Hypersen Confocal Studio

Instructions for PC Software of Chromatic Confocal Sensors

Hypersen Technologies Co., Ltd.

V1.3

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I. Software installation

1.1 Software overview

The Hypersen Confocal Studio software can be used with the high-precision Chromatic Confocal Sensors (HPS-CF series) produced by Hypersen Technologies Co., Ltd., which can help customers quickly complete the measurement with a sensor and the setting of various parameters convinently.

1.2 Necessary system environment

Items	Configuration
Operating system	• Windows 10 (Home/Pro/Enterprise) 64bit • Windows 7 (HomePremium/Professional/Ultimate) 64bit
CPU	CPU processor i5 Above 1.7GHz
Memory	Above 8GB
Hard Disk (free space)	Above 1GB
Resolution	Above 1024×768, 1920×1080 recommended
.NET Framework version	.NET Framework4.6.1
Interface	USB3.0 (USB2.0 interface is not supported)

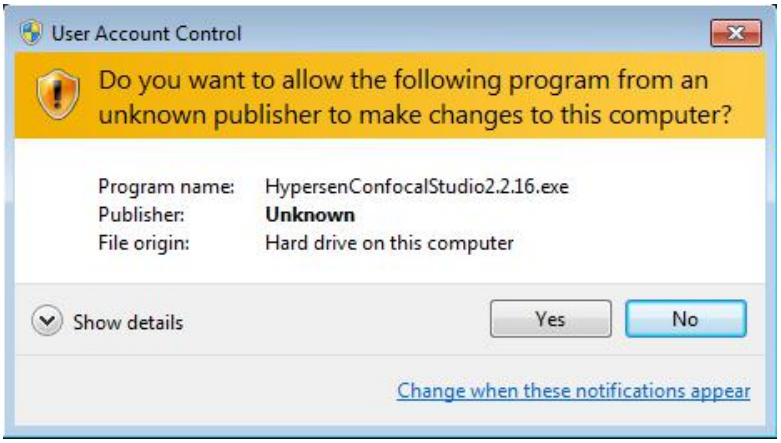
1.3 Install Hypersen Confocal Studio

1.3.1 Preparations for installation

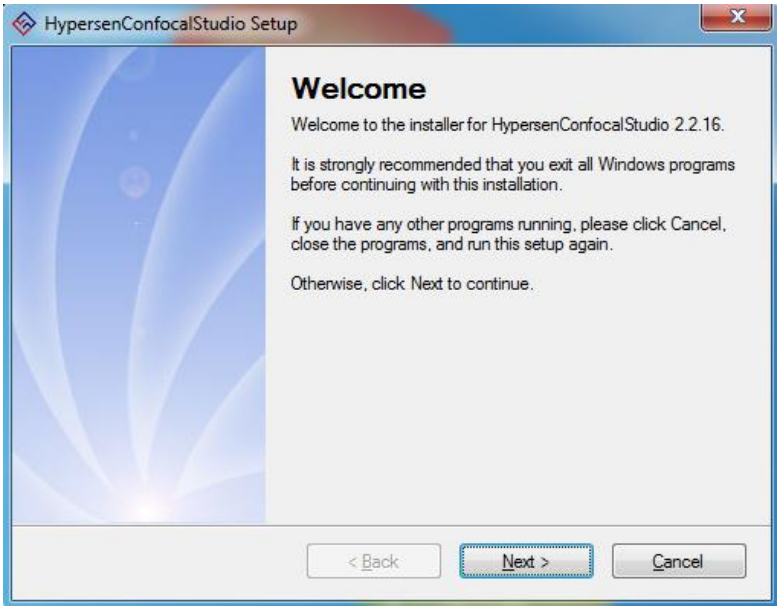
- Connect one end of the USB3.0 cable to the HPS-CF controller and the other end to the USB3.0 interface of the PC. When the connection is done, a disk drive with the same name as the HPS-CF controller will appear on the PC.
- Hypersen Confocal Studio can only be installed on the hard disk. The free space of the hard disk where it is installed must be greater than 1G.
- Please close other running applications before installation. It is recommended to connect to the Internet to download the required environment of the software on-line.
- Check whether or not this software has been installed on the PC. If so, uninstall it first (refer to 1.4 Uninstall Hypersen Confocal Studio) before installation.
- Check whether or not .NET Framework4.6.1 has been installed on the PC. If not, install "…/.NET4.6.1/NDP461-KB3102436-x86-x64-AllOS-ENU(CHS).exe" in the disk directory first.

1.3.2 Installation steps

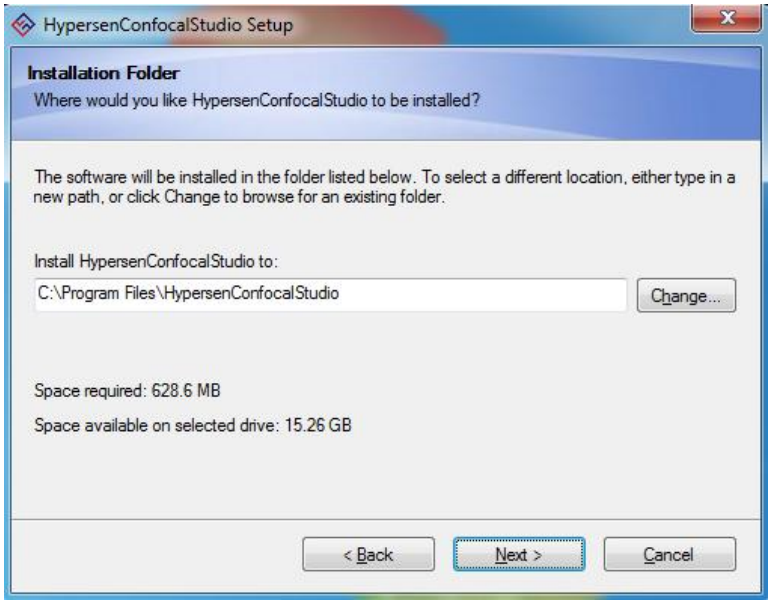
1. Please execute the installation as the Administrator. Double-click on ".../CFX000_Client_Install/setup.exe" to begin installation. If the [This app from the publisher changes your device] screen is displayed, click on [Yes].



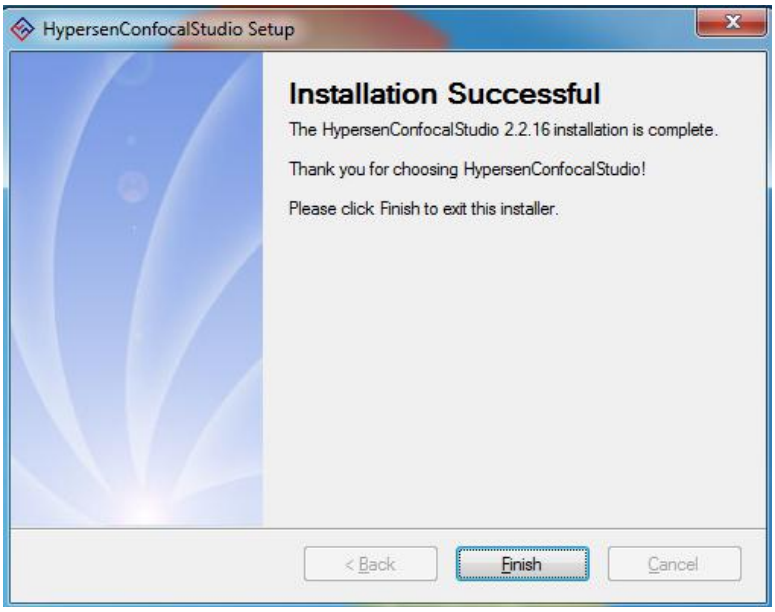
2. The interface for beginning the installation is displayed.



3. Select the designated installation path. When installing Hypersen Confocal Studio, the installer will automatically install the device driver and the dynamic link library and create environment variables. Please install Studio following the instructions of the installer.



4. When the installation is done, the interface below will be displayed. Please restart the PC.



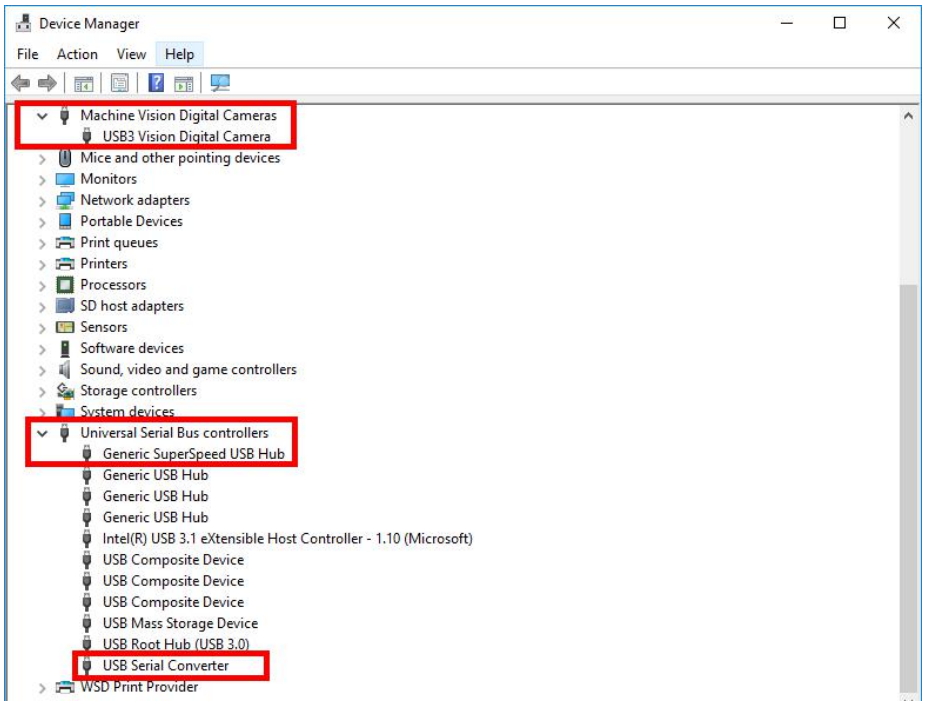
After installation:

- Check the [Confocal] icon on the PC desktop.

