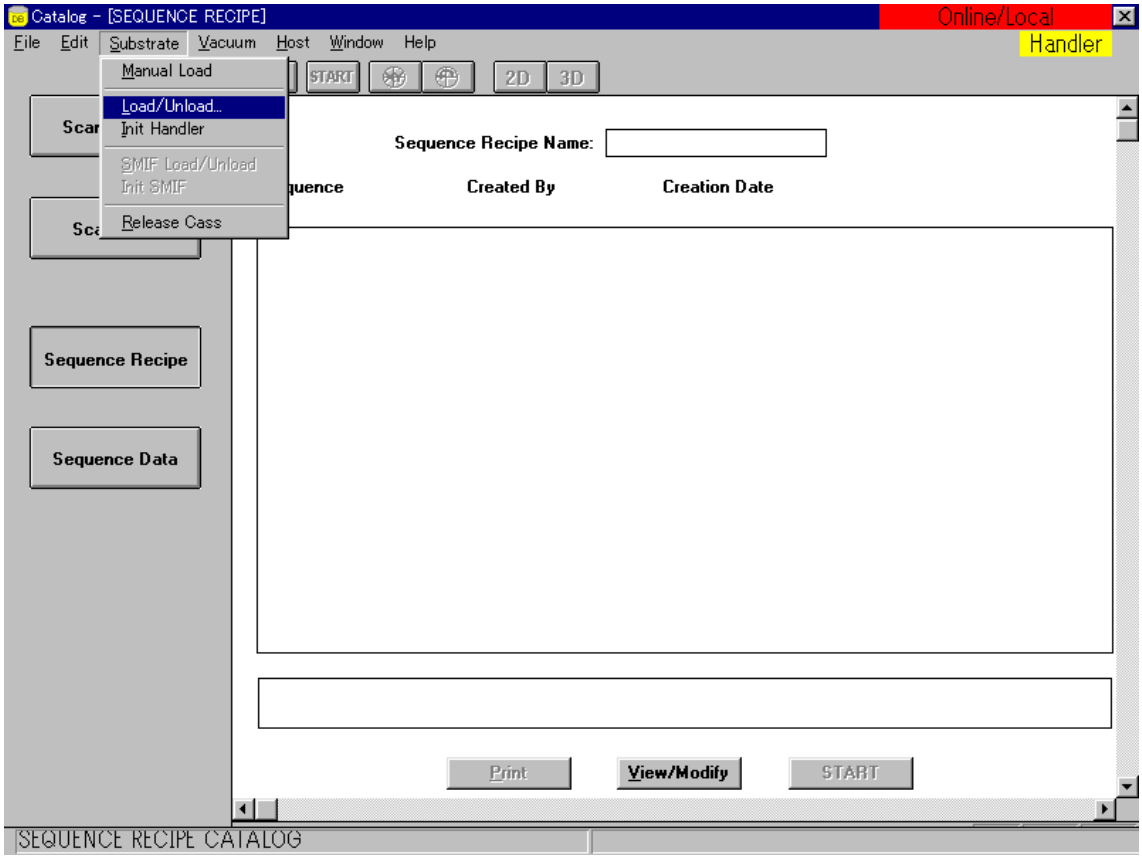
 button: Print out

 button: Export

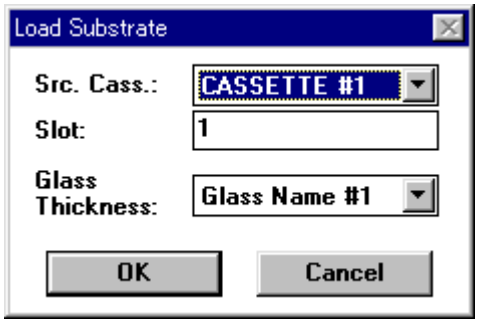
 button: Import

 button: Open the recipe or data selected.

1.7. Loading and Unloading



Go to Scan, and select Substrate and Load/Unload in the menu bar.



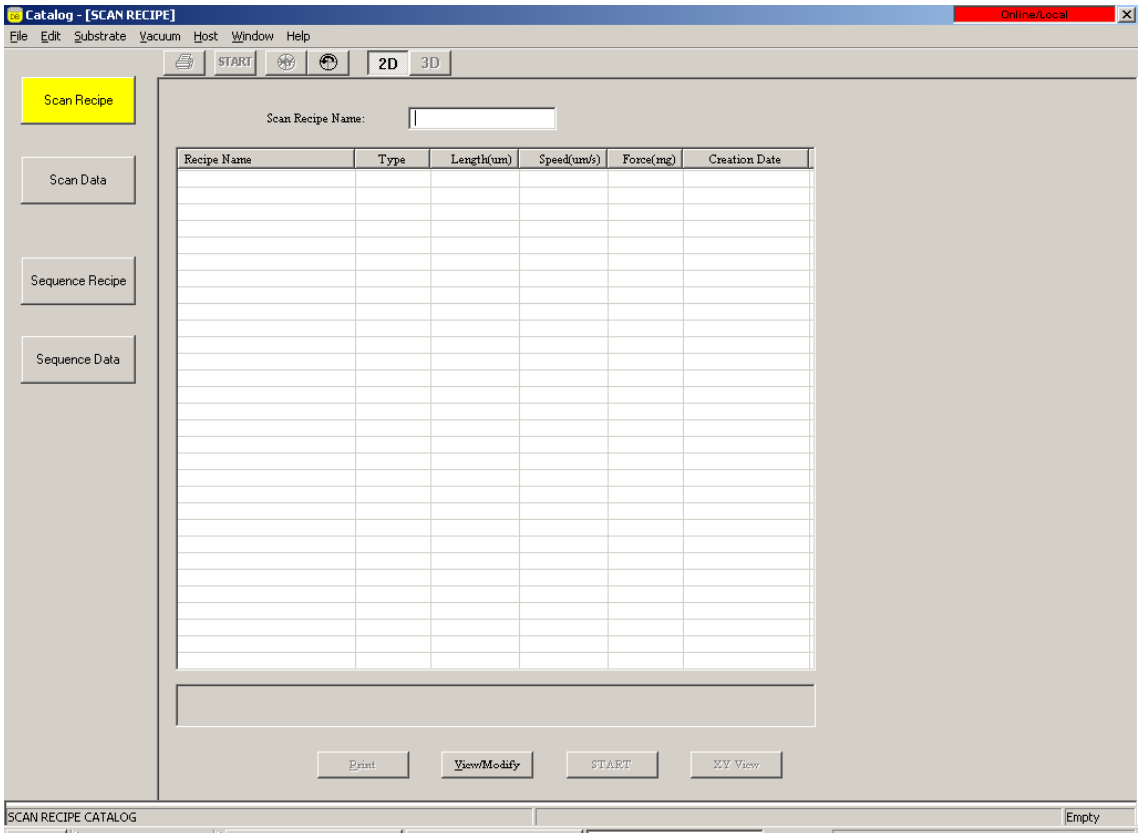
Once the stage moves to load/unload position of the substrate, the window above will appear. Then, enter a cassette number and a substrate layer you want to load. Press “OK.” Follow the similar procedure in unloading.

2. Scan Recipe

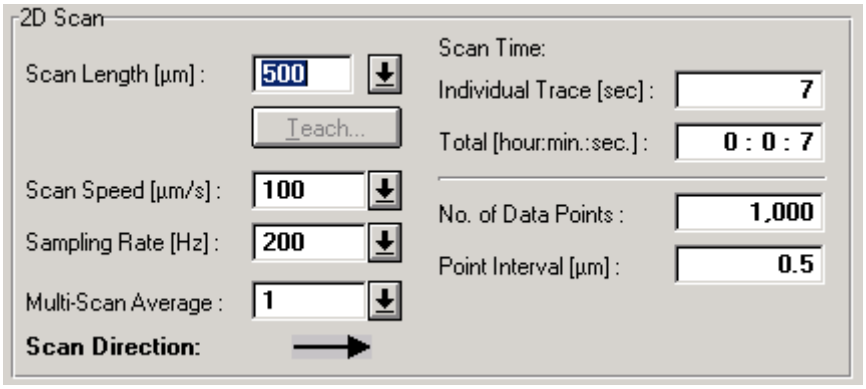
Recipes are a list of measurement conditions.

Scan Parameter
Setting form is displayed in the main window.
Setting of scan parameters.
Setting screen is divided into the following 3 (three).

- 2DScan
- Stylus
- Vertical Range



2.1. 2D Scan



- Scan Length

Values from 1um to 90mm can be set as Scan Length, while values of 8mm or longer should have 400 um/s or higher scan speed. Either click the text box and enter an appropriate value or select a best value in the drop-down list. Teaching is also available.

- Scan Speed

Select a scan speed from the preset values.
Configurable scan speeds are as follows:
1, 2, 5, 10, 20, 50, 100, 400, 1000, 2000, 5000, 10000, and 25000 (um/s)

- Sampling Rate

Select a sampling rate, which is a data point number collected per second.
Configurable sampling rates are as follows:
50, 100, 200, and 500Hz (in case of scan speed of 1um/s)
50, 100, 200, 500, and 1000Hz (in case of scan speed of other than 1 um/s)

- Multi Scan Average

Repeat Max. 10 times of scans and calculate the average of the data, so that low repeatability due to stage drift can be compensated.

- Scan Direction

Either way of scan direction, from right to left or from left to right, can be set. Click an arrow showing the desired direction.

- Scan Time (Total)

This is the total number of hours needed for data collection in a recipe measurement.

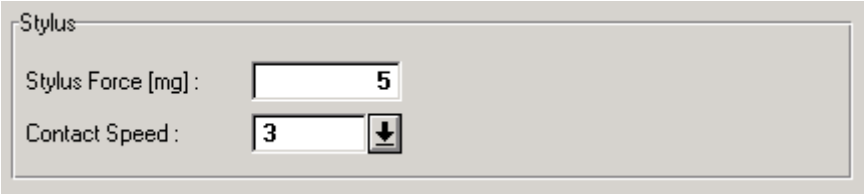
- No. of Data Points

This is the number of data points for 1 scan.

- Point Interval

This is the distance between consecutive data points within 1 scan.

2.2. Stylus



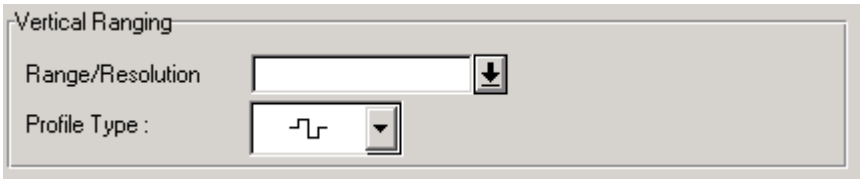
- Stylus Force

Stylus Force shows a downward force from stylus that touches the top surface of a sample during measurement. The force can be set from 0.5mg to 15mg. (Default value: 5mg)
Stylus Force needs to be set higher to maintain contact pressure of stylus on the sample surface, when scan speed is set quicker.
It is recommended that stylus force should be set lower when a soft sample is measured with small radius stylus. Generally, stylus force when set high will be less affected by ambient environment noise.

- Contact Speed

Contact Speed is a parameter to represent fall velocity when a stylus drops down and touch the substrate. Select a value from 1 fastest to 10 lowest.
It is recommended that value 1 or 2 would be desirable for aluminum or photo-resist measurement, and that value 1 to 3 would be desirable for stylus radius smaller than 5um.

2.3. Vertical Ranging



- Profile Type

Click the drop button to select one appropriate profile type of the followings.
（Please note only when 131um Range is selected, a profile type can be selected.）

⌐¬ Center:

Select this type unless big peak or valleys are not measured.

⎍ Peak Bias:

Select this type when a big peak or its vicinity of 65um or higher is measured.

⎎ Valley Bias:

Select this type when a big peak or valley or its vicinity of 65um or higher/deeper is measured.

- Range/Resolution

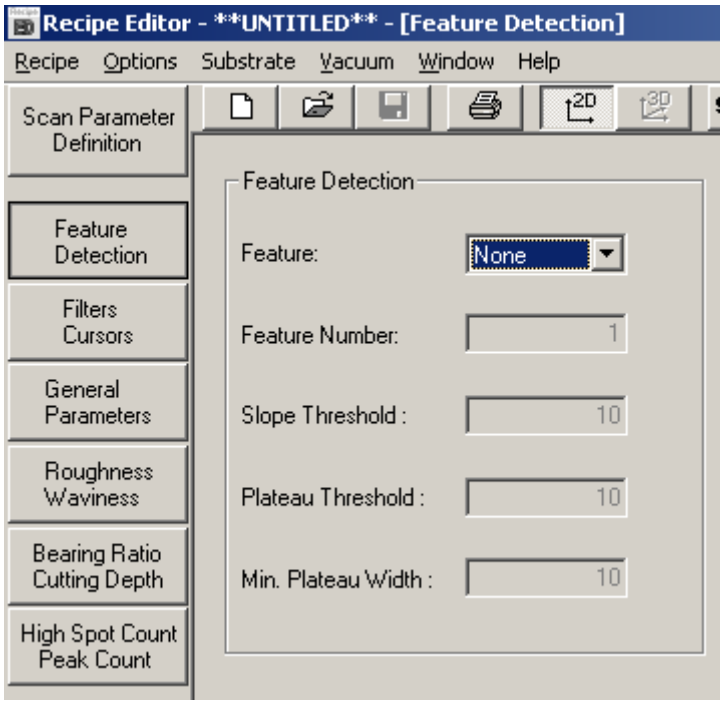
This is a vertical ranging of microhead.

