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**RCT-RA260
ROUNDNESS MEASURING
MACHINE MANUAL**



Roundness Overview

The roundness measuring instrument takes the precision rotation center as the rotation datum to evaluate the roundness of any section for the measured workpiece according to the measurement of radius variations from the actual contour to the rotation center of the workpiece by detector at different rotation angle position.

It can be used for the roundness, concentricity, surface runout and other parameter measurement of each section profile of the inner and outer rotary surfaces.

Installation Requirement

Power Supply: AC 220V±5% 50Hz need separate ground wire.

Power: 500W

Work Environment:

Worksite temperature 15~25°C, ideal temperature 20±2°C,

Relative humidity < 70%

There should be no dust, vibration, noise, airflow, corrosive gas and strong magnetic field affecting the measurement in the operation environment room.

Air source request: air pressure 0.5-0.8 Mpa, air flow: > 0.2m³/min,

instrument inlet air pressure dew point < 10°C,

Oil mist concentration < 0.5mg/m³,

Solid < 3um, Solid particle content 5mg/m³

Instrument Structure



Software Installation Process

1 Software Installation File

- ◆ Software package



SPWSetup...

- ◆ Dongle drive installation package



HASPUserSetup.exe

- ◆ Motion control card drive installation package



driver 文件夹

- ◆ Capture card drive installation package



USB1808 驱动

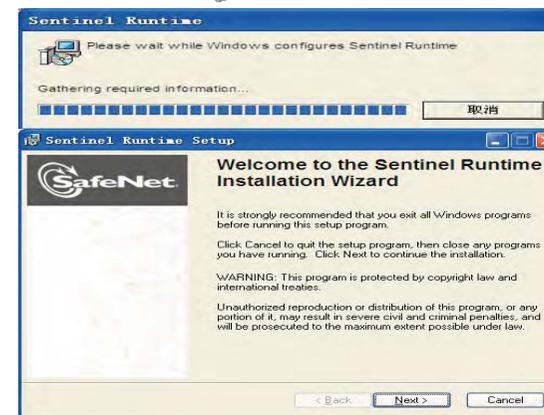
2 Dongle drive installation

- ◆ Double click icon

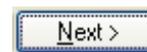


HASPUserSetup.exe

following page pops up



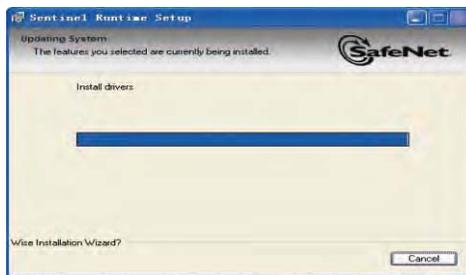
Click



following page pops up



Select I accept the license agreement and click **Next >** following page pops up



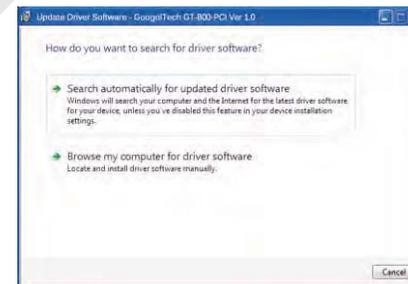
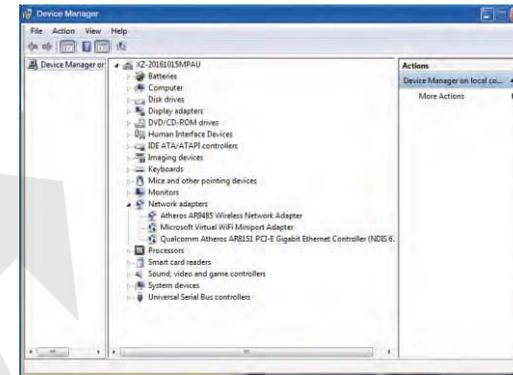
Click **OK** , finish the Dongle drive installation

3 Motion control card installation

Right-click mouse on “Computer” on desktop: select Manage



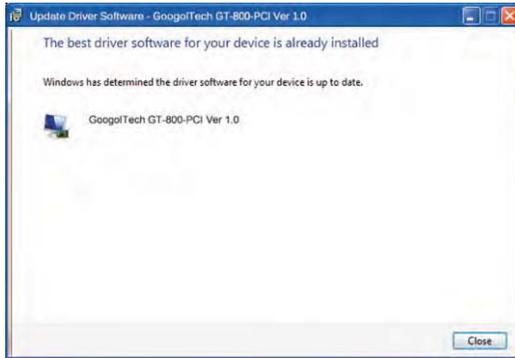
Select device manager and click scan to detect hardware.