- Check the device driver. Connect the USB3.0 interface of the PC to the HPS-CF controller with a USB3.0 cable, connect the power cable and power it up. Open [Device Manager] to view the following four drivers.

  1. View [USB3 Vision Digital Camera] under [Machine Vision Digital Cameras].

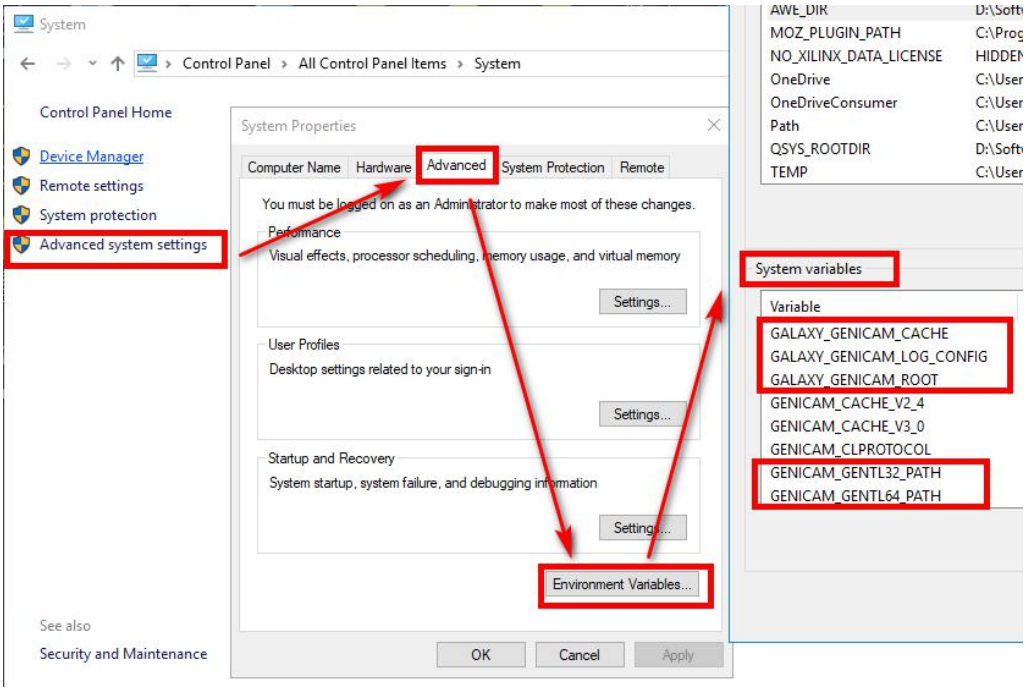
  2. View [USB Serial Converter], [Universal SuperSpeed USB Hub] and [Universal USB Hub] under [Universal Serial Bus Controller].



- After installation and after restarting, check the environment variables. Right-click on [My Computer/This Computer] => [Attributes] => [Advanced System Settings] => [Advanced] => [Environment Variables] => [System Variables].

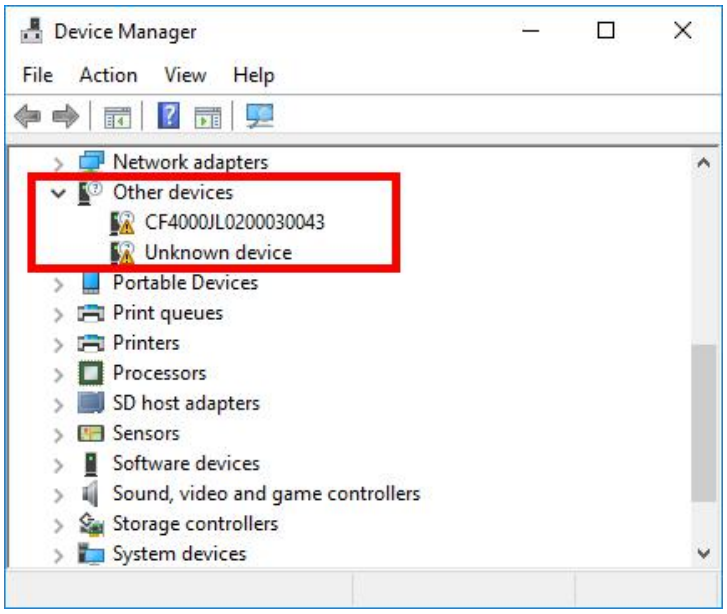
  1. View nine system variables, i.e., [GALAXY_GENICAM_ROOT], [GALAXY_GENICAM_CACHE], GENICAM_GENTL64_PATH], [GENICAM_GENTL32_PATH] , [GALAXY_GENICAM _LOG_CONFIG], [GENICAM_PATH_Win32_i86],[GENICAM_PATH_Win64_x64],[GENICAM_PATH_Win32] and [GENICAM_PATH_Win64].

  2. In the [path/PATH] of the system variables, check the four variables, i.e., [%GENICAM_PATH_Win32%],[%GENICAM_PATH_Win32_i86%],[%GENICAM_PATH_Win64%] and [%GENICAM_PATH_Win64_x64%].



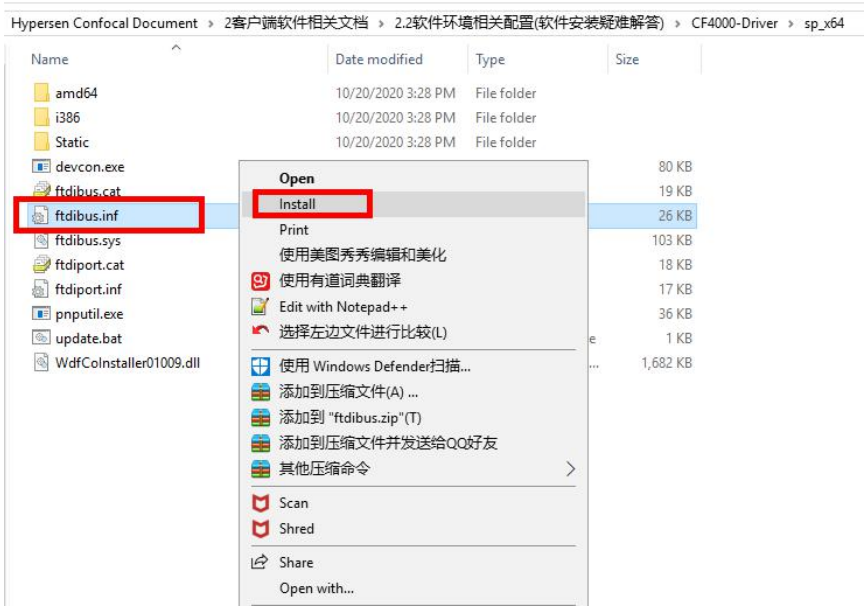
If it cannot be used normally after installation, refer to the following troubleshooting methods:

- If it is checked that the driver installation failed, a yellow exclamation mark will appear.



1. For example, when installation of [CF4000JL0200030021] fails, double-click on [...\HPS_Install\CF4xxx_BAT\ CF4xxx_Drivers\camera_x64\HPSCF4xxxUpdateDriver.exe] to start installation and wait for the installation to be completed.

2. For example, when installation of [Unknown Device/No Device] fails, double-click on [...\HPS_Install\CF4xxx_BAT\ CF4xxx_Drivers\sp_x64\ftdibus.inf], select “Install” and wait for the installation to be completed.



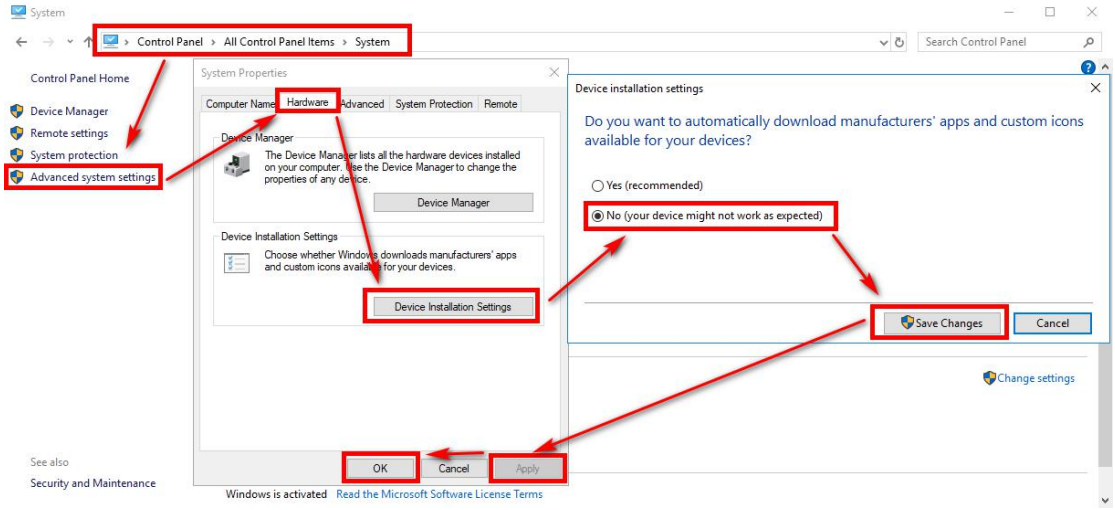
3. In the Windows 7 system, when [Unrecognized USB device] pops up, and neither of the drivers [Universal SuperSpeed USB Hub] nor [Universal USB Hub] are found, right-click on [...\HPS_Install\Intel_USB_3.0_Driver\ Drivers\Win7\x64 \iusb3hub.inf], select “Install” and wait for the installation to be completed.