26um (±13um)　　Resolution:　0.015625Å

131um (±65.5um)　　Resolution:　0.357Å

2.4. Feature Detection

Setting Feature Detection will enable to automatically detect a specific profile. This will result in higher throughput and consistent measurement.



2.4.1. Feature

Either specifying a Feature of the sample detected or disabling this Feature Detection is possible.

- None — Disables Feature detection
- Up Edge — Rising Edge
- Up Base — Rising Base
- Down Edge — Decaying Edge
- Down Base — Decaying Base
- Convex — 凸
- Concave — 凹

2.4.2. Feature Number

When multiple edges are detected with one scan, this Feature Number helps select a specific edge to be detected. All the edges detected during a scan will have consecutive numbers 1 to N.

2.4.3. Slope Threshold

This is for edge detection. Enter large figure when step height is high enough compared to surface roughness or noise, but enter little number when it is just slightly higher. Number, 0 through 50, is accepted. Default value is 5.0 for step height and 1.0 for apex and applicable for the measurement 200Å or higher.

2.4.4. Plateau/Apex Threshold

This is for edge position determination. Enter the same value as Slope Threshold in case of edge and enter very little number in case of apex. Default value is 5.0 for step height and 0.0 for apex and applicable for the measurement of 200Å or higher.

2.4.5. Minimum Plateau Width

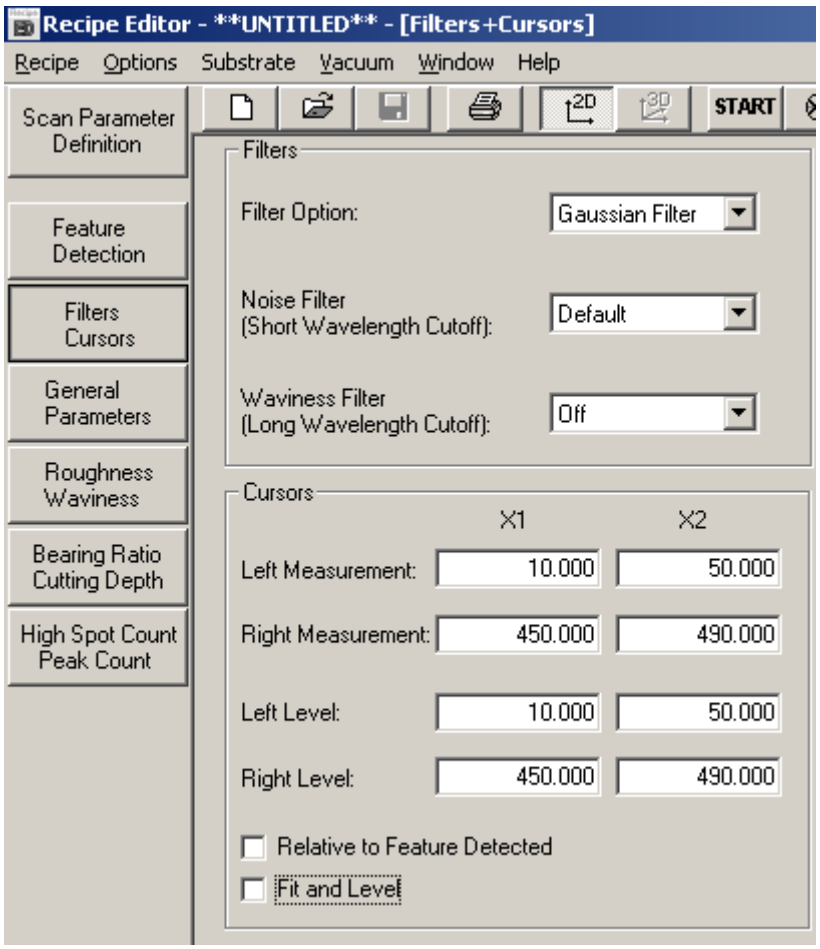
This defines the horizontal length of minimum plateau between the rising edge and the decaying edge. This will eliminate possible error in

identifying projections as a step height. Enter a wider value than the noise peak and try to enter little number which is smaller than the actual step height value. The scope of area is 0.005um to 1000.0um.

2.5. Filter/Cursors

This chapter is composed of 2 sections:

- Data Filter by software and
- Cursor position setting



2.5.1. Filter Option

Either one of these can be selected:

Gausian: Profiler Software for Windows

RC: Software for DOS

2.5.2. Noise Filter (Short Wavelength Cutoff)

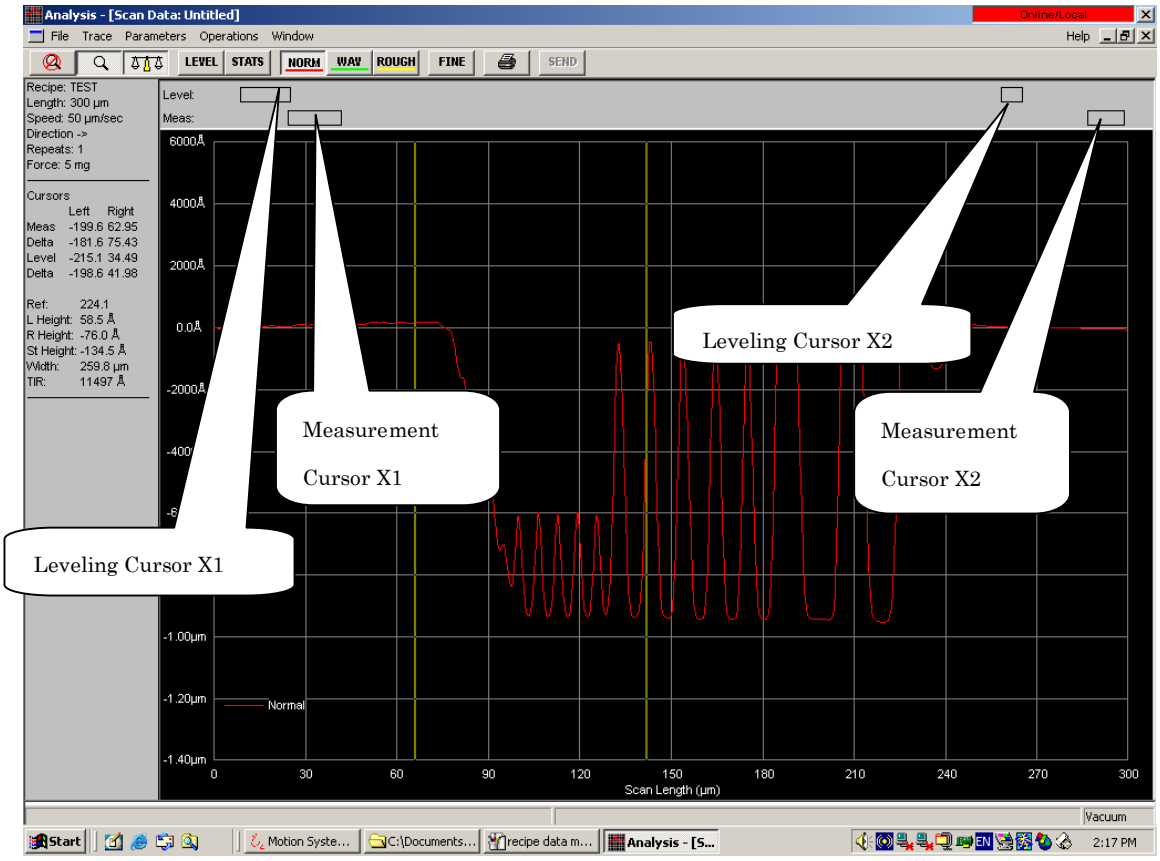
This is used to cut out short wavelength component from measurement data.

2.5.3. Noise Filter (Long Wavelength Cutoff)

This is used to cut out long wavelength component or wave undulation from measurement data.

2.6. Cursors

Data Analysis Window uses two pairs of cursors. The positions specified by leveling cursors X1 and X2 will be a tracing basis. Surface parameter is calculated between measurement cursors X1 and X2.



2.6.1. Relative to Feature Detected

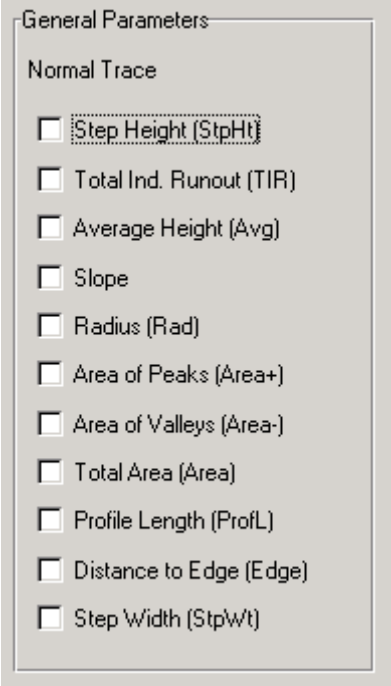
Set cursors' position in every measurement attempt.

2.6.2. Fit and Level

With Fit and Level function, you can measure by cutting out one circular arc component from trace data.

General Parameters

Surface Analysis Parameters are registered in the General Parameters form. You can either enable or disable each parameter, and calculation result of surface analysis parameters set to be “enabled” are displayed.



- Step Height (StpHt)

Difference in height between step bottom and its top.

- Total Indicator Runout (TIR)

Difference in height between the highest point and the lowest of the measurement cursors

- Average Height (Avg)

Average height

- Slope

To be calculated based on horizontal distance and vertical displacement between right and left measurement cussors

- Radius (Rad)

To calculate radius of curvature on the basis of a portion of curve of the profile

- Area of Peaks (Area+)

Area of Peaks calculated on the basis of profile centerline

- Area of Valleys (Area-)

Area of Valleys calculated on the basis of profile center line

- Total Area (Area)

Total of both values of Area of Peaks and Area of Valleys

- Profile Length (ProfL)

Profile Length when a profile is extended into line

- Distance to Edge (Edge)

Distance between scan start position and the first UP or DOWN Edge of a profile

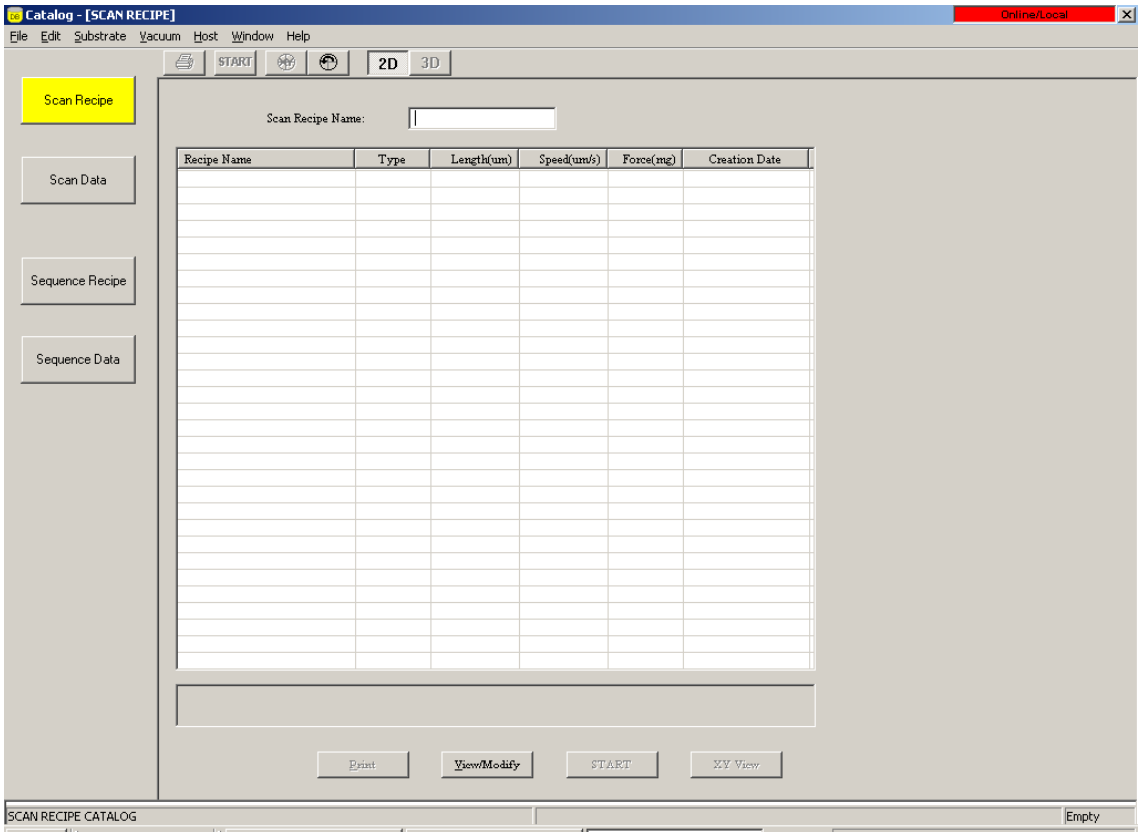
- Step Width (StpWt)