Choose Browse my computer for driver software browse specified file path.



Choose F/XXX/driver/Chinese/Windows/Driver, click OK, then click Next, will see the below interface.



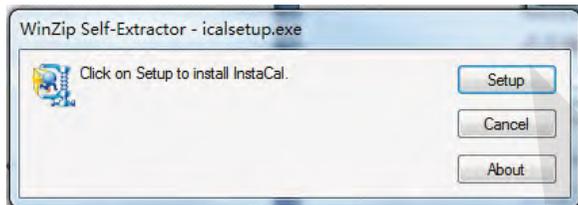
4 Capture card driver installation

- ◆ Open 1808 file

- ◆ Double click



- ◆ Click Yes



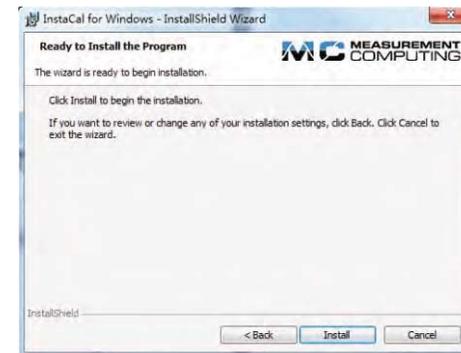
Click Setup



Click Next



Click Next



Click Install
Click Always trust, then click installation



Click Finish, complete the installation.

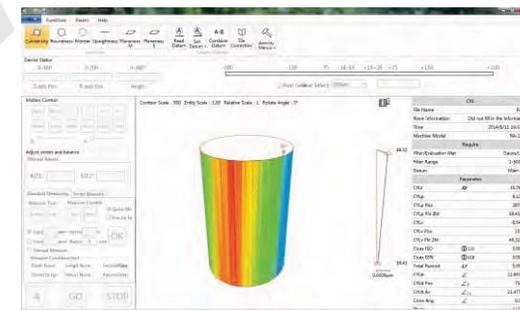
Instrument Operation Instructions and Cautions

- ◆ Before instrument operation, please check the power supply and air source. The instrument is not allowed to be operated while there is no air or the air pressure is insufficient.
 - ◆ Firstly, clean the measured workpiece and clamp it on the turntable (usually clamped by a three-jaw chuck).
 - ◆ During the batch measurement, clamp the first workpiece on the chuck and control the stylus to approach the workpiece, but not contact it temporarily. Observe the gap between the workpiece and the stylus during turntable rotation, adjusting the workpiece position, then contact the stylus on workpiece.
- During the batch measurement, clamp the first workpiece on the chuck and control the stylus to approach the workpiece, but not contact it temporarily. Observe the gap between the workpiece and the stylus during turntable rotation, adjusting the workpiece position, then contact the stylus on workpiece. According to the reading bar value of the detector on software interface, adjust the workpiece position or move back the detector at horizontal direction, making sure the detector reading value is less than $\pm 300\mu\text{m}$.

- ◆ Place the measured workpiece on turntable, make centering and leveling adjustment, making sure the axis of the workpiece and the rotation axis of the spindle coincide. The detector reading value on software interface should be around $-20\mu\text{m}$ during the measurement.
- ◆ Choose the parameters need to be measured, make the turntable rotate automatically, then click measure
- ◆ The data evaluation method and wave band can be set after measurement operation.

Software Operation Instructions

1 Software Interface Instructions



◆ **Instrument Status**

| Device Status | | |
|---------------|------------|--------|
| 0-300 | 0-200 | 0-360° |
| Z axis Pos | R axis Pos | Angle |

Z axis Pos: read the current grating position value of Z axis
R axis Pos: read the current grating position value of R axis
Angle: record the angle value of the current spindle, that is the circular grating value.



Detector reading: read the detector value of contact amount.
The variation of the red bar is determined by the detector reading value.

In order to make the detector application field getting wider, the measuring range of the detector needs to be classified.

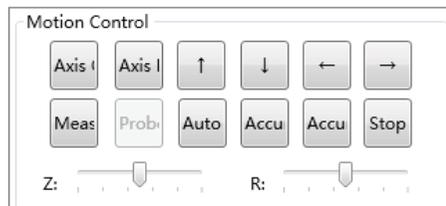
It is needed to be divided into 5 gears.

The first gear: measuring range is the biggest, the accuracy is the lowest.

The fifth gear: measuring range is the smallest, the accuracy is the highest.

Measuring range: 1st gear is $\pm 300\mu\text{m}$, 2nd gear is $\pm 150\mu\text{m}$, by similar rules for other gears.