4. [When the designated environment variable and path are not found in the system

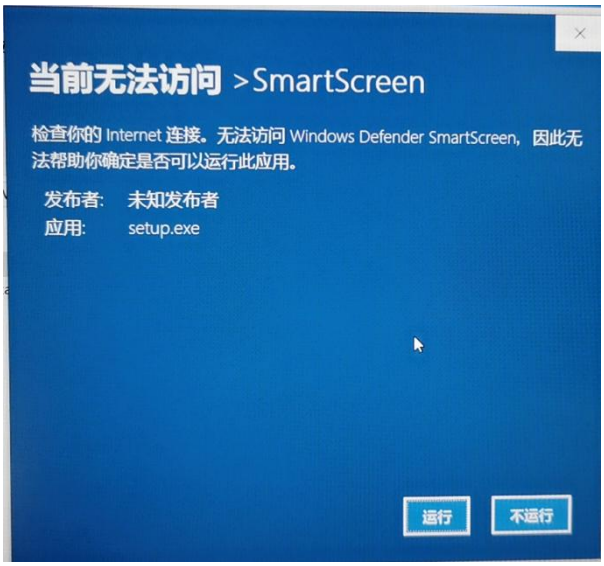
environment variables] or [The system environment variable length is greater than 1023 error during installation], you need to make a configuration according to [HPS-CF4000 environment variable configuration.txt] (Note: "..." is the selected installation directory).

- In checking the drivers, [USB3 Vision Digital Camera] is not found under [Machine Vision Digital Cameras], but [MER-XXXXXX] is found under [Universal Serial Bus Device]. This device driver cannot be uninstalled.

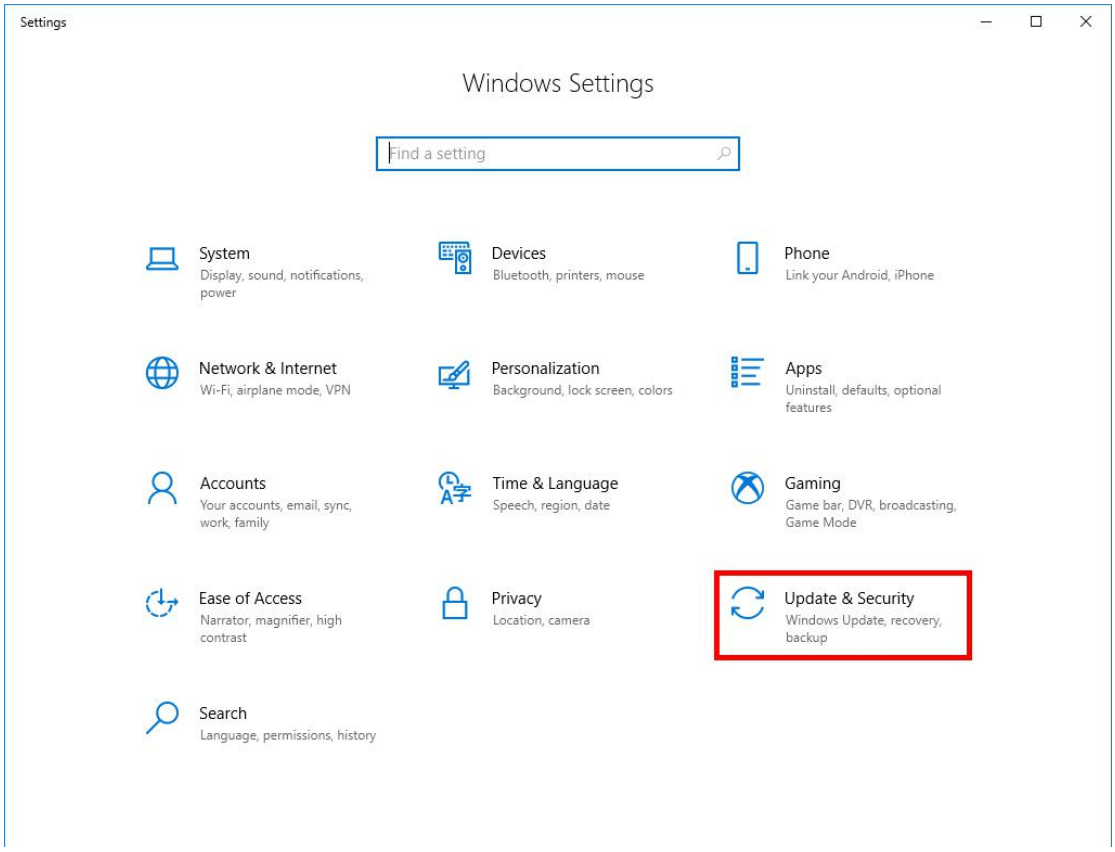
In the above situation, go to [Control Panel] => [System] => [Advanced System Settings] => [Device Installation Settings] => Select [No (Your device may not work properly) N] => [Save Changes]=>[Apply]=>[OK]. Then uninstall the driver, double-click on [...\HPS_Install\CF4xxx_BAT\CF4xxx_Drivers\camera_x64\HPSCF4xxxUpdateDriver.exe] to start installation and wait for the installation to be completed.

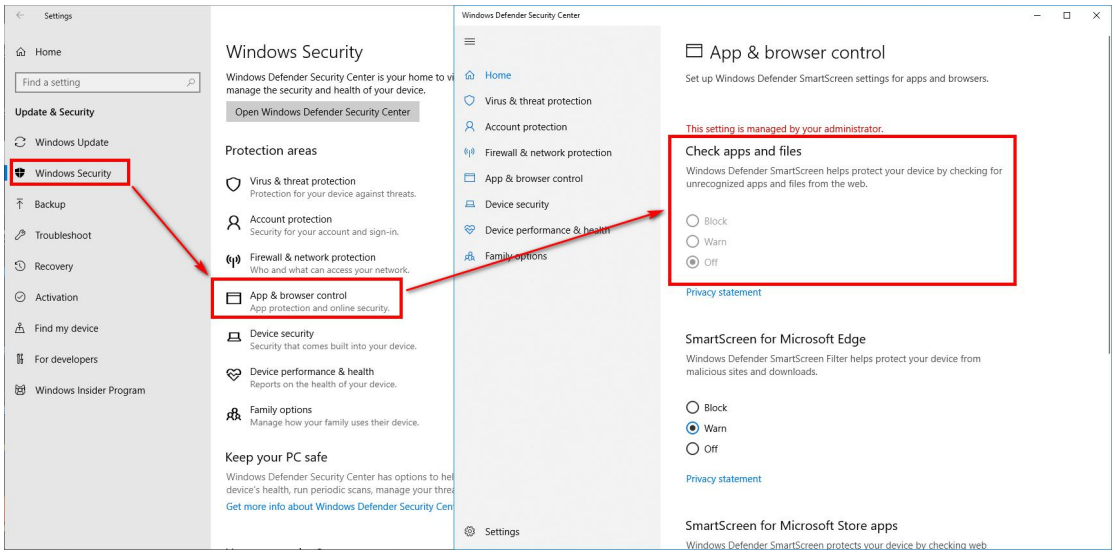


- In Windows 10, when you double-click on [Setup.exe], [Currently Unavailable>SmartScreen] pops up.



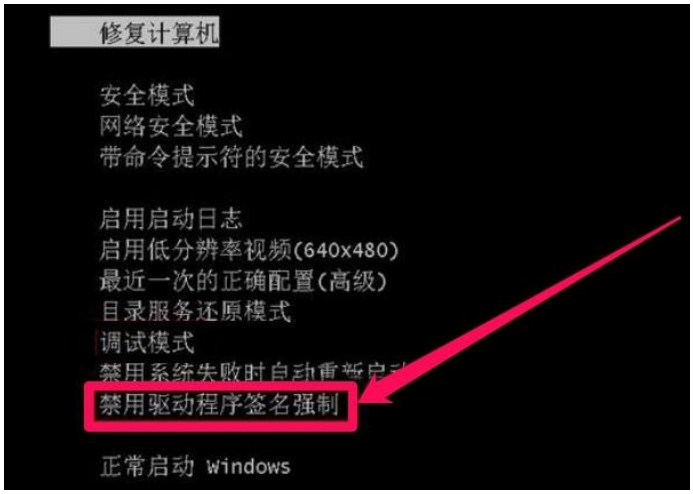
In the above situation, press the shortcut key [Win+i]=>[Windows Settings]=>[Update and Security]=>[Windows Security]=>[Application and Browser Control]=>[Check Apps and Files]= >Select [Warning] or [Close].