Distance between the first UP and the following DOWN of a profile

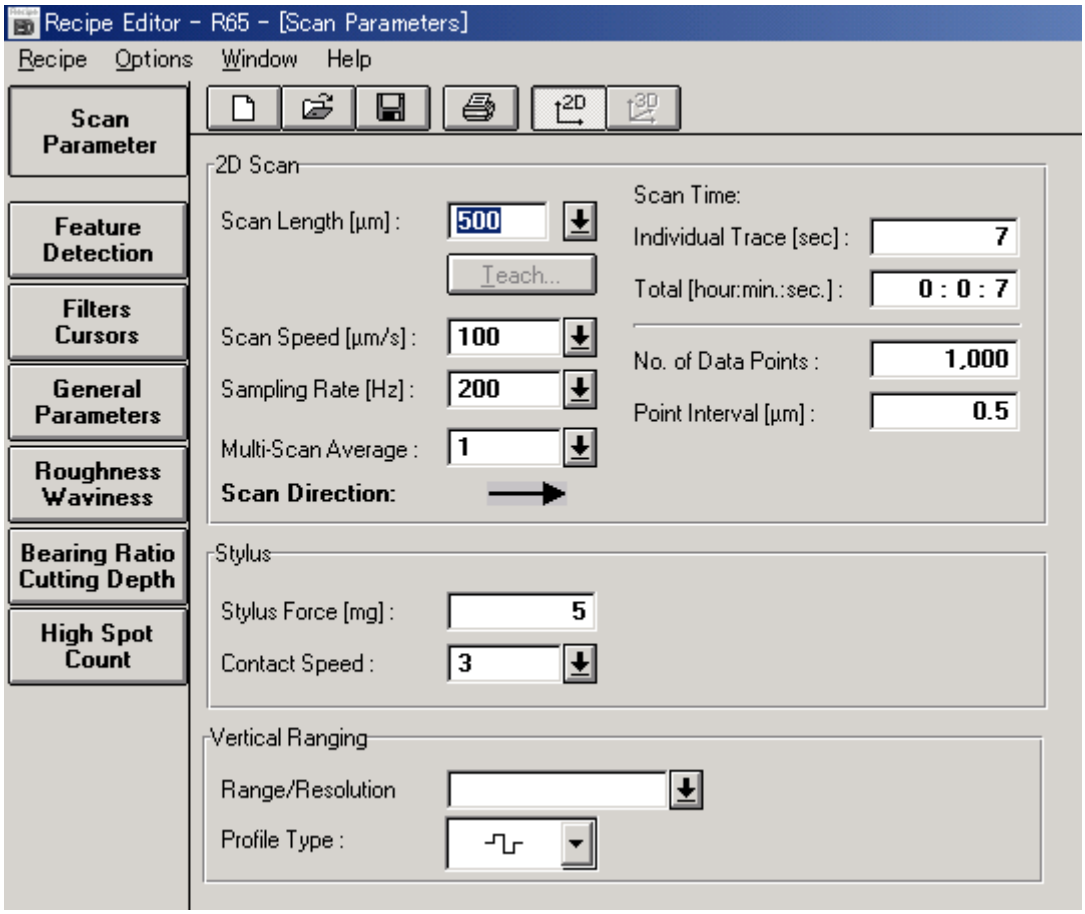
3. How to Create Scan Recipe

3.1. Double-click on Scan.

3.2. Click on Scan Recipe.

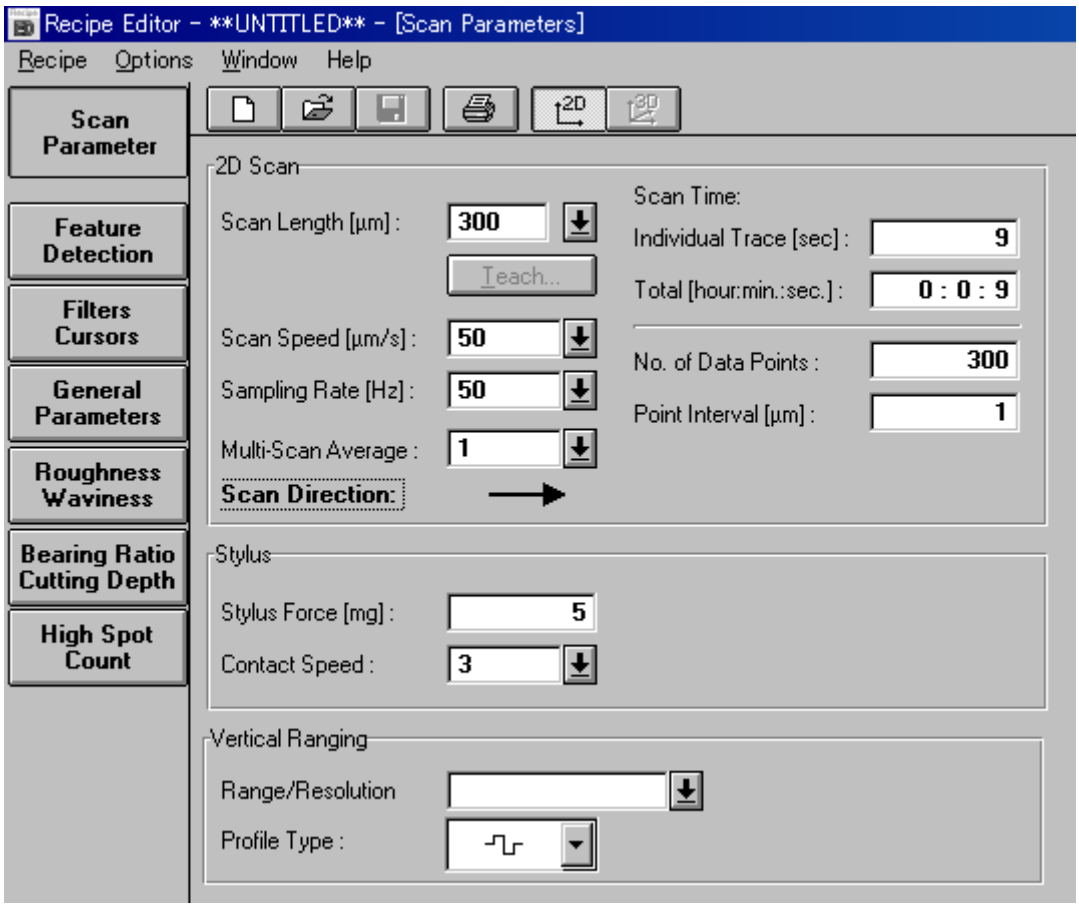


3.3. Click on View/Modify.



3.4. Set Scan Parameters.

Example:



- Scan Length:

You can choose and set Scan Length from 1um to 90mm (however, 8mm or longer length is only for scan speed 400um/s or quicker). Either enter an appropriate value by clicking the text box or select on of the values from the drop-down menu. You can also teach.

- Scan Speed: Select a Scan Speed from preset values.

- Sampling Rate:

Select a Sample Rate, data point quantity collected per second.

- Multi Scan Average: Calculate the average of max. 10 scan data.

- Scan Direction:

You can choose Scan Direction, right to left or left to right.

- Scan Time (Total):

Total time required for data collection by recipe measurement

- No. of Data Points: Data quantity collected by 1 scan

- Point Interval: Distance between consecutive data points in 1 scan

- Stylus Force:

This is downward Force applied to Stylus. (0.5mg - 15mg)

- Contact Speed:

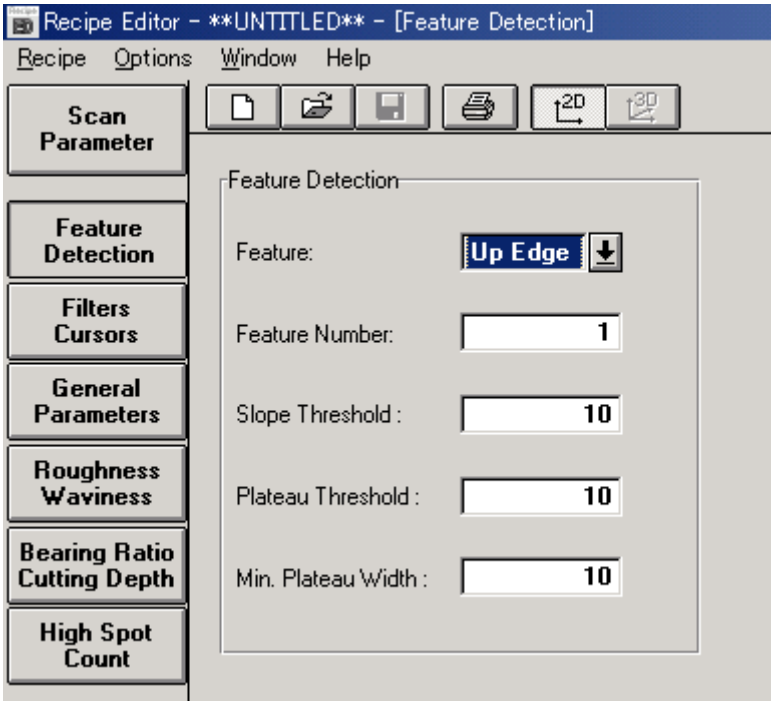
This is Fall Velocity at which speed the stylus contacts a substrate. Select a value from 1 to 10.

- Range/Resolution:

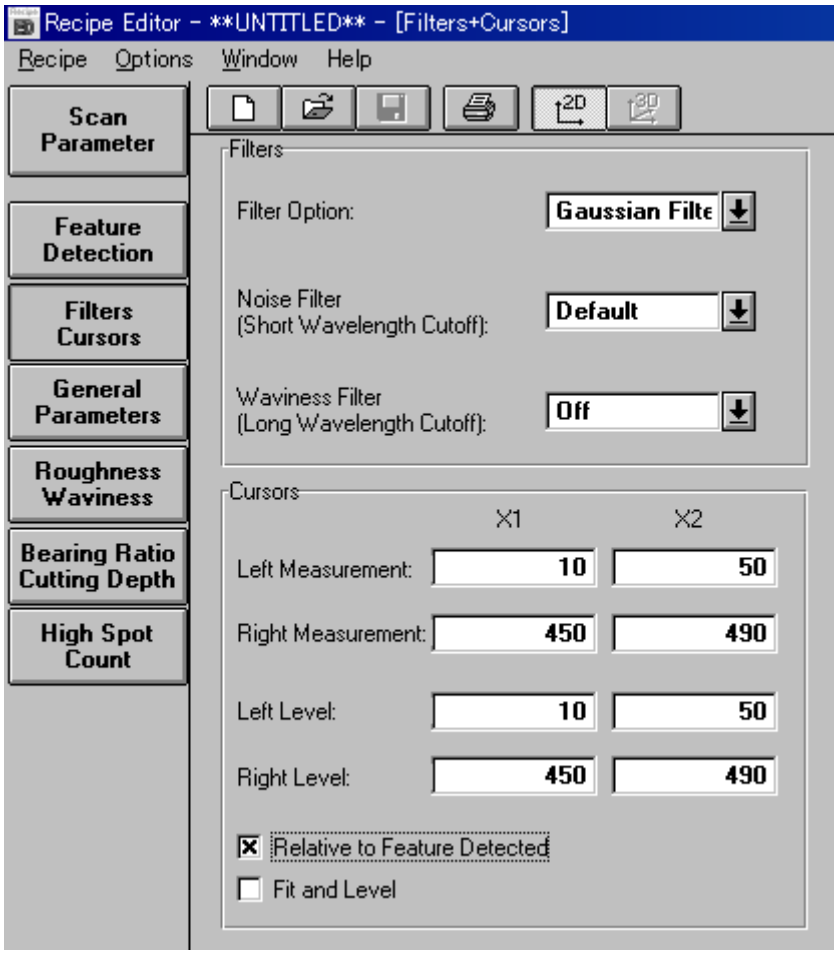
This is vertical range of microhead {26um (±13um), 131um(±65.5um)}

- Profile Type: Profile Type can be selected only for 131umRange.

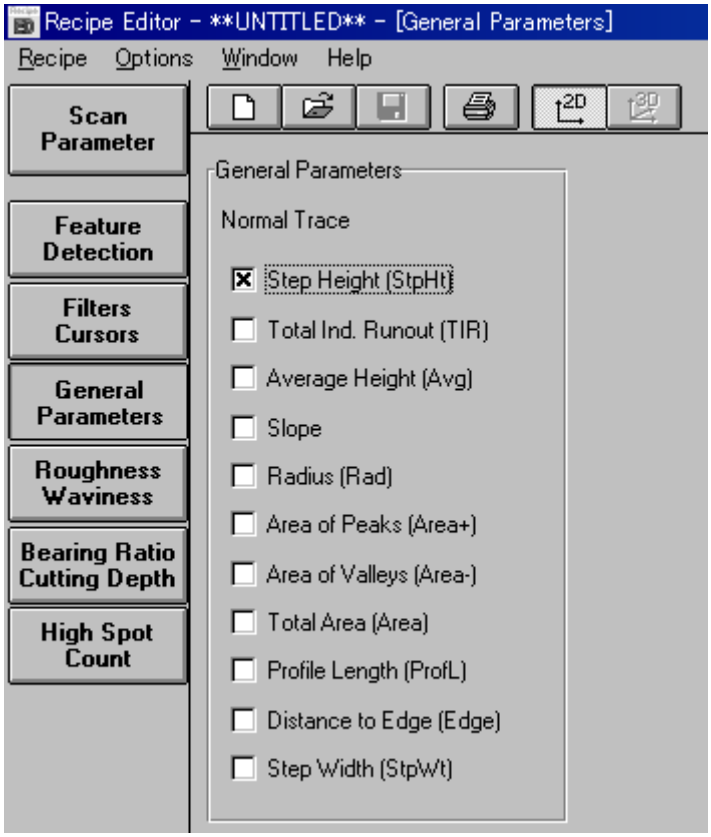
3.5. Select Feature Detection to select Up Edge in Feature.