◆ Motion Control

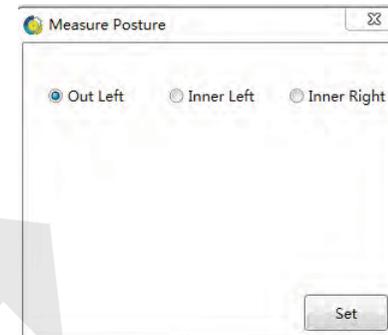


Axis I **Axis I** Used for the spindle lock and unlock for some special model instrument.

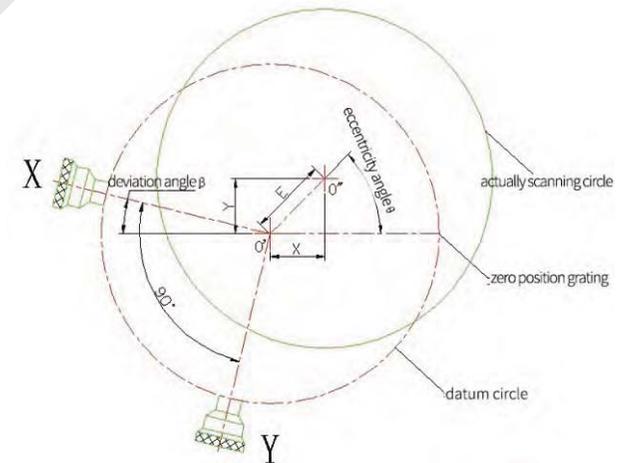


Control detector movement of upward and downward at column vertical direction, left and right at horizontal direction.

Meas Used for measurement switch for inner hole and outer hole.



Switch the measure position according to the direction of detector, inner circle and outer circle



Principle of centering

X is the micrometer head knob for centering adjustment of X direction, Y is the micrometer head knob for centering adjustment of Y direction, O' is the center of datum circle and O" is the actual center of scanned circle.

The value of E is the distance between O' and O", that is the eccentricity value of the scanned circle, θ is the eccentric angle and β is the deviation angle of X direction micrometer head knob relative to the zero position of the grating. The positions of the X and Y direction micrometer head knob are perpendicular to each other.

The operation steps are:

Rotate the spindle for one circle (start from the zero position of the grating, end with the start position), obtain the eccentricity value E and the eccentric angle θ of the actual scanned circle.

Calculate the value of X and Y according to the value of E and θ .

The adjustment amount of X direction and Y direction are the half amount of X value and Y value respectively.

Since there is an inevitable angle β between the X direction and zero position of grating during mechanical installation, the actual adjustment amount of the X direction and Y-direction need correction according to the β angle.

The loaded configuration file of β angle can be set by operator.

The operation steps of centering and leveling:

Step1: Choose the measurement direction according to the actual measurement requirements and the system defaults is the outer circle.

Step2: Select the suitable gear according to workpiece, usually with $300\mu\text{m}$.

Step3: Clean the measured workpiece and clamp it with precision chuck. Control the stylus to approach the workpiece slowly but not contact on it. Rotate the turntable clockwise, observe if the distances between stylus tip and the surface of workpiece are same.

If the differences are big, adjust the two centering knobs to make it is smaller. Then contact the stylus on workpiece slowly, adjusting the detector reading value is around 0.

Step4: Rotate the turntable clockwise slowly, if the detector reading bar is close to +300, move the detector to right direction, to make sure the reading bar keeping less than +300 even the contact amount between stylus and workpiece is with maximum pressure.

If the detector reading bar is less than +300 and the opposite direction exceed over -300, it needs to adjust the centering knob and move the detector to left side slowly, to making the detector measuring range reading bar fluctuation is less and within the measuring range during workpiece rotation.

Step5: Record the detector reading bar value while the centering knob is parallel to the horizontal direction during turntable rotation.

Record the new value after turntable 180 degrees rotation, then adjust the value to the half of sum of two times reading bar value by centering knob twist.

Rotate the turntable with 90 degrees and record the third time detector reading bar value.

Rotate the turntable with 180 degrees again and record the fourth time detector reading bar value.

Then adjust the value to the half of sum of the third and fourth time reading bar value by centering knob twist, making sure the workpiece is symmetrical around the rotation center.

Step 6: For the vertical adjustment of workpiece, it needs to conduct the above step 5 operation for the lower part sections of workpiece measurement surface, then make leveling adjustment for upper part sections of workpiece by leveling knob twist, to making sure the detector measuring range reading bar fluctuation within the measuring range during workpiece rotation by leveling knob twist.

Record the fifth time detector reading bar value while the leveling knob is parallel to the horizontal direction during turntable rotation, and then record the sixth time new value after turntable 180 degrees rotation.