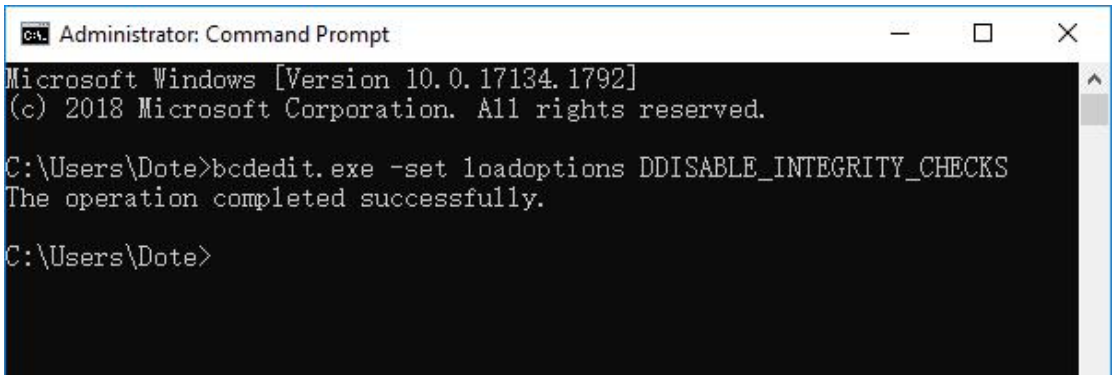




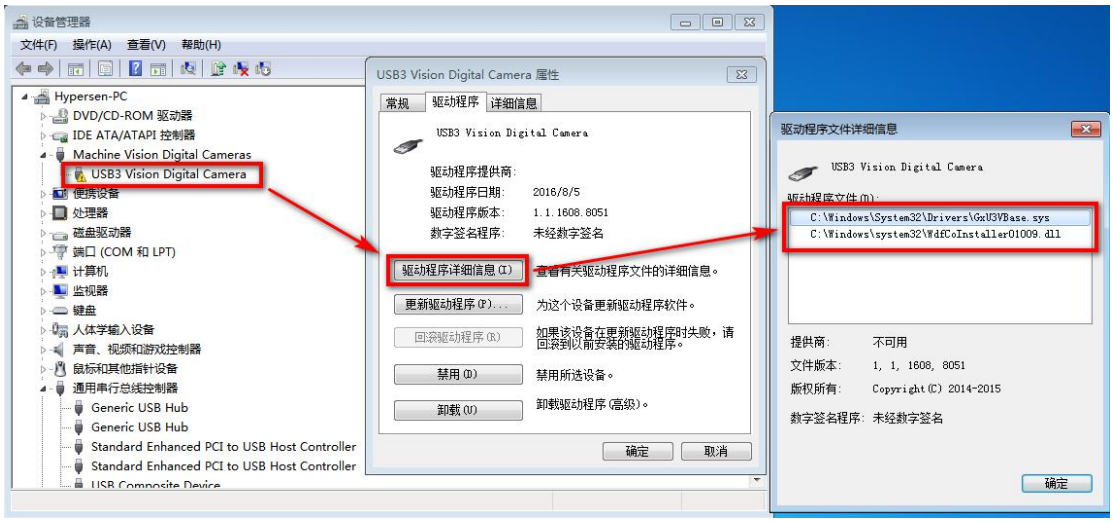
- For Windows7, after the software installation, a [Yellow Exclamation Point Mark] is seen before [USB3 Vision Digital Camera] when checking the driver. Reasons: The Windows 7 system driver requires a digital signature.

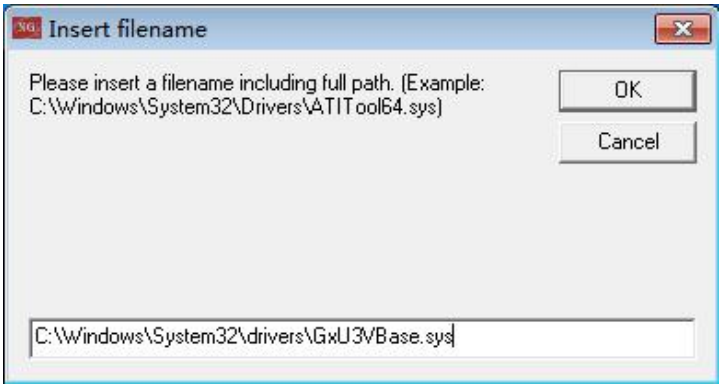
1. Restart the computer. Before entering the user interface, press [F8] in advance => Enter [Advanced Mode] => Select [Disable Driver Signature Enforcement] => Press [Enter]. This is a one-time solution. If you want to disable the digital signature for a long time, you need to follow [All Programs]=>[Accessories]=>[Command Prompt]=>Right-click, and run as the administrator=>Enter [bcdedit.exe -set loadoptions DDISABLE_INTEGRITY_CHECKS] command=>[Enter] and wait for the prompt [Operations completed successfully] => restart the computer.

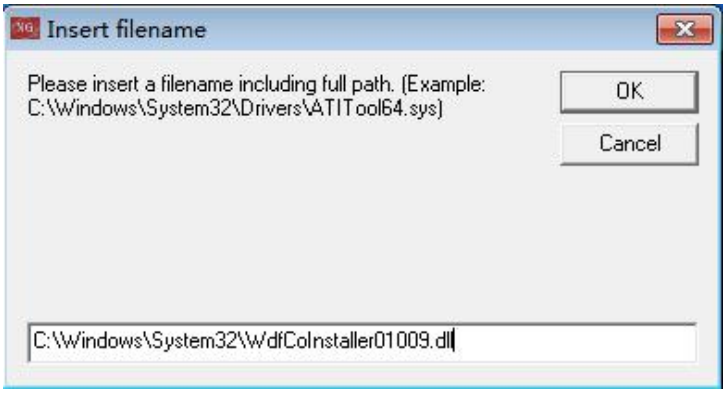


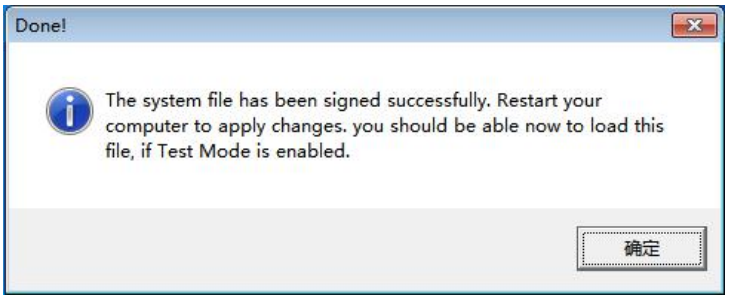


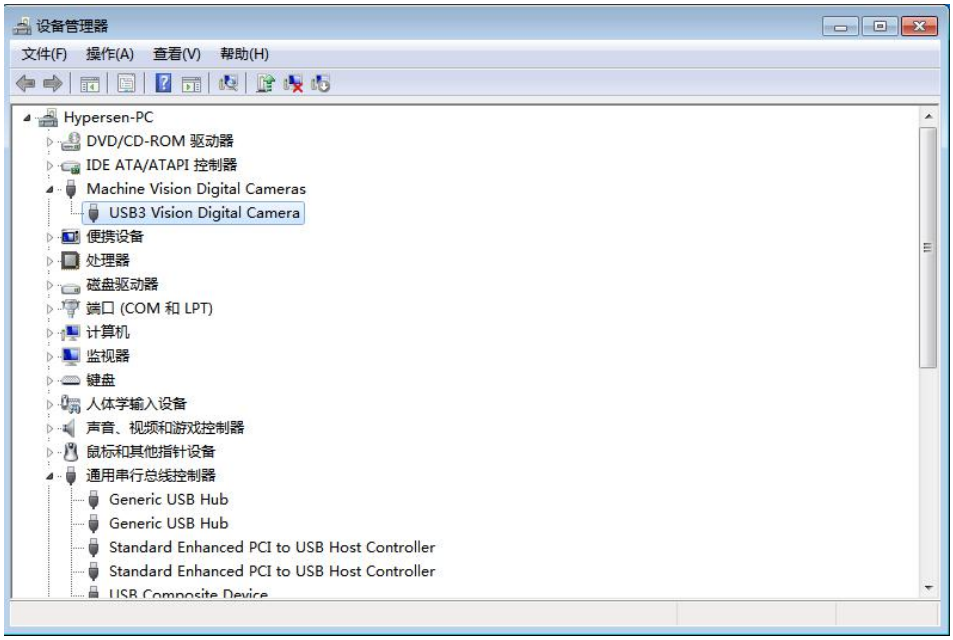
2. If the problem of the driver [Yellow Exclamation Mark] is still not resolved after Step 1, use the following method: ① Right-click on the device manager to view the [Attributes] of the driver => [Driver] => [Driver details]=>Record the two driver paths/find the corresponding files. ②Right-click to run [...\Win7 digital signature\dseo13b.exe] as the administrator=>[Next]=>[Yes]=>Select [Sign a System File]=>[Next]=>Enter the two paths recorded respectively=>[OK]=>[OK]=>Re-plug the USB3.0 cable.





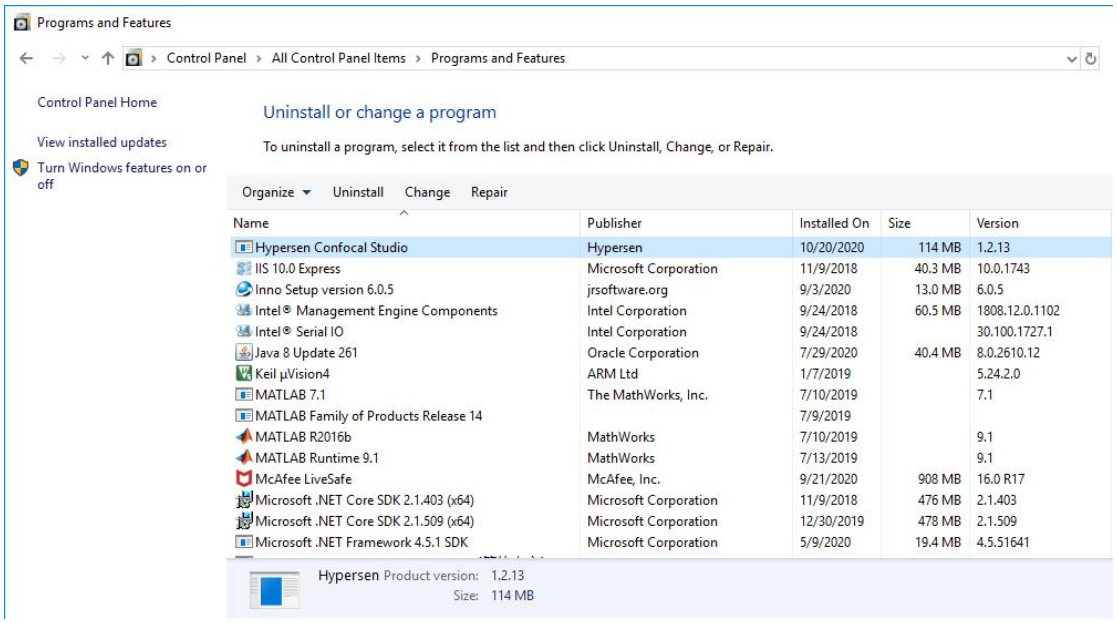

Insert filename
Please insert a filename including full path. (Example: C:\Windows\System32\Drivers\ATITool64.sys)
OK
Cancel
C:\Windows\System32\WdfCoInstaller01009.dll


Done!
The system file has been signed successfully. Restart your computer to apply changes. you should be able now to load this file, if Test Mode is enabled.
确定


设备管理器
文件(F) 操作(A) 查看(V) 帮助(H)
Hypersen-PC
DVD/CD-ROM 驱动器
IDE ATA/ATAPI 控制器
Machine Vision Digital Cameras
USB3 Vision Digital Camera
便携设备
处理器
磁盘驱动器
端口 (COM 和 LPT)
计算机
监视器
键盘
人体学输入设备
声音、视频和游戏控制器
鼠标和其他指针设备
通用串行总线控制器
Generic USB Hub
Generic USB Hub
Standard Enhanced PCI to USB Host Controller
Standard Enhanced PCI to USB Host Controller

1.4 Uninstall Hypersen Confocal Studio

1. Click [Programs and Functions] on the control panel to display the [Uninstall or Change Programs] interface.



2. Select Hypersen Confocal Studio and then click on [Uninstall]. If “you really want to uninstall [Hypersen Confocal Studio]” pops up, click on [Yes] and wait for uninstallation to be completed.