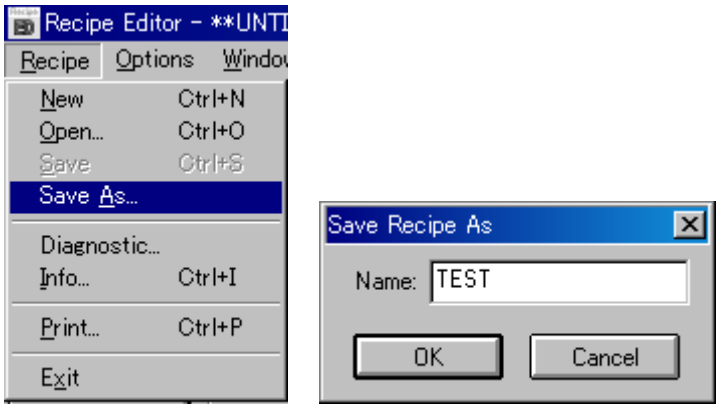
3.6. Select Filters Cursors and check Relative to Feature Detected



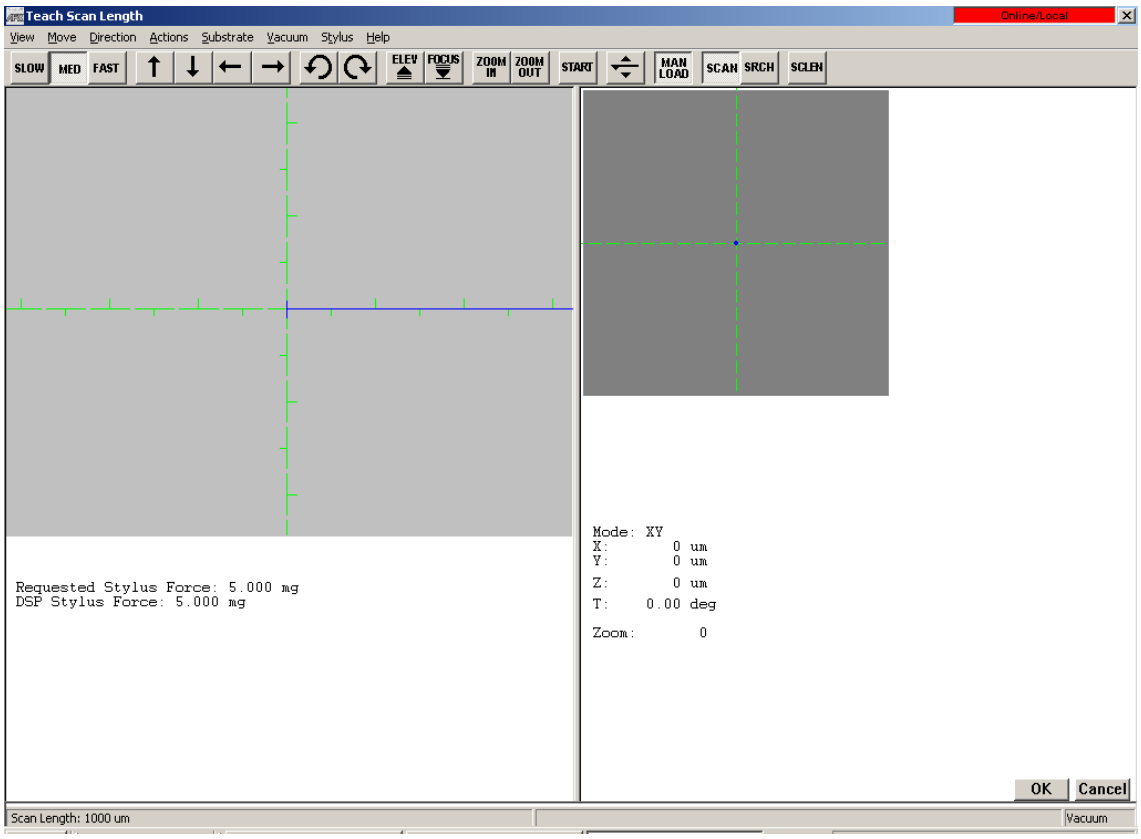
3.7. Select General Parameters and check Step Height



3.8. Save Recipe



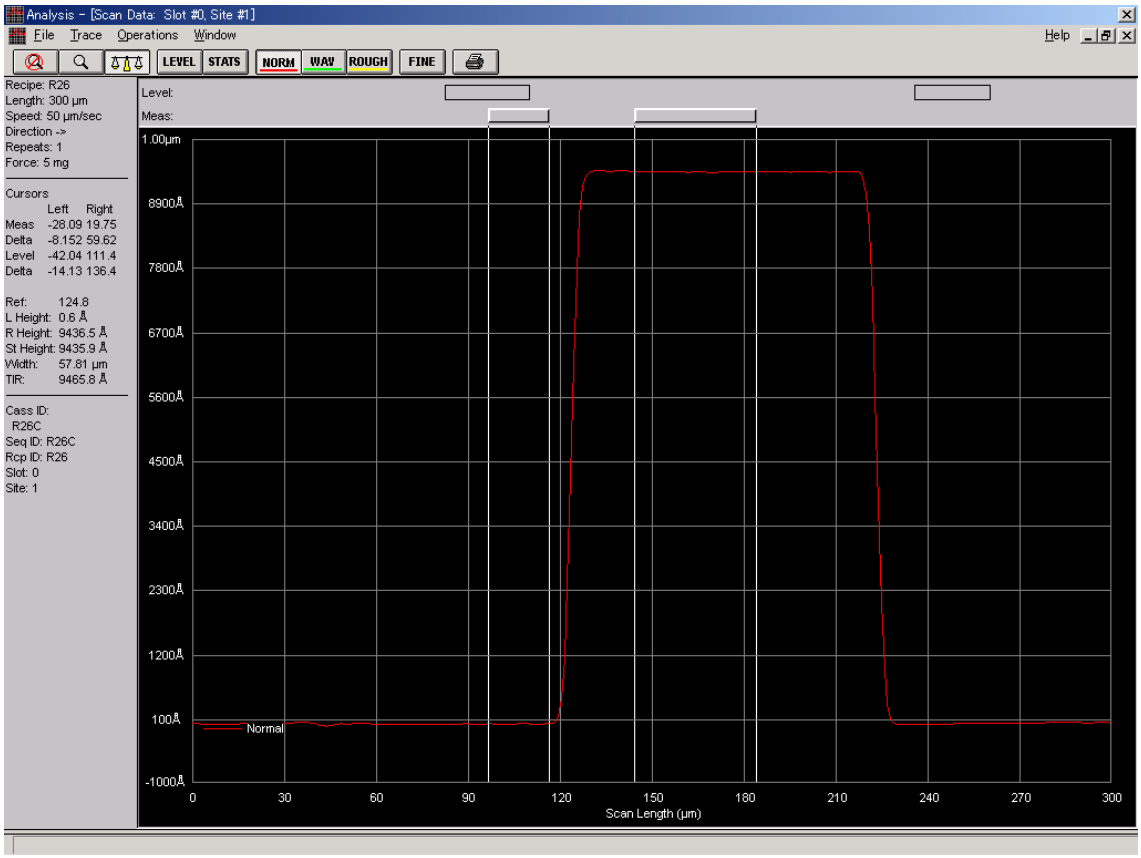
3.9. Select XYView to measure a sample. The blue line in the XYView screen is the measurement position.



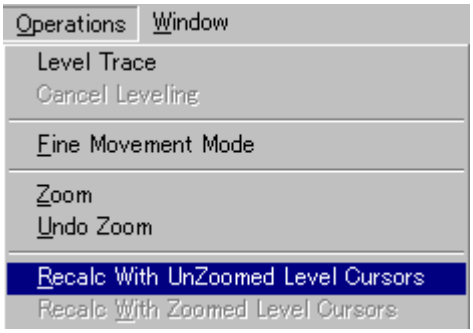
3.10. Adjust level cursors and measurement cursors .

Click the LEVEL button on the menu to adjust LEVEL.

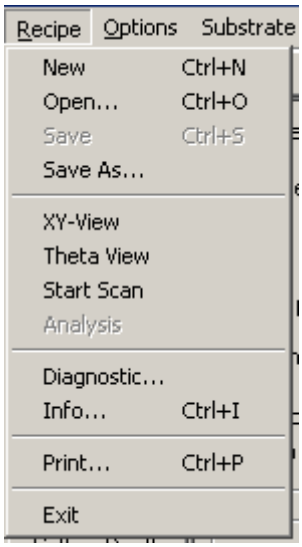
Click the LEVEL button again to adjust Measurement.



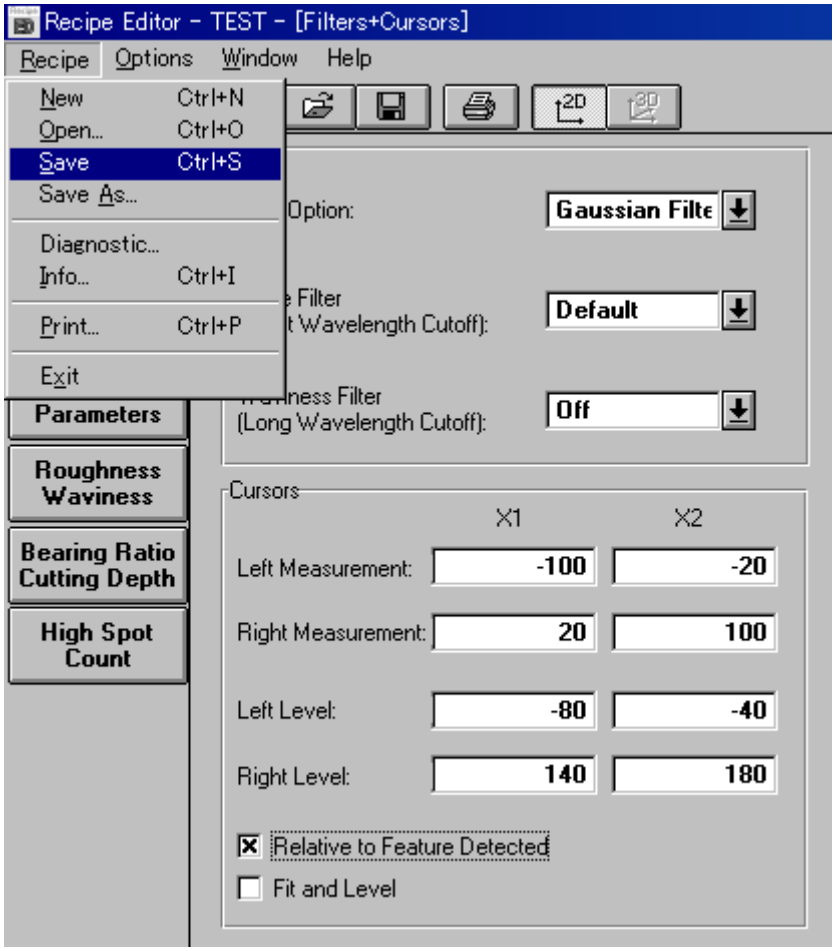
3.11. Select Recalc With Unzoomed Level Cursors in Operations on the Menu. (Cursor position is now reflected upon the recipe.)



3.12. Select Edit Recipe in Recipe on the Menu to return to Recipe Editor.



3.13. Save and store the cursor position in the Recipe.



4. Sequence Recipe

Multiple points of a sample can be automatically measured with the sequence program. The sequence program consists of a combination of recipe at each measurement point and measurement axis. Automated measurement of multiple points helps improve productivity of the system.