Adjust the value to the half of sum of fifth and sixth time reading bar value by leveling knob twist.

Rotate the turntable with 90 degrees after adjustment and make the same adjustment for another diagonal, making sure the workpiece is symmetrical around the rotation center.

NOTES:

Adjust the centering knob while for lower part sections and adjust the leveling knob while for upper part sections of workpiece during workpiece vertical adjustment.

After the adjustment is completed, the variation of detector reading bar of the upper and lower sections should be same, and the deviation between the displayed circle diagram and reference circle should be very small.

2 Menu List Instructions

It includes Open, Save, Save As, Auto Save, Print, Print Preview, Exit, etc.

◆ **File save and data file save format**

Save different data file according to measuring items. The file is saved in the "data" directory under the software directory and the saved path can be set by operator.

The file extension of cylindricity data file is CYL, roundness data file is RON, commutator data file is MOT, straightness data file is STR and flatness data file is FLT.

- ◆ **Open**
Only display files with corresponding extensions for the measurement according to the measuring requirements.
- ◆ **Save As**
Record current operation, save as copy and the file name can be edited by operator.

NOTES:

The file name of corresponding roundness data file should be saved with same name as cylindricity data file after the file name edited while the data type is cylindricity data file.

- ◆ **Auto Save**
It is a switch type function. All measurement files are saved as the current diagram in drawing area and current data table content automatically after this function is enable.
- ◆ **Print Preview**
The measuring report can be previewed before print.

3 Measuring Functions

The measuring functions menu includes two parts, "Functions" and "Datum Operate". They are fixed menu.



The activity menus are the submenu of different measuring functions. The corresponding submenu can be displayed according to selected measuring functions.

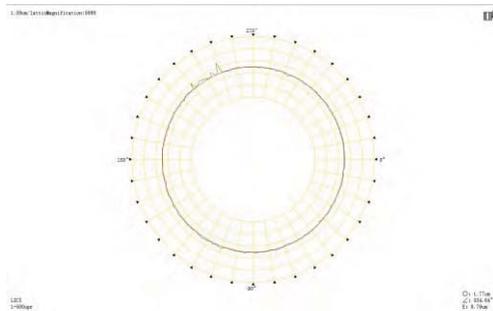


◆ Roundness Measuring Function

Click  switch to roundness measurement. Adjust workpiece position, making the detector range reading bar value is around -20 and rotate the turntable.

Click  to start the measurement.

Roundness measurement graph drawing



Roundness measurement activity menus

Click  enter the profile analysis interface, use mouse wheel to control the zoom in and zoom out for profile graph.

Click  to make spectrum analysis for profile graph, interface as below.



Under profile analysis, mark the highest and lowest point on the selected area of roundness graph.

Click  shows the roundness parameter report under ISO standard

| RON | | |
|-----------------------|---|------------|
| File Name | | Rs-ra1.ron |
| Piece Information | Did not fill in the information | |
| Time | 2018/11/26 17:02:06 | |
| Machine Model | RS1600 S2 | |
| Require | | |
| Filter/Evaluation Met | Gauss/LSCI | |
| Filter Range | 1-500upr | |
| Datum | Main axis | |
| Parameter | | |
| RONt |  | 0.51μm |
| RONp | | 0.22μm |
| RONp Pos | | 123.37° |
| RONv | | -0.29μm |
| RONv Pos | | 292.56° |
| Ecc | E | 0.80μm |
| Ecc Pos |  | 337.49° |
| Conc |  | 1.19μm |
| Runout |  | 1.19μm |
| Zht | | 88.89mm |
| Area Diff | | 0.02mm² |

Click  shows the roundness statistical table report under, picture as below.

| upr | RON | Standar | Result | RONp | RONv |
|-----------|------|---------|--------|------|-------|
| 1-500upr | 0.51 | 0 | NO | 0.22 | -0.29 |
| 1-250upr | 0.50 | 0 | NO | 0.22 | -0.28 |
| 1-150upr | 0.47 | 0 | NO | 0.21 | -0.26 |
| 1-50upr | 0.37 | 0 | NO | 0.18 | -0.19 |
| 1-15upr | 0.23 | 0 | NO | 0.11 | -0.12 |
| 15-500upr | 0.42 | 0 | NO | 0.17 | -0.24 |
| 15-250upr | 0.40 | 0 | NO | 0.17 | -0.24 |
| 15-100upr | 0.35 | 0 | NO | 0.16 | -0.19 |

The roundness value (RON) corresponding to each upr are the sum of peak and valley value.