2. Basic operations

2.1 Procedure before measurement

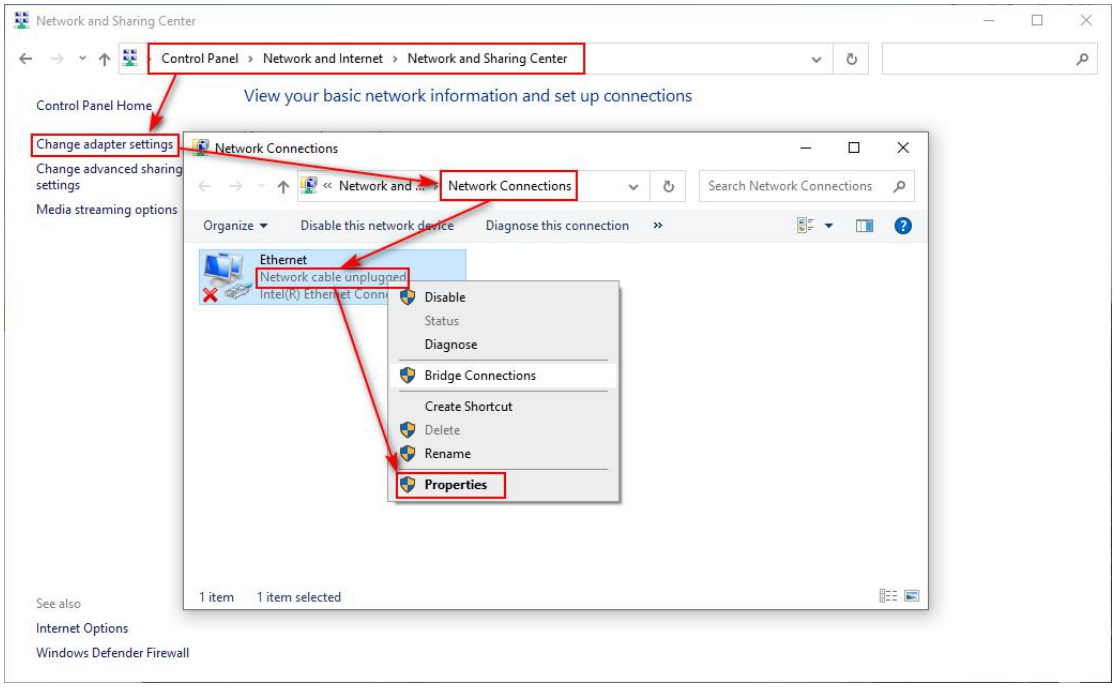
2.1.1 Preparations before measurement

- Install the software Hypersen Confocal Studio on the computer.
  Refer to [1.3 Install Hypersen Confocal Studio].

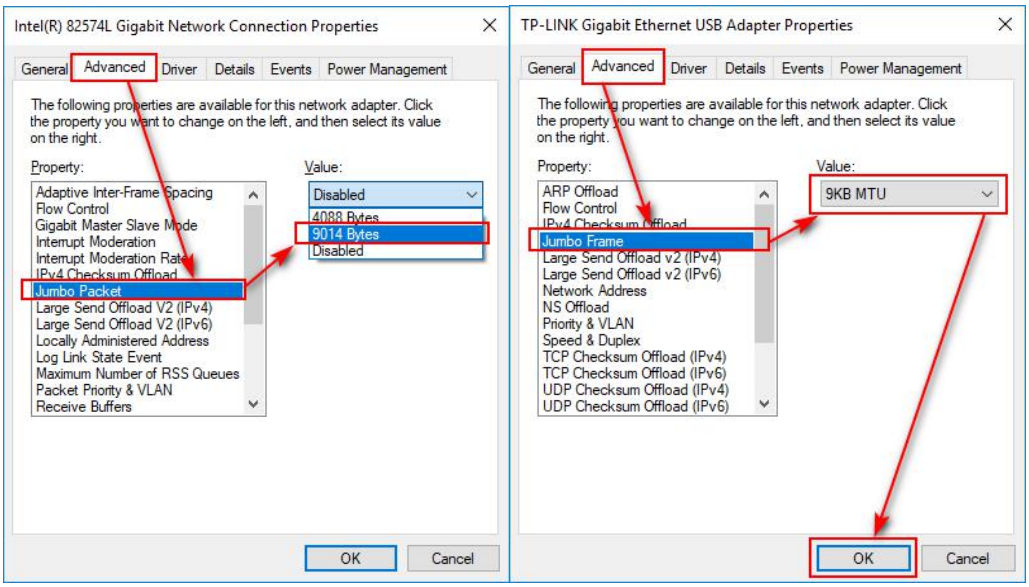
2.1.1.1 HPS-CF2000

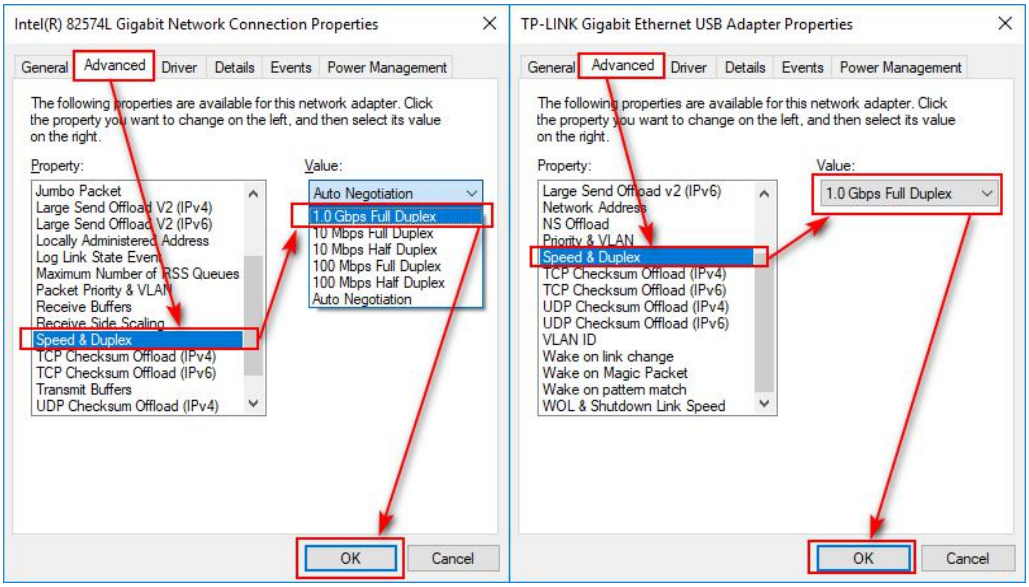
- Connect the controller and the sensor head with an optical fiber cable, connect the controller and the PC with a network cable, and finally connect the controller power supply with a three-hole power cable.
- The configuration of the Gigabit Ethernet network card is as follows: [Control Panel] => [Network Sharing Center] / [Network Connections] => Find the corresponding Ethernet card, check whether the network card is [Unidentified Network], right-click and select

[Properties].

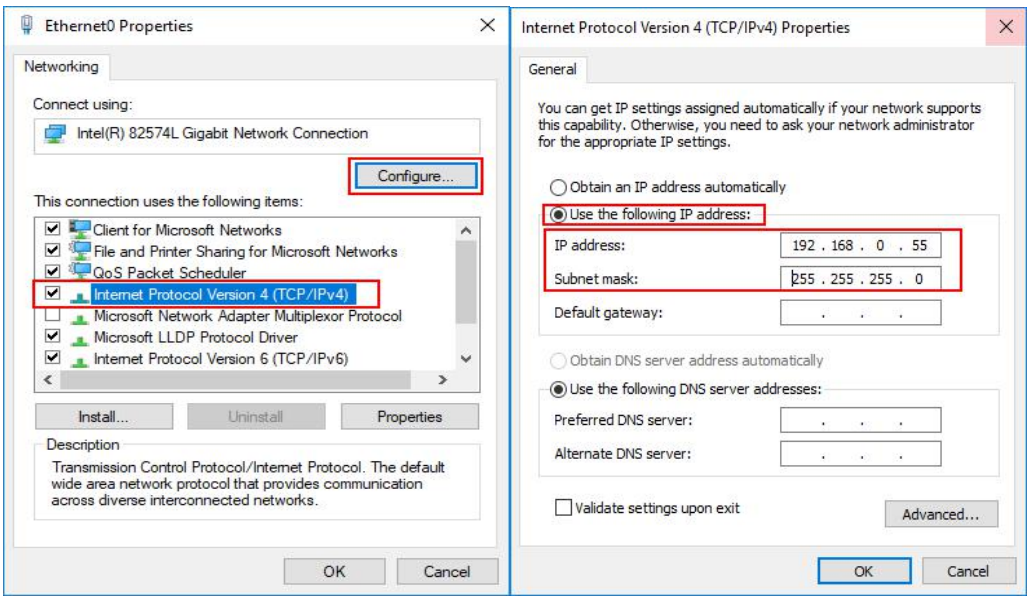


- Configure network card parameters: Click [Configuration] => select [Advanced] => find [Jumbo Frame/JumboFrame], select [9KBMTU] for the corresponding value => find [Speed&Duplex], and select [1.0Gbps Full Duplex] => Click [OK].