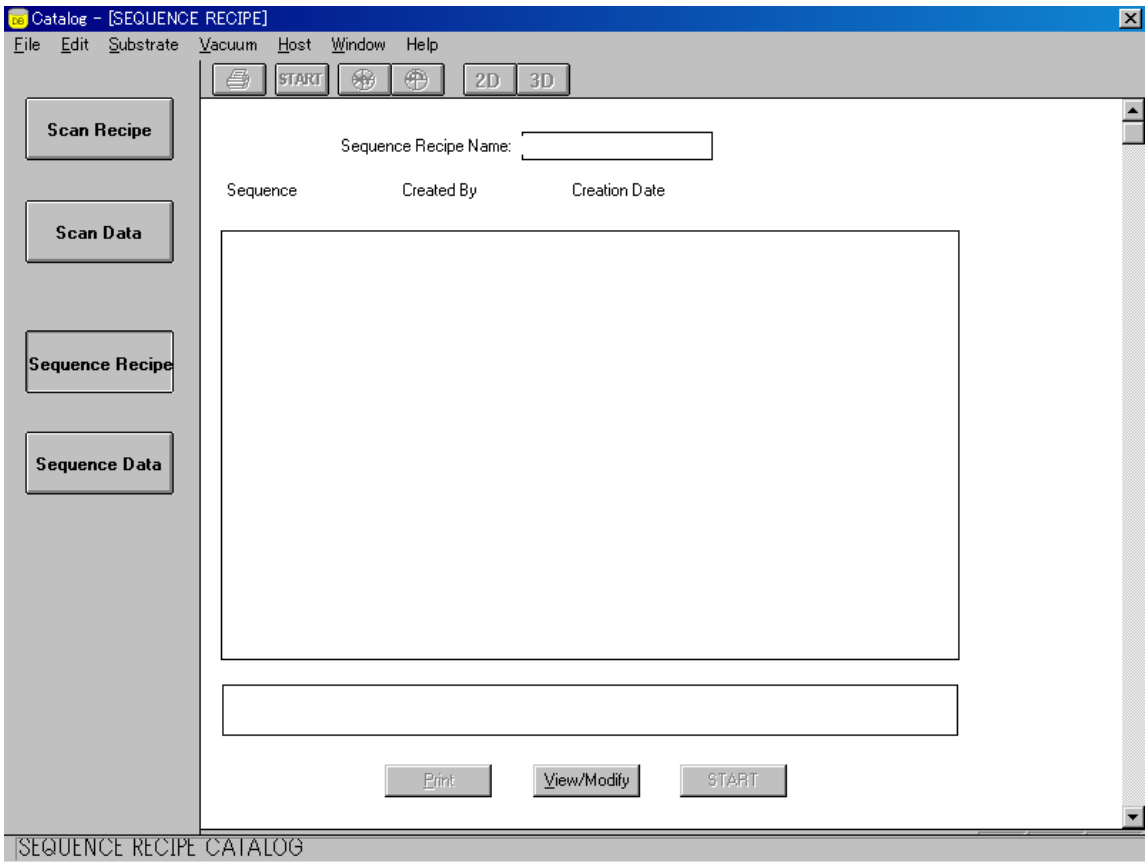
Sequence Measurement Function:

- Capable of combining multiple measurement points and recipes
- Setting reference point to compensate X, Y, and θ between substrate (Deskew)
- Settable manual or automated (pattern recognition) deskew
- Pattern search function for the case where there is no deskew pattern within the camera view. (Pattern recognition option)
- Multiple analysis mode which enables to analyze one scan by using multiple recipes.
- Teaching of a reference point for a measurement point and deskew, including rotation angle.
- Automatic display, print and save of all the statistics of measurement points and/or raw data.

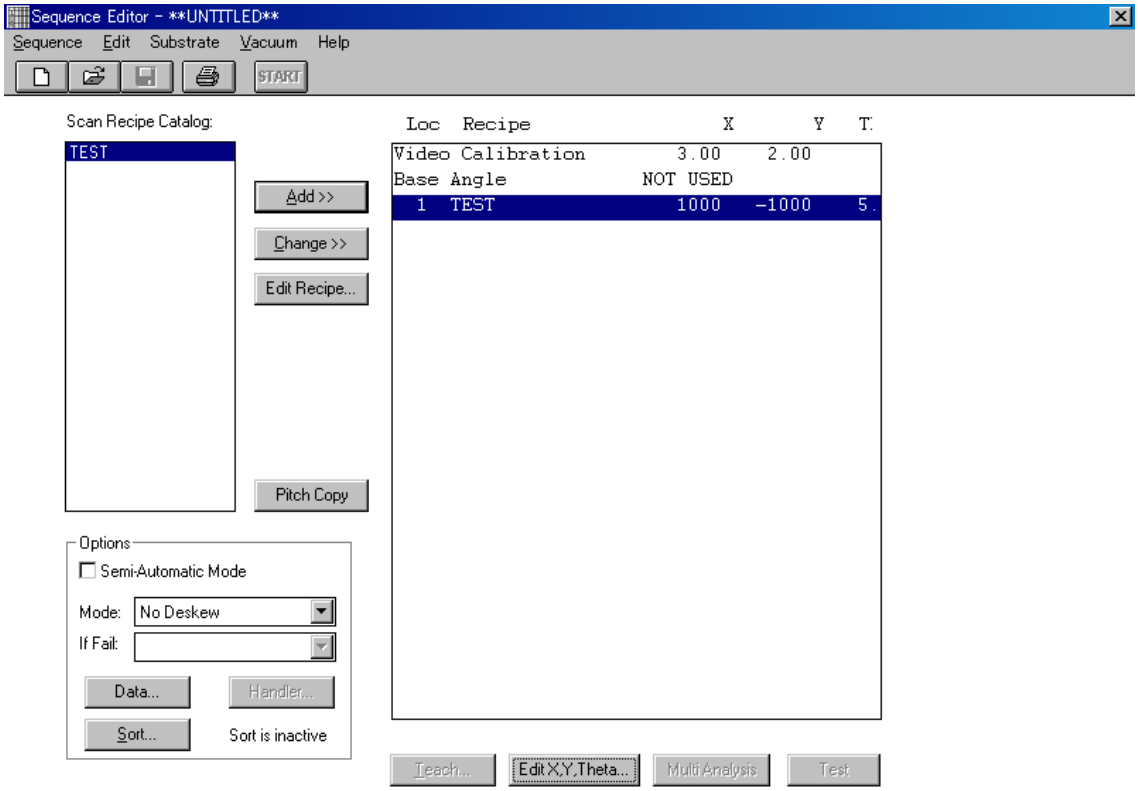
4.1. Sequence Edit Window

This is to create and edit sequence programs and also to set various sequence options.

4.1.1. Double-click the scan icon in the top-level menu to open the sequence recipe catalog window.



4.1.2. Click “View/Modify” in the bottom of the sequence recipe list, or double-click an entry of the list to call so that the sequence edit window will appear.



4.1.3. 

4.1.4. Menu Bar: 

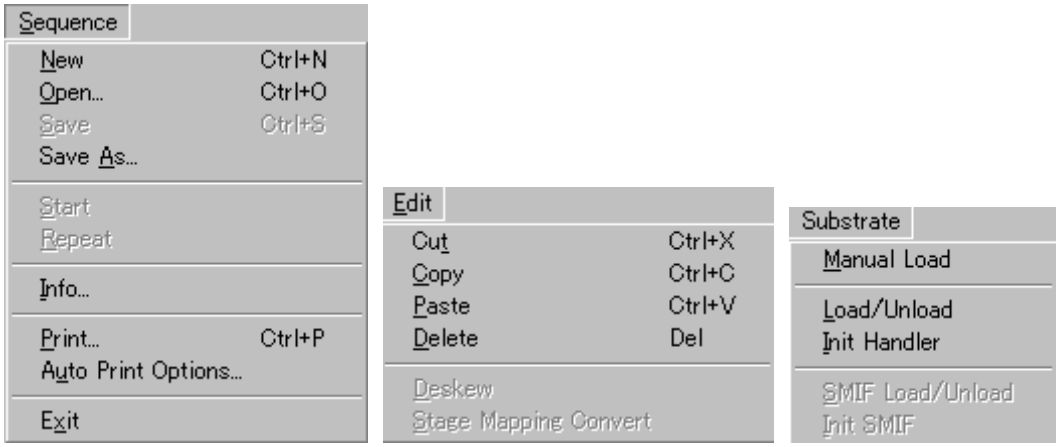
This is to retrieve and save sequences; copy and delete recipes in the list; load/unload substrates; and set vacuum on/off.

4.1.5. Tool Bar: 

Opening of New file and Sequence file, Save, Print and Sequence Start are available.

- Recipe Catalog : Recipe catalog for recipe selection and control button for sequence creation.
- Option Section : Setting of sequence options.
- Sequence List : List of sequence linked with measurement coordinates and recipes.

4.1.6. Menu Bar



Manual Load : Move a stage to a manual load position and return it to its original position.

Load/Unload : Load/Unload a substrate if the handler option is available.

Init Handler : Initialize a handler if the handler option is available.

4.1.7. Tool Bar

New : Load a new default sequence.

Open : Open the file open dialog box.

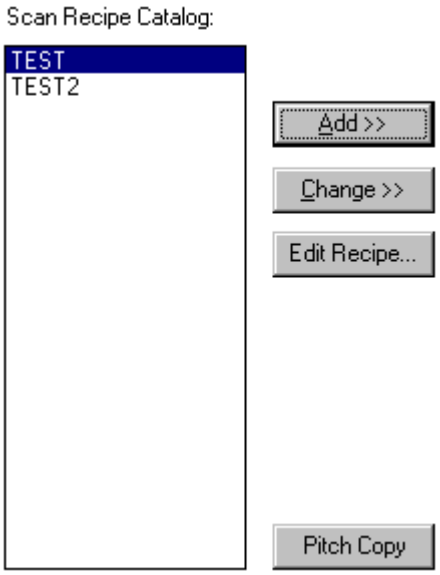
Save : Save a current sequence.

Print : Print

Start : Star measurement with a current sequence.

4.2. Recipe Catalog

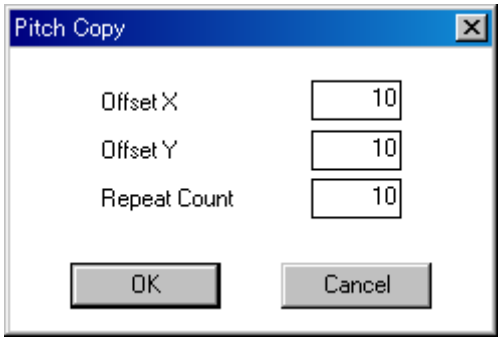
This is a list box showing recipes to choose from.



- Add: Add a recipe to the sequence list.
- Change: Change a recipe in the sequence list for a selected recipe.
- Edit Recipe: Open the scan recipe editor.

- Pitch Copy:

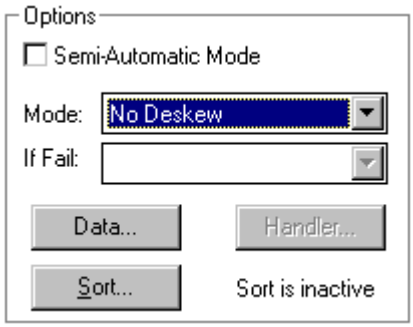
Add a recipe in to a sequence list by setting offset X and Y and repeat count.



Loc	Recipe	X	Y	T
Video Calibration		3.00	2.00	
Base	Angle	NOT USED		
1	TEST	0	0	0.
2	TEST	10	10	0.
3	TEST	20	20	0.
4	TEST	30	30	0.
5	TEST	40	40	0.
6	TEST	50	50	0.
7	TEST	60	60	0.
8	TEST	70	70	0.
9	TEST	80	80	0.
10	TEST	90	90	0.
11	TEST	100	100	0.

4.3. Option Section

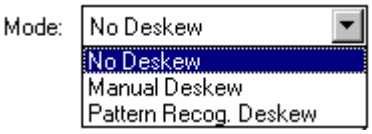
This is to select a sequence mode and set data options for sequence measurement and a handler options. Also, it is to select the semi automatic mode.



4.3.1. Semi Automatic Mode

The semi automatic mode measurement displays trace data after each measurement, then start a next measurement. Data can be confirmed each time. Before a succeeding measurement, remeasuring is also available, if required, by changing a current measurement point.

4.3.2. Mode



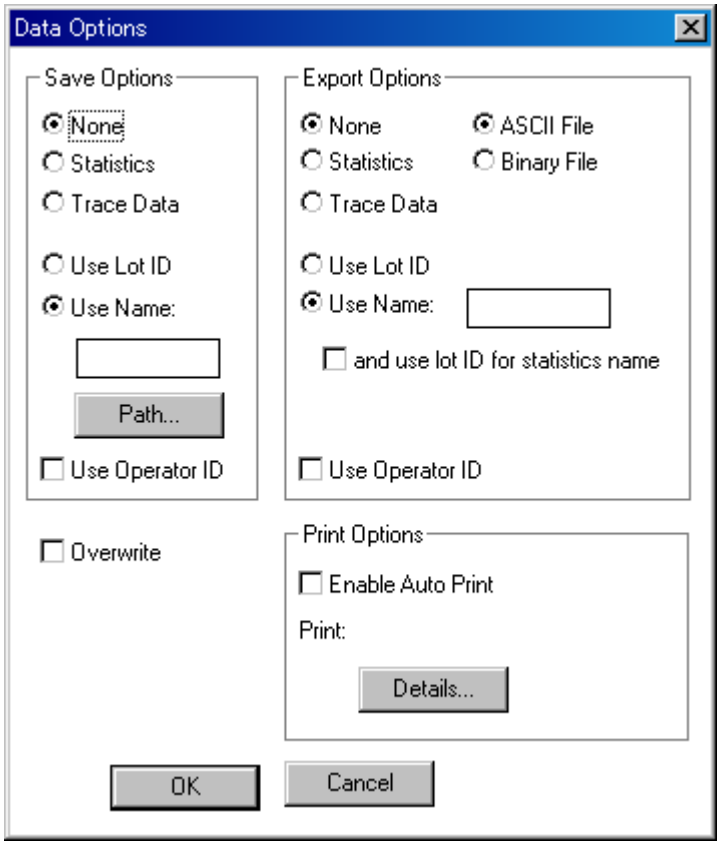
- No Deskew : Set no pattern for deskew.
- Manual Deskew : Set a sequence deskew point similarly to a measurement point.
- Pattern Rec.Deskew : Set a sequence deskew point with the pattern recognition option.