Click  will show below table.

| Index | Angle | Height | Width | Start Pos | End Pos |
|-------|-------|--------|---------|-----------|---------|
| 0 | 19.59 | 342.26 | 3372.82 | 107.84 | 127.43 |
| 1 | 5.73 | 100.11 | 3304.64 | 220.97 | 226.70 |
| 2 | 12.21 | 213.28 | 2709.43 | 255.77 | 267.97 |
| 3 | 8.18 | 142.95 | 2105.37 | 94.10 | 102.28 |
| 4 | 4.63 | 80.92 | 2032.33 | 141.11 | 145.74 |
| 5 | 11.29 | 197.31 | 1557.35 | 342.55 | 353.84 |
| 6 | 5.62 | 98.12 | 1429.97 | 134.72 | 140.34 |
| 7 | 3.12 | 54.51 | 1384.56 | 148.38 | 151.50 |
| 8 | 3.28 | 57.27 | 1294.27 | 72.85 | 76.13 |
| 9 | 3.77 | 65.87 | 1066.09 | 1.71 | 5.48 |

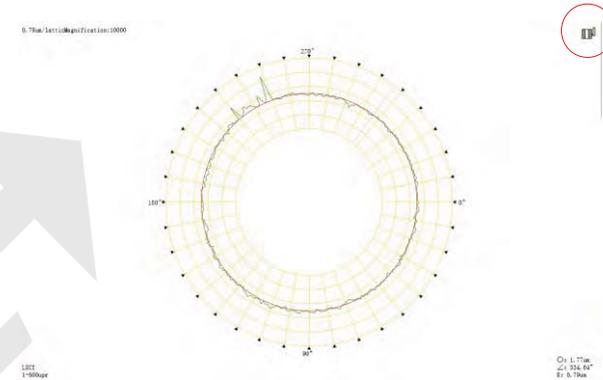
Angle: the value of end position angle minus start position angle for the angle of protruding part.
 Height: the chord height of the protruding part minus the radius.
 Width: calculate the chord length of the protruding part based on input cylinder diameter.
 Start Position: the start position angle of the protruding part.
 End Position: the end position angle of the protruding part.

Click  will show below list.

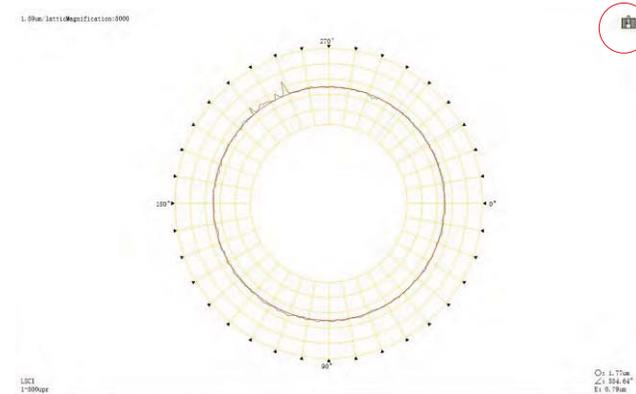
| Waviness | |
|----------|---------|
| Wc | 0.12µm |
| Wp | 0.16µm |
| Wv | -0.22µm |
| Wz | 0.38µm |
| Wa | 0.04µm |
| Wq | 0.01µm |
| Wsm | 5.00° |

Wc: The average height of the waviness profile unevenness.
 Wp: The maximum peak height of waviness.
 Wv: The maximum valley depth of waviness.
 Wz: The maximum height of waviness profile.
 Wa: The arithmetic average deviation of waviness profile.
 Wq: The root-mean-square deviation of waviness profile.
 Wsm: The average distance of waviness profile.

Click  to switch the direction of inner and outer circle for measurement graph.

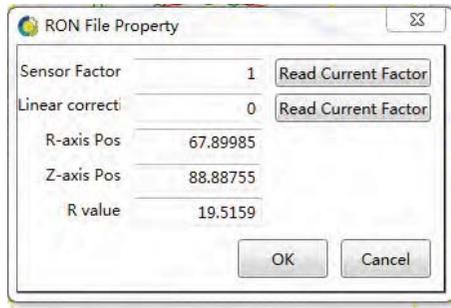


After switch, the graph show as below.



Click  to make data recalculation and refresh the result data.

Click  to set the roundness data display on file property.



Click  to set the roundness parameter display.