- Configure communication parameters: click [Internet Protocol Version 4 (TCP/IPv4)] => select [Use the following IP address], enter the IP address*[1] and subnet mask of the same network segment*[2] as the controller's IP address = >Click [OK].



* 1: The controller has two IPs for users to connect (default IP-unchangeable: 192.168.0.2; user-defined IP-changeable: 192.168.0.2).

* 2: The same network segment: It's the same network address by ADDING the IP address and subnet mask. To achieve that, the network ID must be the same. The calculation method of the network ID of various IPs is different, which needs to be judged according to the number of bits of the subnet mask.

The calculation method of the network identification is to AND each digit of the IP and the subnet mask, which is: 0 and 1 = 0, 0 and 0 = 0, 1 and 1 = 1.

Example: To And 192.168.0.2 (controller IP) & 255.255.255.0 (preset subnet mask), we need to convert to binary first and then AND each bit.

IP 11000000.10101000.00000000.00000010
Subnet mask 11111111.11111111.11111111.00000000
Get an AND result 11000000.10101000.00000000.00000000

Convert it to decimal 192.168.0.0, which is the network ID. Then, select an IP address as the IP of the network card provided that the IP address is different from that of the controller and conforms to the corresponding specifications, such as: 192.168.0.55. Then check if the PC has the same network as the controller according to ADD method.

2.1.1.2 HPS-CF4000

- Connect the controller and the sensor head with an optical fiber cable, connect the controller and the PC with a USB3.0 cable and finally connect the controller to the power supply with a three-hole power cable.
  Refer to [Install/Connect the Device] and [Communication Interface] in [User Manual for HPS-CF4000 Chromatic Confocal Displacement Sensor].

2.1.2 Setting the measurement conditions

- According to your needs, set the system settings, measurement methods and judgment output setting in accordance with [3. Measurement settings] under Hypersen Confocal Studio.
  Refer to [3.1 System settings], [3.2 Measurement modes], [3.3 Judgment output setting].

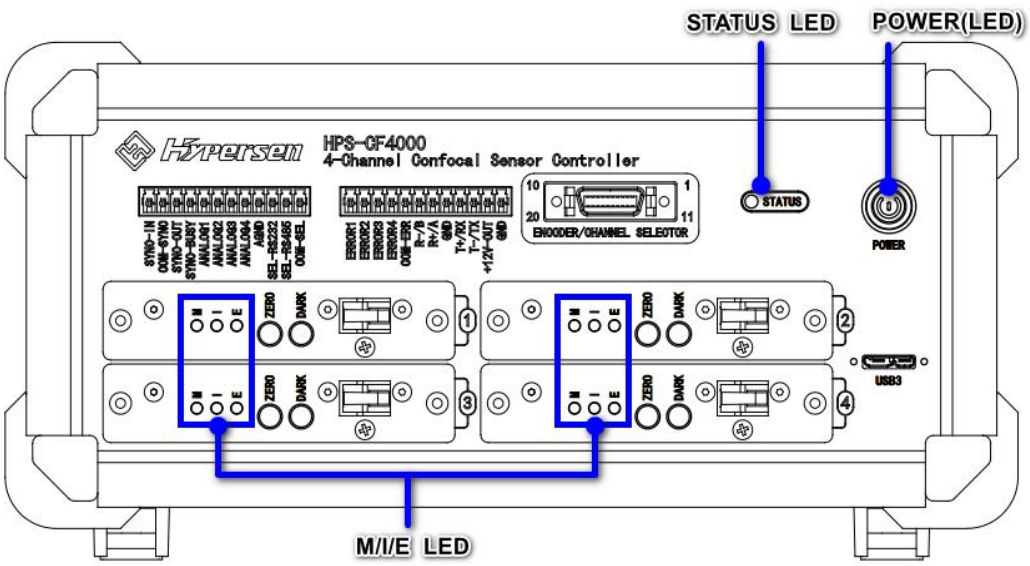
2.1.3 Display of measurement results

- Measurement results are displayed in Hypersen Confocal Studio according to the the contents of measurement settings.
  Refer to [2.3 Names and functions of the parts of the main interface].

2.2 Start and exit

2.2.1 Starter the controller

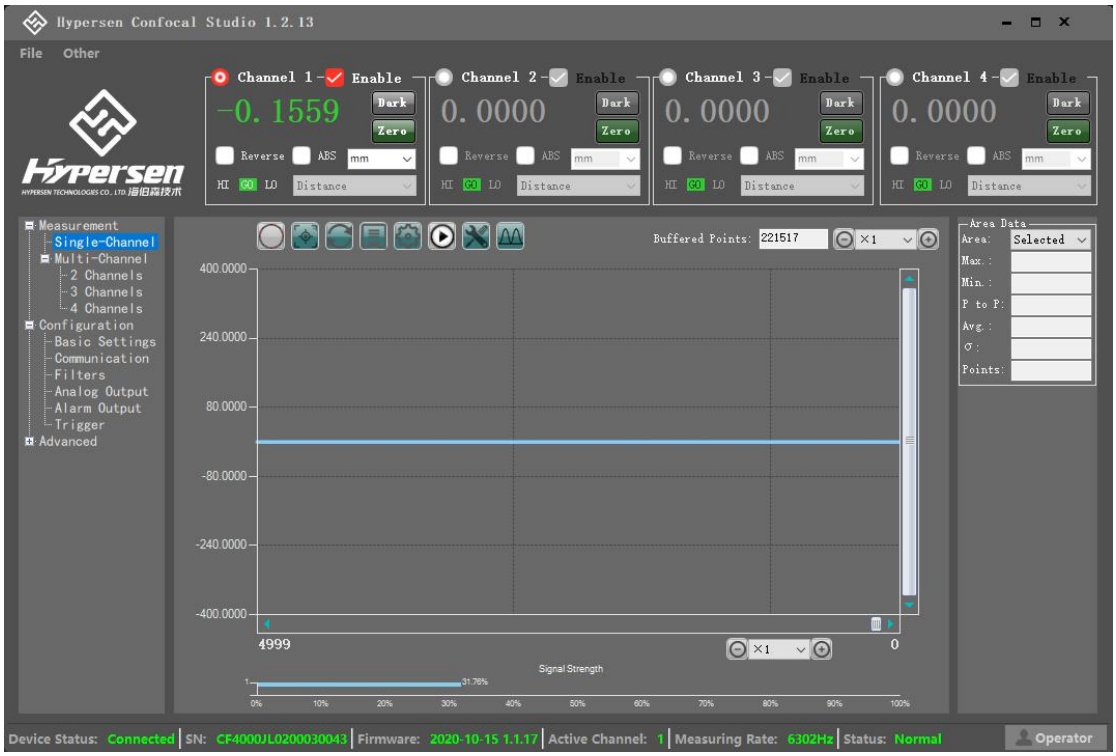
- Confirm that all devices are properly connected.
- Press the [POWER] button of the controller to turn it on and the POWER light will change to green.
  Normal startup: the system is initialized, the STATUS indicator (yellow light) on the panel blinks once every 0.3s, a total of 3 times, and the M, I, and E indicators (green lights) on each board blink together (each indicator blinks once every 0.3s). When the initialization is done, the STATUS indicator on the panel changes to yellow and the M, I, E indicators on each board go out.



2.2.2 Start Hypersen Confocal Studio

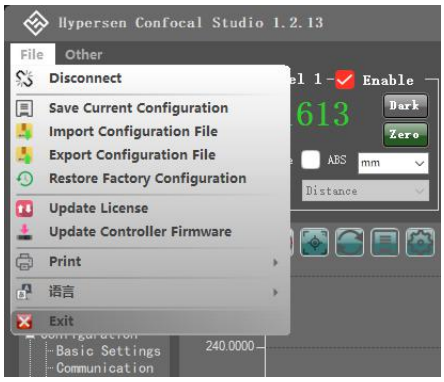
- In the Start menu of Windows, select [All Programs] => [Hypersen Confocal] => [ConfoCal] or double-click on the Hypersen Confocal Studio icon on the desktop.