4.3.3. Fail Option

This is to select an option in the case where the pattern recognition function cannot recognize a deskew point correctly.

- Proceed Measurement : Continue sequence.
- Skip, No Measurement : Quit measuring of a relevant substrate.
- Retry Pat.Rec.Manually : Move to a manual deskew.
- Cancel Sequence : Cancel sequence. Need to restart to remeasure.

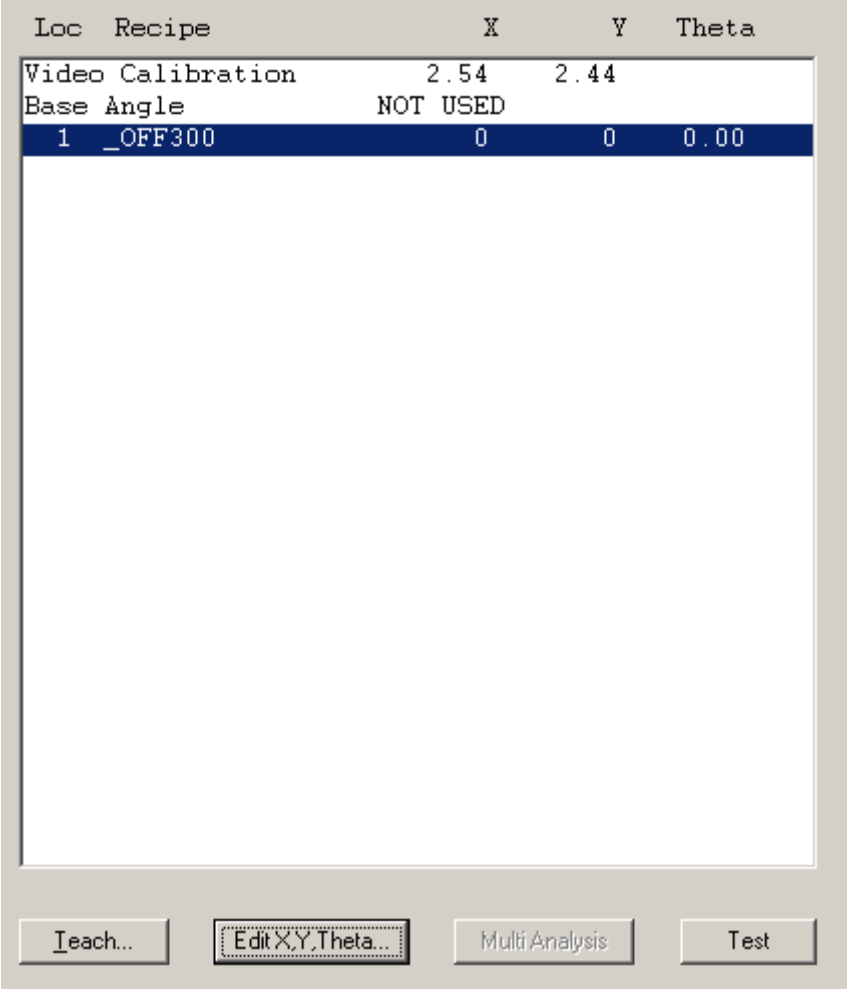
4.4. Data Option



- None : Unable to save, export, or print data.
- Statistics : Save, export, or print statistics data of configured parameters and/or recipe ID.
- Trace Data : Save, export, or print statistics data of configured parameters, recipe ID and/or measurement data.
- Use Lot ID : Save as lot ID.
- Use Name : Save as a set name. Set path (directory).

- Use Operator ID: Use operator ID.
- ASCII File: Export data in unformatted ASCII (TXT file).
- Binary File: Export data in binary format (special file for binary format).
- Overwrite: Overwrite an existing file when saving a new file as the same name as the exiting file.

4.5. Sequence List



- Teach... :

Determine a measurement point by actually checking a substrate.

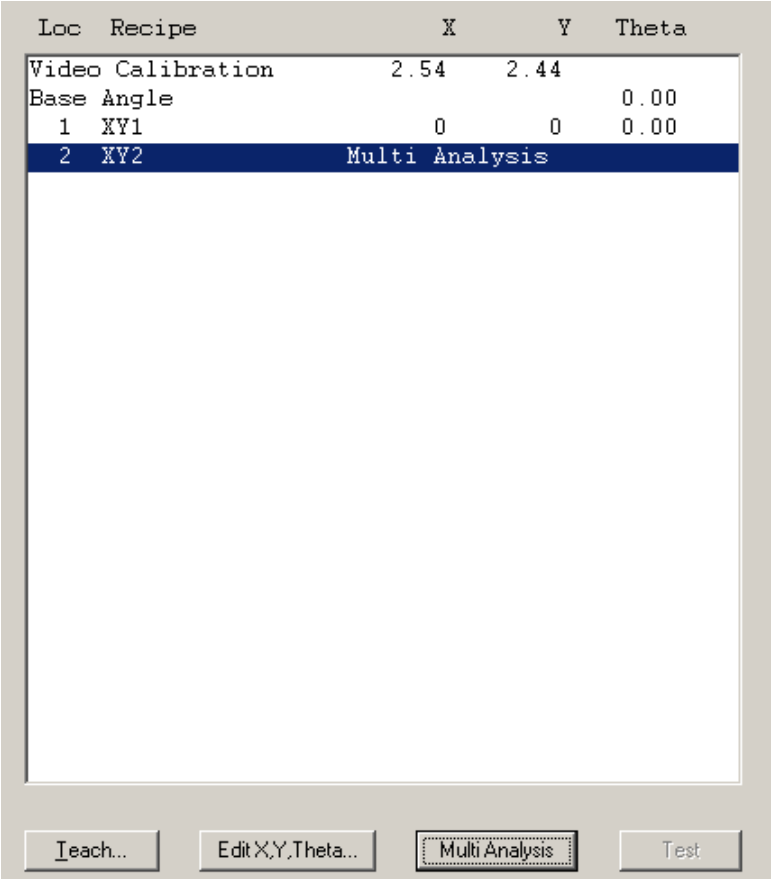
- Edit X,Y,Theta... :

Determine a measurement point by numerical values.

4.6. Multi Analysis: Multi Analysis (Multiple Analysis Function)

Multiple data analysis function enables to re-analyze the data under another recipe condition by using the firstly-scanned data.
Multiple data analysis function makes measurement time shorter in the cases below.

- To measure two height differences with only one scan and each needs its own cursor setting.
- To measure under different filter setting.
- To measure with different analysis parameters on a recipe.



In this case, measure with "XY1"scan recipe, and then analyze the "XY2" data by using the data from the first scan.
*A recipe for analysis, "XY2" in this example, must have the same measurement length, measurement speed, stylus pressure, sampling rate, contact speed and range as those of a measurement recipe, "XY1" in this example.

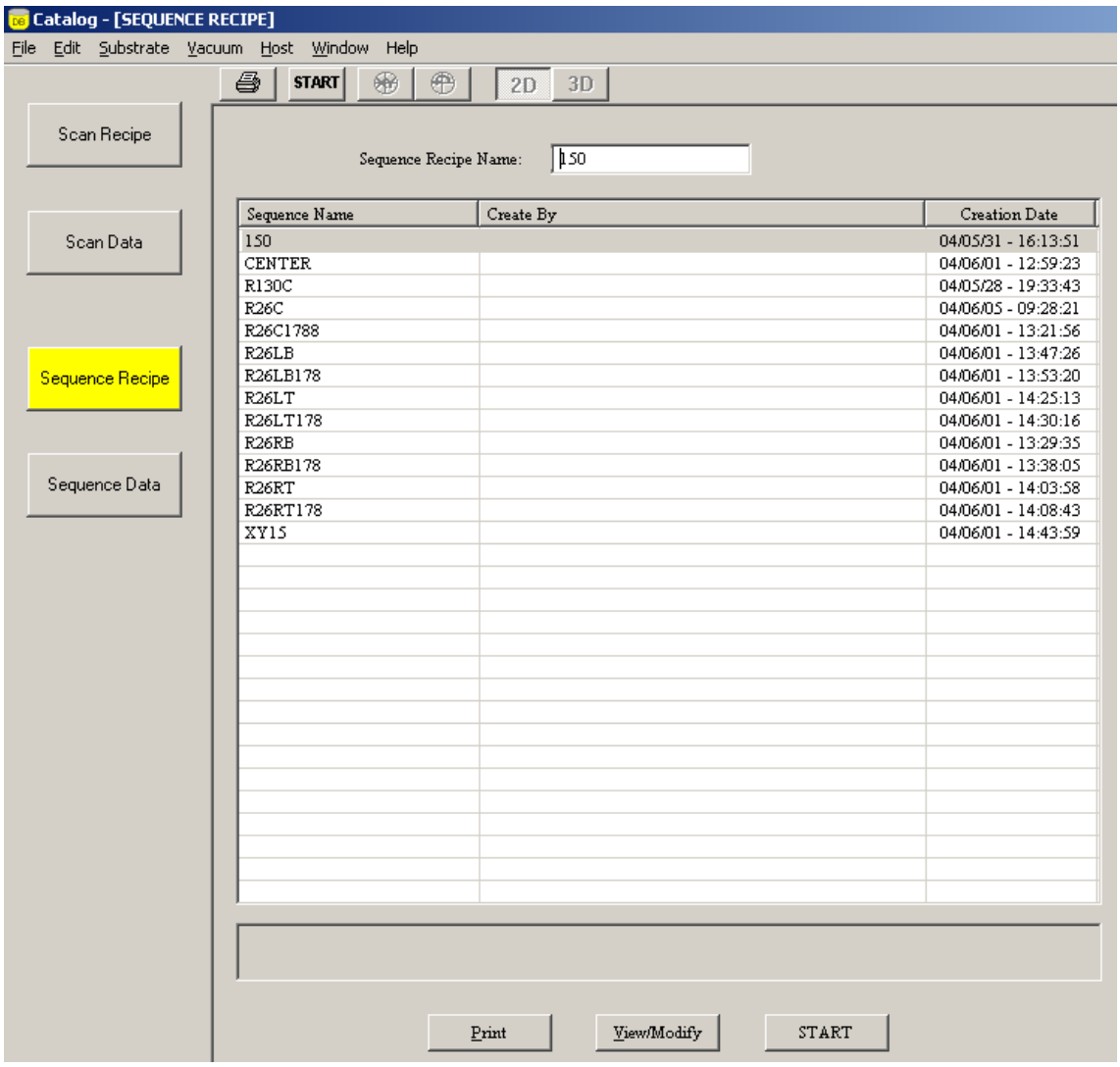
5. Sequence Recipe Creation

Sequence measurement needs the followings.

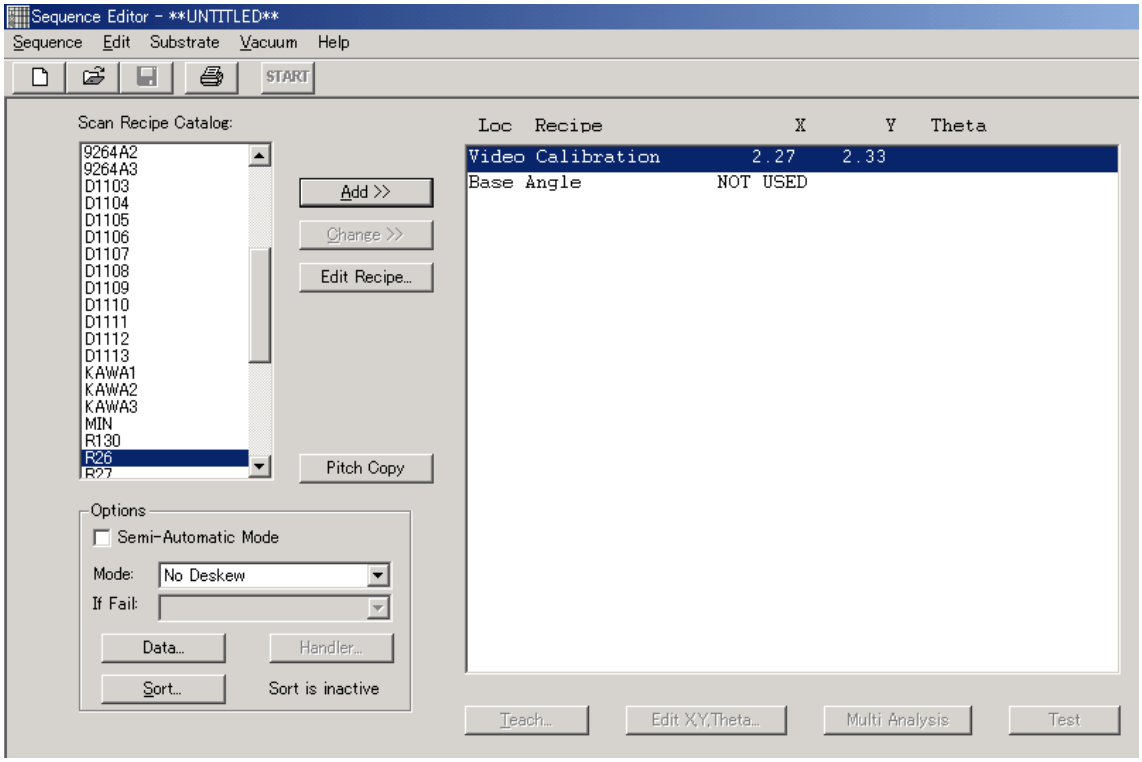
- Sample (Substrate to measure)
- At least one recipe