SPECIFICATION

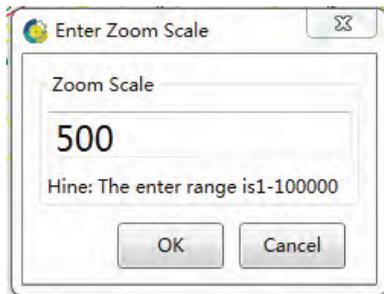
| | | |
|--------------|---|--|
| Probe | measuring range | ±300µm |
| | resolution | 0.001µm |
| | linear accuracy | 0.25% |
| Ruby stylus | size | Ø2x10mm |
| | direction | two directions |
| X axis | adjustable angle | ±45° |
| | travel | 165mm |
| | excess range | 25mm |
| Z axis | drive mode | by hand |
| | drive mode | motor |
| | travel | 320mm |
| Rotary stage | movement speed | 0.5~10mm/s |
| | rotation accuracy | (0.025+6H/10000)µm for H≤20mm, H is the measuring height in mm |
| | rotation speed | 6rpm |
| | max. measuring diameter | 260mm |
| Rotary axis | max. workpiece diameter (rotation diameter) | 400mm |
| | radial rotation accuracy | ±0.0125µm |
| | axial runout accuracy | ±0.05µm |

| | | |
|---------------------|-------------------------------|-----------------|
| Adjustable 3D stage | diameter | 180mm |
| | adjustment range of center | ±3mm |
| | adjustment range of level | ±2° |
| Granite stage | weight capacity | 20kg |
| Precision chuck | external grip diameter | Ø1~Ø81mm |
| | internal grip diameter | Ø31~Ø70mm |
| Air filter | pressure range | 0~0.8mpa |
| | oil mist removal accuracy | 0.01µm |
| | export oil mist concentration | 0.5mg/m³ |
| Dimension (LxWxH) | | 1300×795×1715mm |
| Power supply | | 220±10%V, 50Hz |
| Power | | 500W |
| Weight | | 320kg |

◆ Commutator Measuring Function

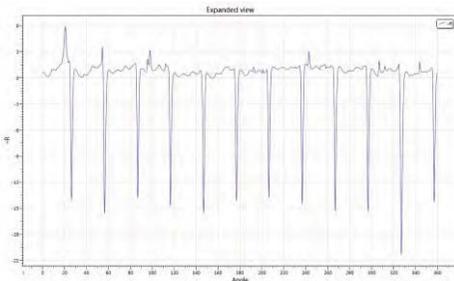
Click  to make the commutator measurement.

Click  the graph can be zoom in and zoom out by rolling the mouse middle wheel or click  and input the zoom value.

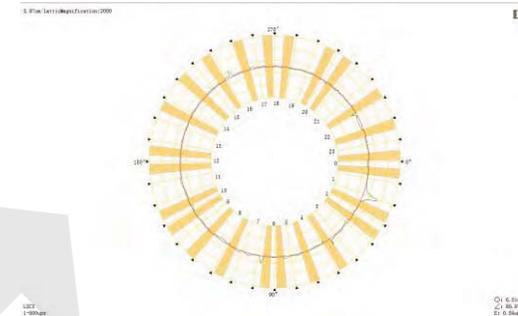


Click  switch to the graph interface.

Click  to make an expand view for commutator measurement graph.



Click  delete the measurement graph part which there is gap on commutator.



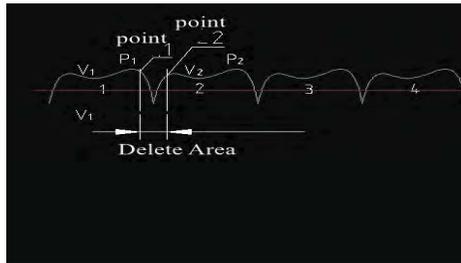
| Mot | | | | | | |
|-------------------|---------------------------------|-------------|-------------|-------------|--------------|--|
| File Name | 16811分27秒.mot | | | | | |
| Piece Information | Did not fill in the information | | | | | |
| Time | 11/29/2018 16:01:28 | | | | | |
| Parameter | | | | | | |
| 1-500μm | RON | | | 6.51 μm | | |
| Incler | Single R | Piece In | Piece Av | P | V | |
| 0 | 0.39 | 0.16 | 5.60 | -0.38 | -0.77 | |
| 1 | 5.24 | 0.33 | 5.02 | 4.83 | -0.42 | |
| 2 | 0.73 | 0.09 | 2.69 | -0.01 | -0.79 | |
| 3 | 2.65 | 1.58 | 2.79 | 1.90 | -0.74 | |
| 4 | 0.04 | 0.03 | 1.53 | -0.04 | -0.83 | |
| 5 | 0.72 | 0.39 | 0.77 | 0.71 | -0.01 | |
| 6 | 0.17 | 0.37 | 2.30 | 0.10 | 0.07 | |
| 7 | 2.35 | 0.58 | 3.03 | 2.23 | 0.12 | |
| 8 | 0.51 | 0.06 | 0.73 | -0.25 | -0.80 | |
| 9 | 0.43 | 0.14 | 0.64 | -0.07 | -0.50 | |
| 10 | 0.40 | 0.01 | 1.08 | -0.11 | -0.70 | |
| 11 | 1.05 | 0.77 | 0.63 | 0.33 | -0.63 | |
| 12 | 0.73 | 0.01 | 0.61 | -0.07 | -0.31 | |
| 13 | 0.67 | 0.09 | 0.72 | 0.30 | -0.33 | |
| 14 | 0.49 | 0.06 | 0.53 | 0.35 | -0.14 | |
| 15 | 0.34 | 0.01 | 2.03 | 0.39 | 0.05 | |
| 16 | 2.01 | 0.06 | 1.93 | 2.04 | 0.03 | |
| 17 | 0.45 | 0.33 | 0.90 | 0.58 | 0.11 | |
| 18 | 0.63 | 0.03 | 0.63 | 0.28 | -0.34 | |
| 19 | 0.59 | 0.39 | 0.91 | 0.29 | -0.30 | |
| 20 | 0.59 | 0.17 | 1.08 | -0.03 | -0.62 | |
| 21 | 0.93 | 1.19 | 2.14 | 0.46 | -0.47 | |
| 22 | 1.41 | 0.10 | 1.69 | -0.28 | -1.68 | |
| 23 | 0.47 | 0.40 | 0.73 | 0.01 | -0.45 | |