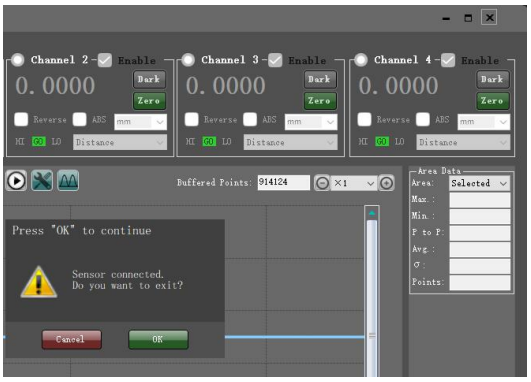
- Select the name of the connected device and connect it to the controller. When the connection is successfully done, the parameters of the controller are automatically loaded. Click on [Start] to run it after configuring [Measurement Mode]. (Take single channel and distance measurement mode as an example)



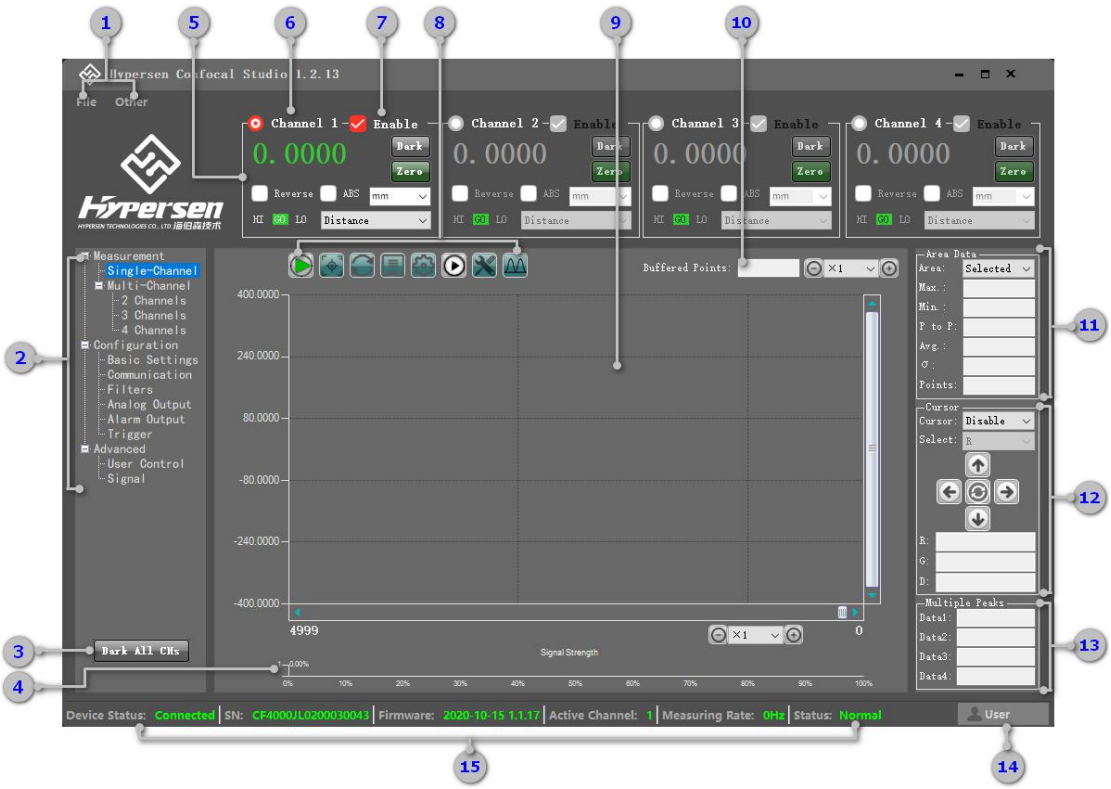
2.2.3 Exit from Hypersen Confocal Studio

- Select the [File] menu => [Exit].
- Close the main interface directly. If the controller is connected, a prompt box will pop up. Select [OK].





2.3 Names and functions of each part on the main interface



S/N	Name	Functions	Reference
1	Menu bar	Select the menus to conduct corresponding settings	2.3.1
2	Function menu	• Number of measurement channels • Choose various measurement configurations • Advanced configuration	2.3.2
3	Dark signal of all channels	Remove background noise	2.3.3
4	Signal strength display area of the designated channel	Signal strength of the current channel (0%-100%)	2.3.5
5	Measurement configuration for Channel 1	• Value and tolerance judgment result of the current measurement point • Dark signal of Dark channel 1 • Zeroing of the value of Channel 1 current measurement point • Flipping of the measured value and output of the absolute distance of the measurement point • Unit display and measurement mode	2.3.9
6	Select Channel 1 to display chart data button	Select a channel to display the trend chart and the signal strength	2.3.4
7	Channel 1 enabling/disabling	Whether or not Channel 1 is enabled	2.3.8

	button		
8	Waveform data processing button	• Start/stop the measurement • Waveform positioning and waveform clearing • Data saving/picture saving/real-time data recording • Chart parameters configuration • Level correction function • Calibration of refractive index	2.3.7
9	Trend chart display area of the designated channel	Show the change in the measured value with a trend chart	2.3.6
10	The cached number of total collected points	The total number of points shown in the trend chart	—
11	Statistics results in the area	• Select area/current window/all data • The maximum value/minimum value/peak-to-peak value/average value/standard deviation/number of valid points in the statistics of statistical data	2.3.10
12	Cursor display and data information	• Display the cursor of the number of X-axis points or the Y-axis values • Display the current value and absolute difference of the cursor	2.3.11
13	Display area of multi-peak function data	Display the distance value of the designated peak and the thickness value between the peaks	3.2.3
14	User mode switching	Operator/user/system administrator mode switching	2.3.12
15	Controller status/information bar	• Device connection status and device working status • The serial number and firmware version of the controller • The number of available/existing channels • Current measuring rate	2.3.13

2.3.1 Menu bar

2.3.1.1 File menu

Items	Contents	Reference
Disconnect	Disconnect from the controller	2.2.2
Save the current configuration	Save the current configuration of the controller	4.3.1
Import the configuration file	Re-import the previously exported configuration file to the controller	4.3.2
Export the configuration file	Export the current configuration of the controller	4.3.3
Restore the factory configuration	Restore the factory configuration of the controller	4.3.4
Update the license	License upgrading	4.4
Update the controller firmware	Controller firmware upgrading	4.5
Print pictures	Page setup/print preview/print	4.6
Language	Chinese/English switching	4.7
Exit	Exit from the Hypersen Confocal Studio software	2.2.3

2.3.1.2 Other menus

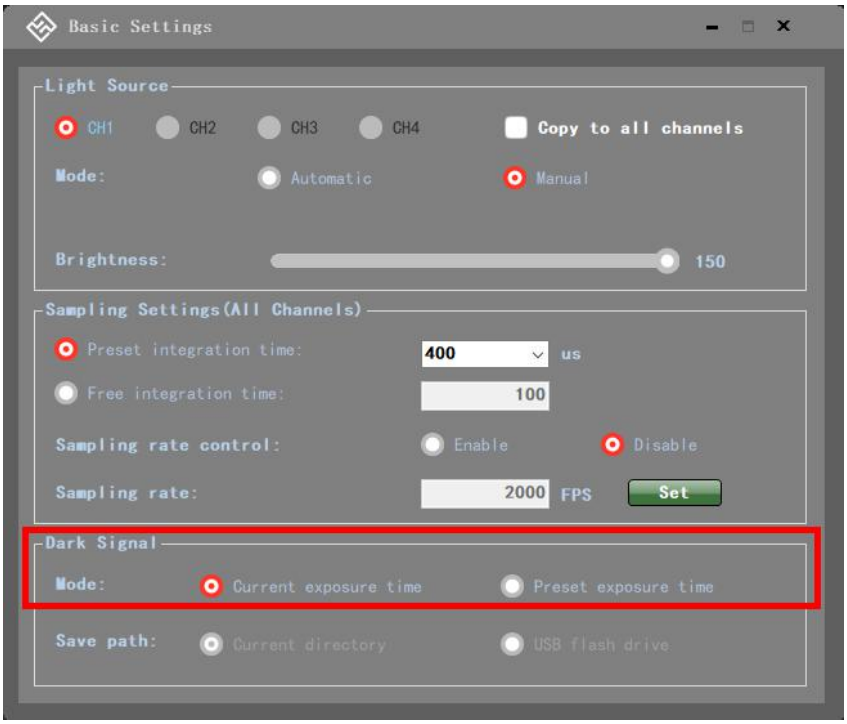
Items	Contents	Reference
Information	Information	4.8.1
Help	Helping document	4.8.2
About	Detailed information about the client software	4.8.3

2.3.2 Function menu

Items	Contents	Reference
Measurement	Single channel/multi-channel	3.2
Configuration	Basic settings	3.1.2.1 3.1.2.4 2.3.3
	Communication	4.1.1
	Filter	3.1.2.5
	Analogue output	3.3.3
	Alarm output (setting of program segment/ upper and lower limits of the tolerance)	3.3.1 3.3.2
	Trigger setting	4.1.2
Advanced configuration	User control	3.1.2.2 3.1.2.3 4.2 3.2.3 3.2.4
	Signal waveform	2.4

2.3.3 Dark signal

- The background dark signal of the chromatic confocal sensor head is generated by the reflection (noise) of the optical components inside the sensor. This signal must be deducted from the actual measurement.
- When the software is started, the background light file in the program directory/U disk will be automatically loaded. If a yellow warning is prompted During [Connect], “automatic Dark” is required. For example, [Cannot find U disk], [No background light file in the U disk], [No background light file in the program running directory].
- The background light is collected, but the user must repeat this operation regularly. (For details, refer to the document "How HPS-CF Chromatic Confocal Sensor Gets Dark Signals")
- In the main interface, the Dark button for all channels/designated channels is used to collect the background light of the channel. You can choose to save collected data to the corresponding directory. Open [Configuration] => [Basic Settings] => [Dark Signal] => Mode selection [Preset Integration Time].



2.3.4 Select a channel to display chart data

- Select the designated channel to display the chart data (including: waveform trend chart, signal intensity and multi-peak data display).

2.3.5 Signal strength display area

- Select the designated channel to display the real-time optical signal intensity of the channel during measurement.

2.3.6 Trend chart display area

- Show the changes in the measured value with a trend chart.
- The X axis represents the number of points measured (dependent on the measurement rate); the Y axis represents the measured value.
- The X-axis has a sliding window function, through which you can view the previous historical measured values in real time (the maximum cached data is 1,000,000).