5.1. Sequence Creation (Sample Measurement without Deskew)

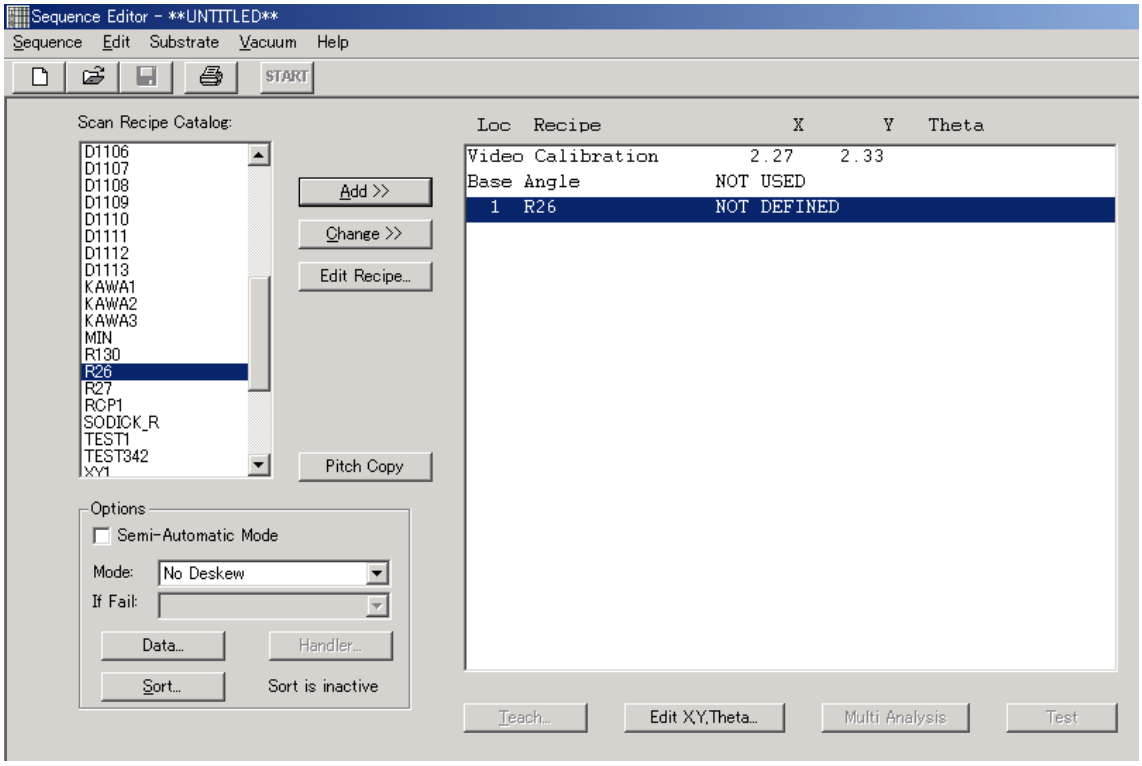
5.1.1. Select “View/Modify” from the sequence menu to display the sequence edit window.



5.1.2. Go to “New” in the sequence menu so that “Video Calibration” and “Base Angle” appears in the right of the sequence list. “Video Calibration” must be conducted again when its zoom ratio is changed. Base Angle: Use when measuring with substrate angle set tat 90° , etc.

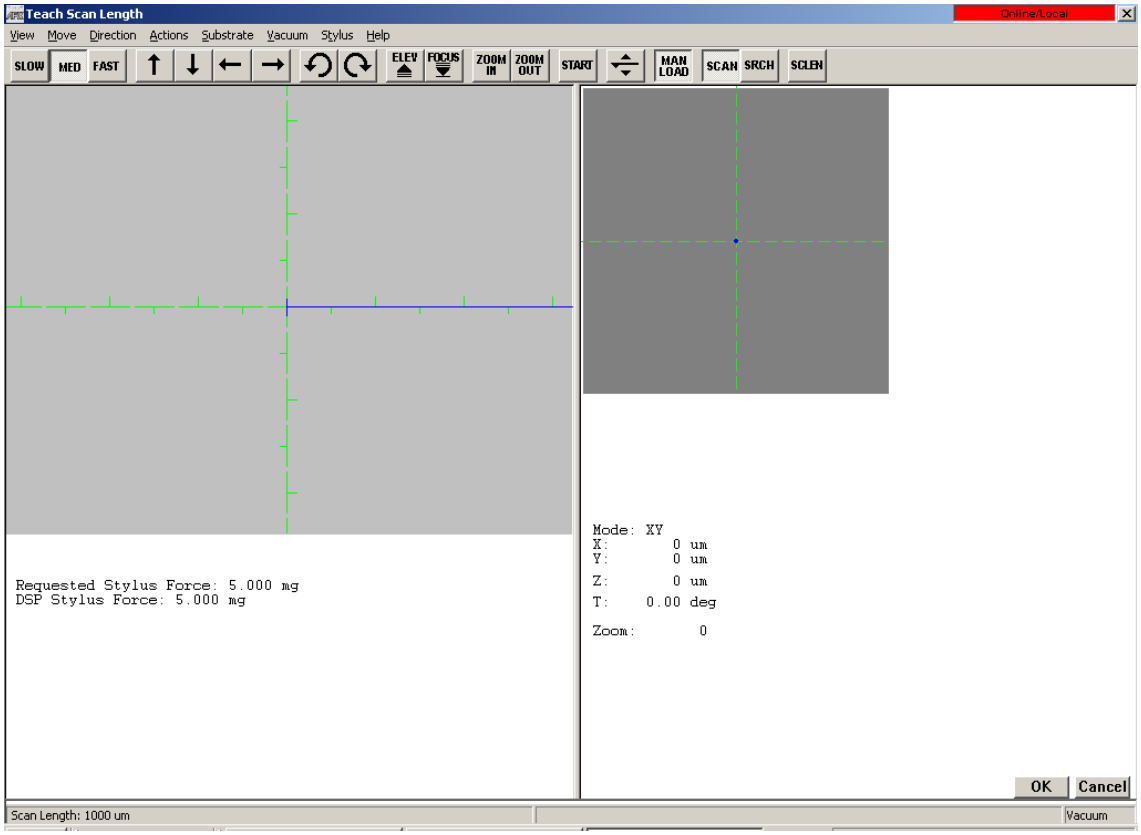


5.1.3. Select a recipe in the recipe catalog list box and either click “Add” or press [Enter] The selected recipe name is now in Location 1 of the sequence list.



5.1.4. Add another recipe to the sequence list in the same procedure as above. [Ctrl+C] to copy and [Ctrl+V] to paste are also available.

5.1.5. Either double-click the line of Location 1 in the sequence list or click the “Teach” button on the line so that the teach location window (XY View) shown below appears.

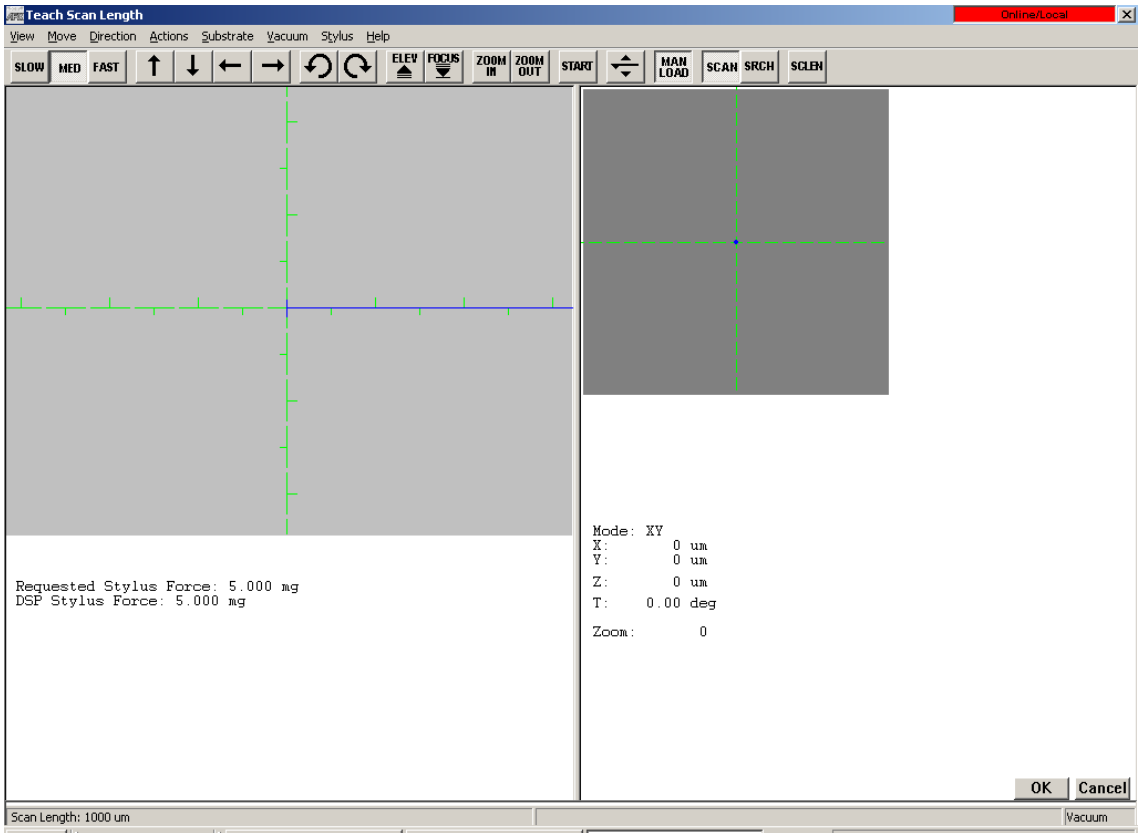


5.1.6. In the teach location window, the blue array over cross hairs shows scan length and scan direction used in the recipe. Using the following procedures assign a scan start position which is shown on the center of the cross hairs.

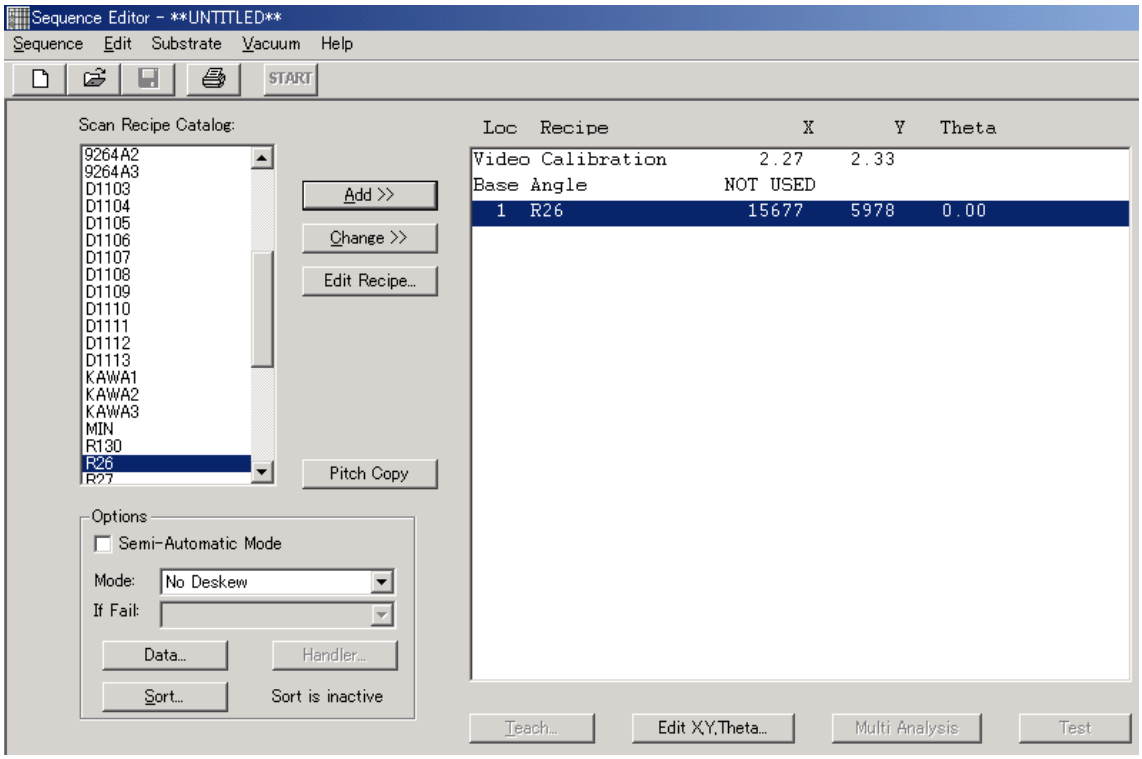
5.1.7. Click either the array button in the tool bar to move a stage or the screen in the right of the video window showing the stage position.