The red color mark value refers to the max. value in the column, green color mark value refers to the min. one in the column.

Single chip runout: the difference between peak value and valley value of corresponding chip.

Adjacent chip runout: The max. value of peak value minus the valley value of adjacent chip.

For example as below picture:
 Calculate the value of P2-V1 and P1-V2, take the max. value as the adjacent chip runout of the second section.
 Gap difference between chips: the absolute value of the two points value minus result of the gap.
 For example as below picture:
 The absolute value of the value of point 2 minus the value of point 1. It is the gap Difference of the second chip



Click to cancel the delete order of automatic sharding.

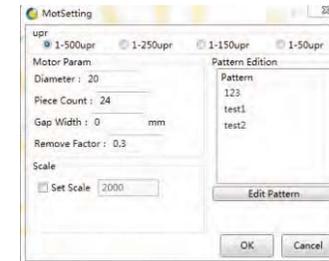
Click to switch graph drawing display of inner and outer circle.

Click to set the Mot file display.



Click to make data recalculation and refresh the graph display.

Click to set the Mot parameter for data calculation.



◆ Single Section Planeness Measuring

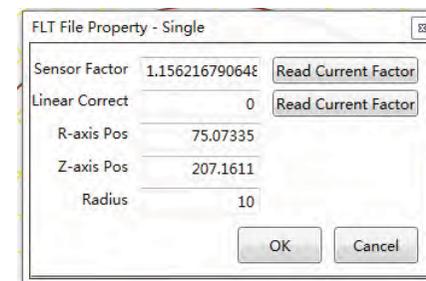
Click adjust the stylus direction to downward for planeness measurement. Make leveling adjustment for measured section and continue for single section planeness measurement.
 The measurement graph and parameter display as below,



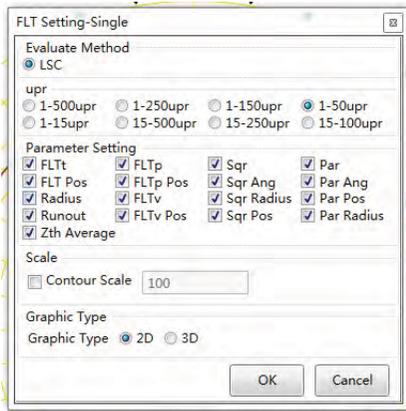
Click can zoom in and zoom out the measurement graph.

Click can rotate the measurement graph with clockwise and anticlockwise.

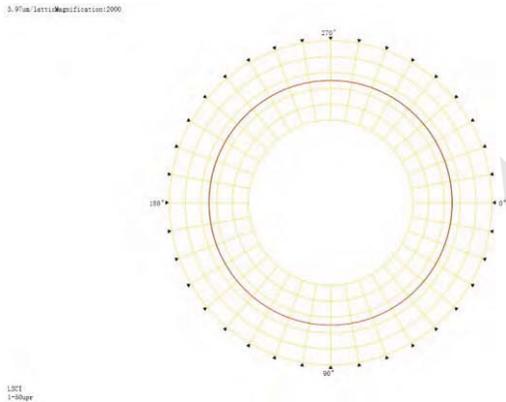
Click can record the flatness calculation parameter.