5.1.8. When it comes near a measurement position, click “Focus” to start focusing.

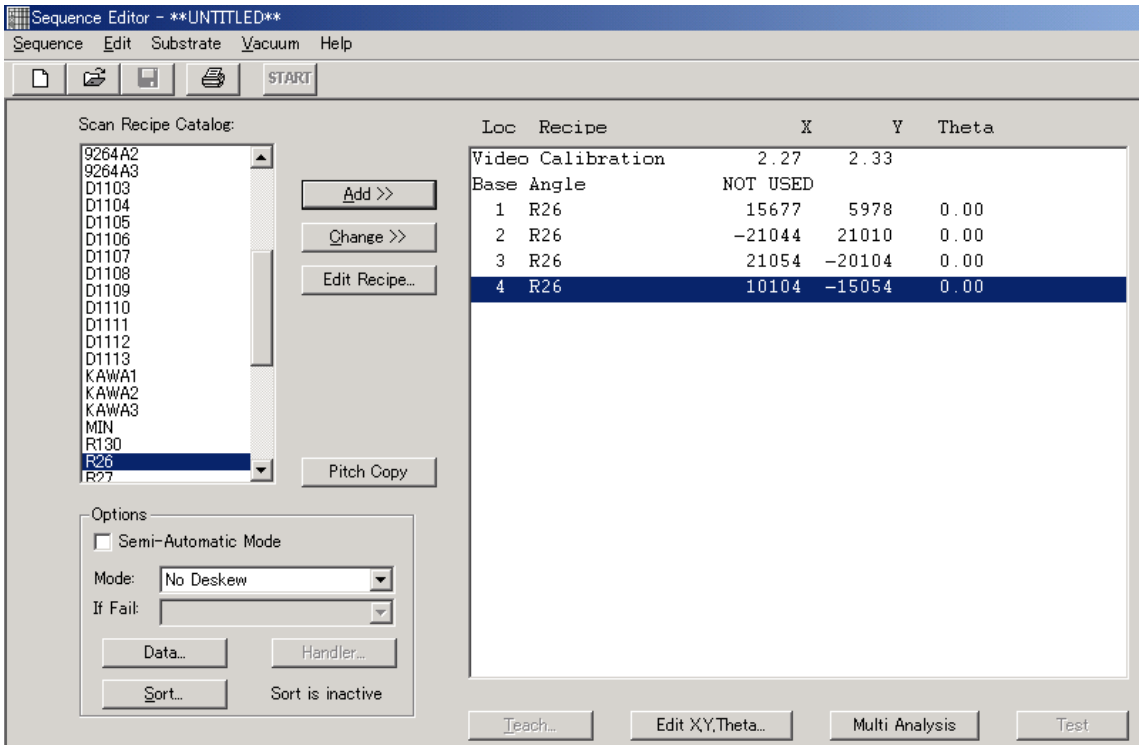
5.1.9. When a measurement position is within the camera field, click the video window to assign a scan start position.



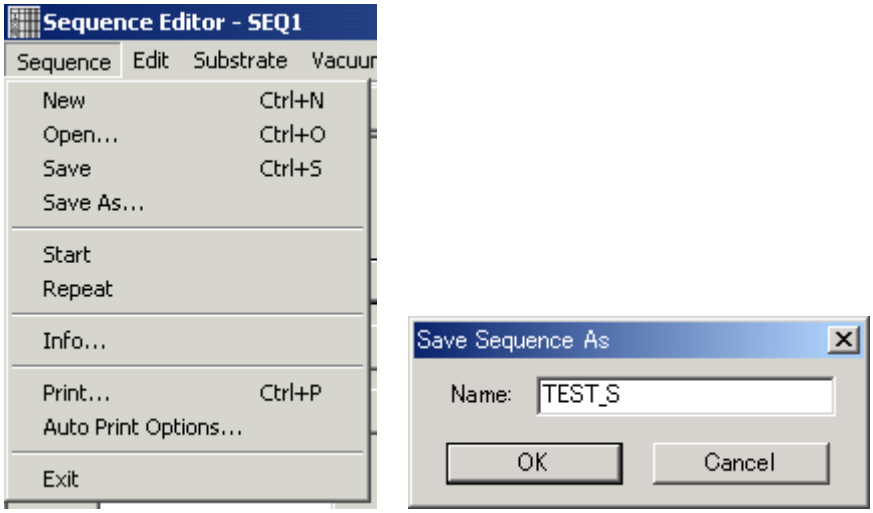
5.1.10. Either click “OK” or press [Enter] to return to the sequence edit window. The XY coordinate of the position assigned by the cross hairs is shown in the right of the recipe of Location 1.



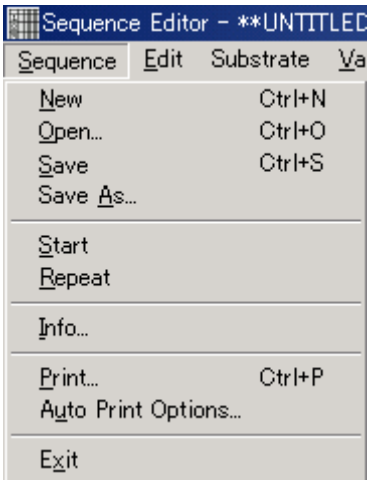
5.1.11. Teaching for other position follows the same procedures as above.

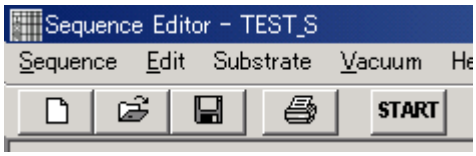


5.1.12. Select “Save As” from the sequence menu to save a created sequence.

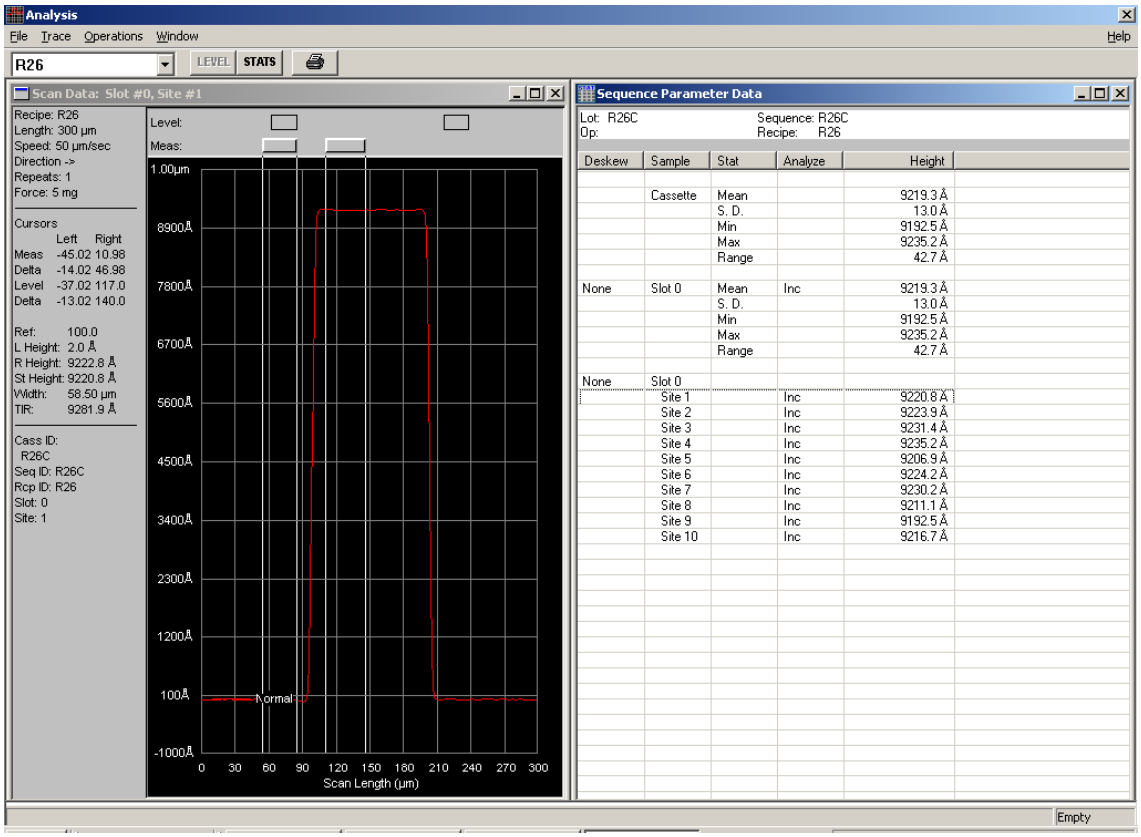


5.1.13. Select “Start Sequence” from the sequence menu or click “Start” in the tool bar to start measurement.





When measurement is completed, the stage will return to the initial position and the scan trace window will appear.



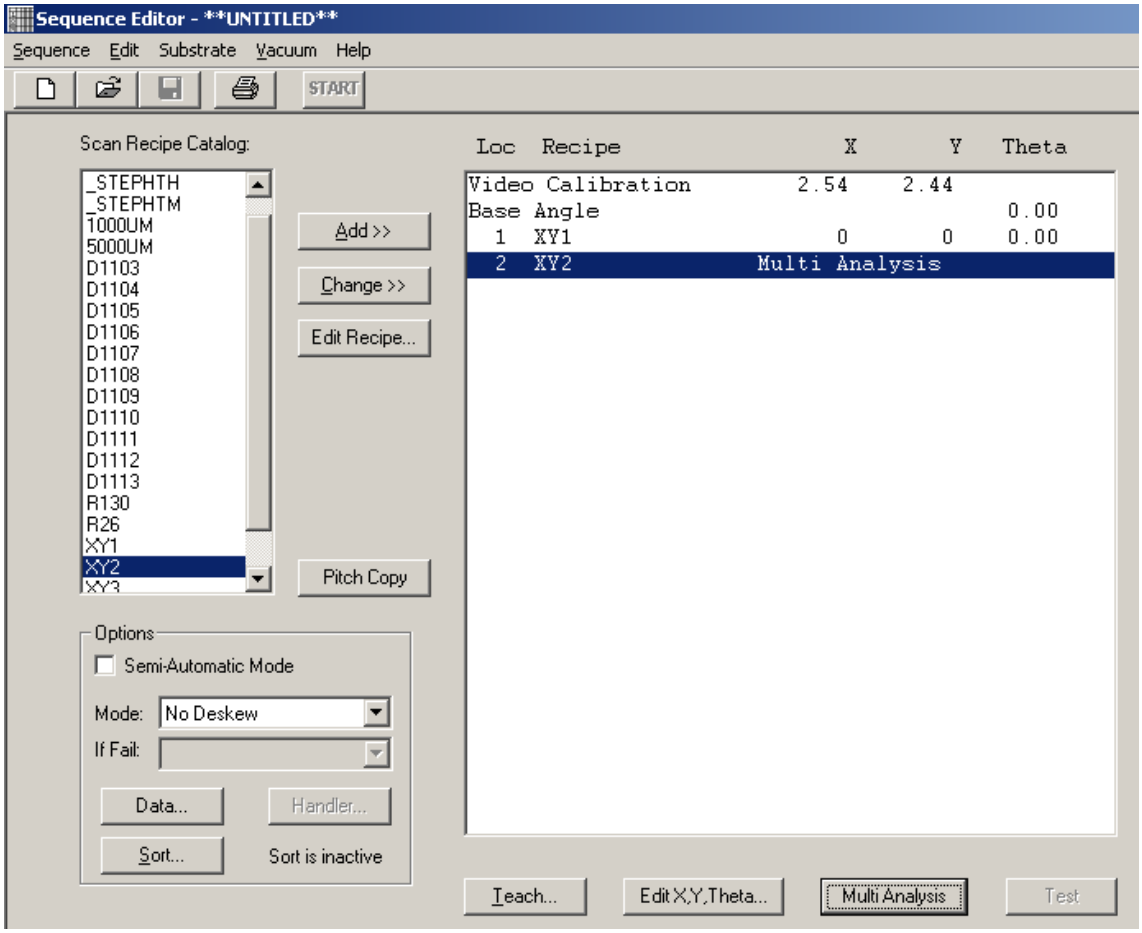
5.2. Sequence Creation with Multi Analysis (Multiple Analysis Function)

Multiple data analysis function enables to re-analyze data under another recipe condition by using firstly-scanned data.
Multiple data analysis function makes measurement time shorter in the following cases.

- To measure two height differences with only one scan and each needs its own cursor setting.
- To measure under different filter setting.
- To measure with different analysis parameters on a recipe.

5.2.1. Create a scan recipe for analysis. This scan recipe must have the same measurement length, measurement speed, stylus pressure, sampling rate, contact speed and range as those of the measurement recipe. To change the content of the recipe, re-set parameters and cursor position and save the new recipe as another name.

5.2.2. Open a sequence recipe to add a created recipe to the sequence list. Set a measurement position. Add a recipe with different parameters and cursor position again. This recipe does not need measurement position setting. Instead, click “Multi Analysis” to make analysis parameters of the recipe start analysis. (In the following case, two sets of data can be analyzed by only one measurement.) The “Multi Analysis” button is not available at the point when the first recipe is entered.



5.2.3. Click “Start” to start measuring a sample. When a box appears to save a sequence recipe, enter a name to save it and start measurement.

5.2.4. When measurement is completed, data will be shown. In order to see each recipe data, click a array key in the drop-down box and click a relevant recipe name. Select “Save Data” from the “File” menu to save data.