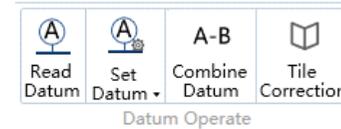
Click  can set the flatness measurement result parameter, scale and graph display contents.



The measurement graph 2D view



4 Datum Loading



◆ Load Datum (“Read Datum”)

As roundness measurement file, the loaded datum type can be roundness file (ron extension), cylindricity file (cyl extension), straightness file (str extension) and combination datum (jzz extension).
The evaluated parameters are runout and concentricity.

As cylindricity measurement file, the loaded datum type can be cylindricity file (cyl extension), combination datum (jzz extension) and single section flatness (flt extension).
The evaluated parameters are coaxiality, perpendicularity and total runout.

As straightness measurement file, the loaded datum type can be straightness (str extension), cylindricity file (cyl extension), combination datum (jzz extension) and single section flatness (flt extension).
The evaluated parameters are parallelism and perpendicularity.

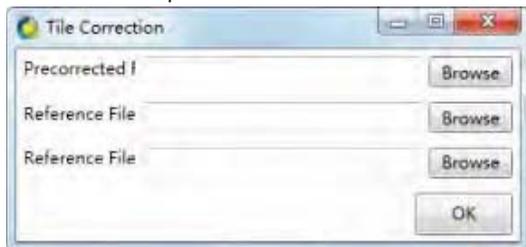
As multi-section flatness measurement file, the loaded datum type can be single section flatness (flt extension), cylindricity file (cyl extension), combination datum (jzz extension) and straightness file (str extension).
The evaluated parameters are perpendicularity, total runout and parallelism.

As single section flatness measurement file, the loaded datum type can be single section flatness (flt extension), cylindricity file (cyl extension), combination datum (jzz extension) and straightness file (str extension). The evaluated parameters are perpendicularity, single runout and parallelism.

- ◆ Datum Set
Set current opened file as default datum file.
- ◆ Combine Datum
Combine two single section roundness files at different height, take as datum axis line.



- ◆ Tilt Correction
Take two roundness files at different height as reference files to make correction for pre-corrected file.



5 Parameter Set

◆ Instrument Initialization

Click  to make initialization and stop initialization.

If the digital position of grating changes, it needs to make initialization.

Workpiece can not be clamped on turntable while for initialization operation.

Below condition will change the digital position of grating:

1. Push horizontal arm the at column vertical direction or horizontal direction by manual.
2. The computer shutdown abnormally.

Click  can set workpiece information.



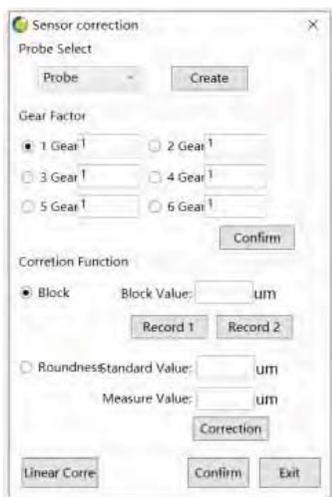
◆ Detector Parameter Calibration



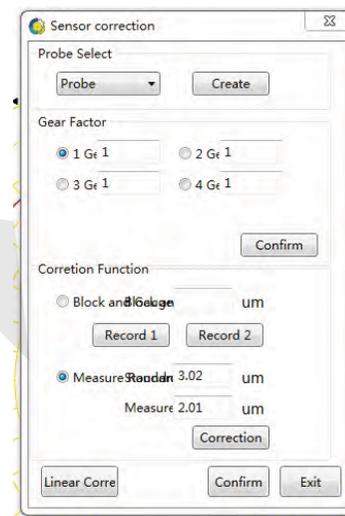
Parameter calibration refers to a length transmission process during measurement parameter calibration, in order to make the detector reading an actual movement length.

It needs to make calibration before measurement operation, steps as below.

1. Select measurement range and filter range (upr 1~500).
2. Put the standard equipped gauge block at the center of turntable, make centering and leveling adjustment and then switch to the needed calibration range.
3. Make roundness measurement for gauge block (for example, measure value input with 2.01).
4. Detector calibration set interface as below



Select "Roundness" under "Correction Function", input value (such as 3.02) of gauge block in "Standard Value", and then input the value (that is 2.01) calculated from above "Step 3" in "Measure Value".



Click "Correction", to start calibration operation.

5. If the deviation of actual measurement value "Measure Value" and "Standard Value" within 3%, it refers to the calibration is successful.

NOTE:

If there is noise, vibration, big fluctuation on temperature, the gauge block is not firmly fixed or the detector is not firmly fixed will make a worse repeatability performance.