Operations with the mouse	Functions
Left-click	Press the Click position to enlarge the X axis and the Y axis, with the value×2
Hold the left button, drag to the left/right and then release it	You can select a value area

Right-click	• If an area is currently being selected, the selection of the area is canceled • If no area is being selected, the previous operation in the chart is undone

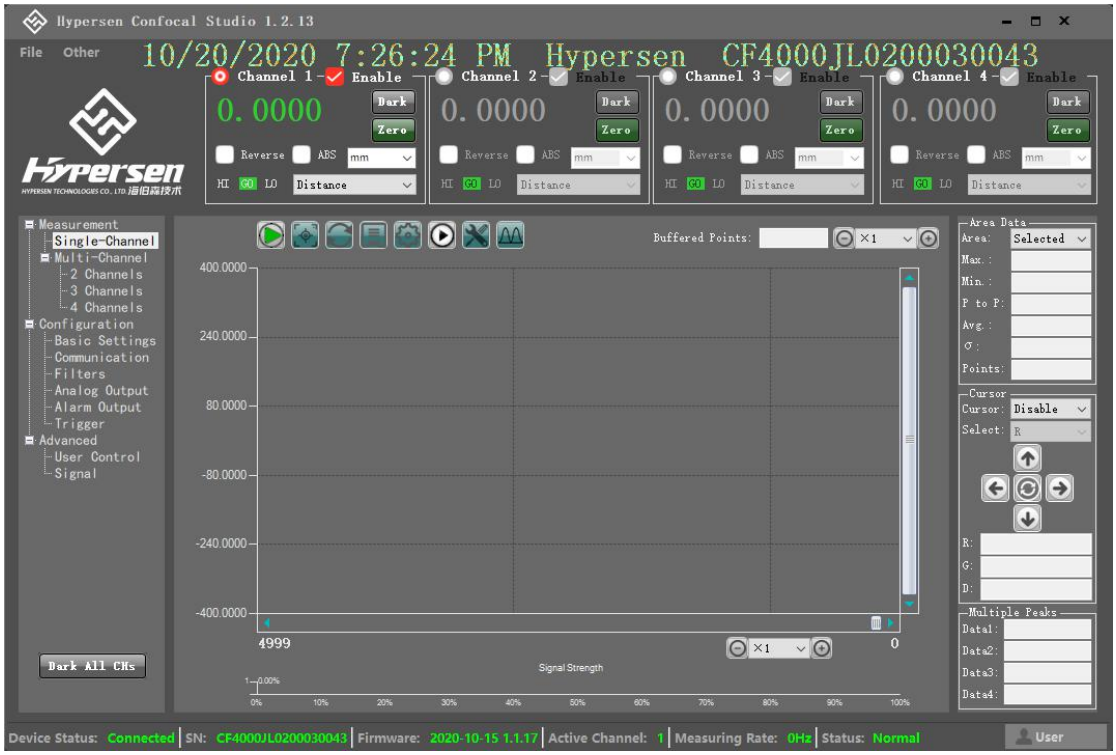
2.3.7 Waveform data processing button

Items	Contents	Reference
Start/stop the measurement	After turning on, the sensor starts to collect data and the display area data is updated	—
Automatic positioning of trend chart waveform	Positioning according to the data in the current window and the move the waveform to the center of the Y axis	—
Refresh/clear trend charts	Clear the display area data of the current trend chart	—
Save	• Save pictures • Save data (Save with measurement stopped) Select an area Current window All data	2.3.7.1
Chart setting	• X-axis sliding window/Y-axis, scroll dimension (speed) • Dimension of cursor movement (speed) • X-axis scale-up mode (fixed in the middle/on the right (default))	2.3.7.2
Real-time data recording	• Record measurement time/measured value/signal intensity • Pay attention to the measurement rate during measurement to avoid too large recording files	2.3.7.3
Level correction of single channel/ Dual-channel calibration	• Valid under single channel and dual-channel • Single channel: Level correction function (select two points as the baseline for correction) • Dual-channel: the calibration function of double-head thickness measurement	3.2.1.3 3.2.5.1
Calibration of the refractive index of a single channel/ Peak selection of dual-channel thickness measurement	• Valid under single channel and dual-channel • Single channel: Calibration of the refractive index (for transparent objects) • Dual-channel: peak selection of double-head thickness measurement (Select the designated peak of the channel to be included in the calculation of the results of Double-head thickness measurement)	3.2.4 3.2.5.2

Scale down	Scaled down by 2 times in the X-axis/Y-axis directions of the trend chart	—
Scale up	Scaled up by 2 times in the X-axis/Y-axis directions of the trend chart (the X axis has mode configuration)	—
×1 Scale up/down	Scaled up/down in the X-axis/Y-axis directions of the trend chart	—

2.3.7.1 Save

- Screenshot taking of PC software, mostly used to save images scanned by the encoder (in bmp and png format).



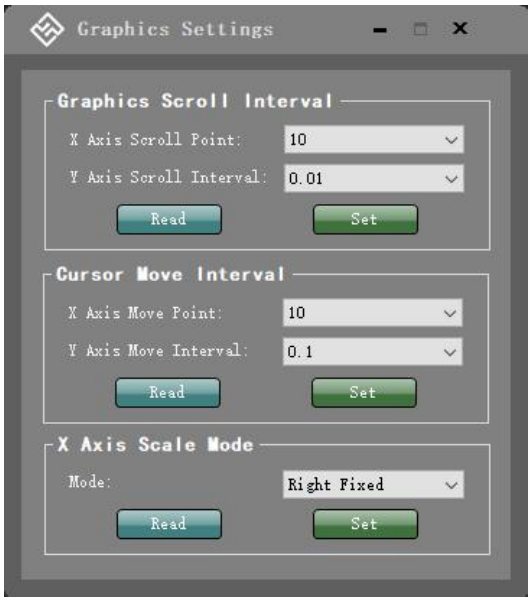
- Data saving (only available when measurement is stopped), mostly used to save data scanned by the encoder (selected area/current window/all data). The file is saved in the CSV format, and saved data include measured values.

Troubleshooting:

- Before using the function of saving pictures, check whether the scaling ratio of the PC is [100%]. If not [100%], there may be errors occur in screenshots.

2.3.7.2 Chart setting

- X-axis sliding window/Y-axis, scroll dimension (speed).
- Dimension of cursor movement (speed).
- Mode of X-axis scale up: scale up when it is fixed in the middle and on the right. By default, scale up when it is fixed on the right.



2.3.7.3 Real-time data recording

- Open the real-time data recording, select the file directory and name a file, and start data recording. The file is saved in the CSV format, and saved data include time, signal intensity and measured value.

Troubleshooting:

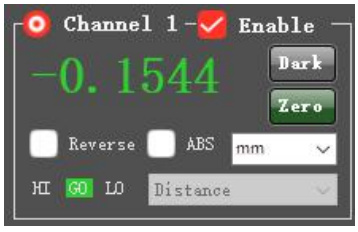
- Due to the high sampling frequency and too many data recorded in real time, the CSV file may be too large to be opened in Excel.

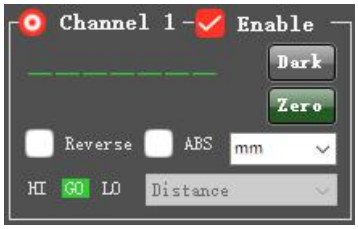
2.3.8 Channel enabling/disabling button

- For existing channels, you can choose to enable/disable the channels. Channels that are not needed can be disabled to increase the measurement rate.
- Disabled channel: if the channel is currently selected for data display, it will automatically search for the next enabled channel (if not found, it will be retained).
- Enabled channel: if only this channel is currently enabled, this channel will be automatically selected for data display.

2.3.9 Configuration and display of channel measurement

- Measured value display area and tolerance judgment result

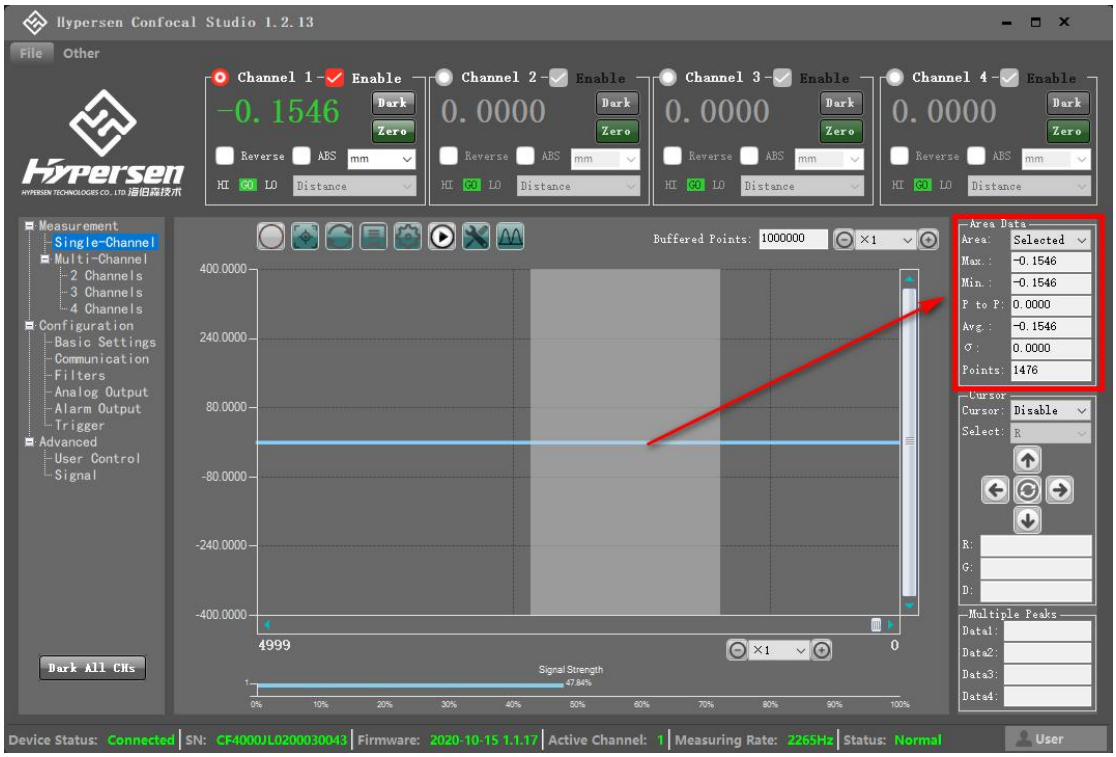
Display area	Contents
	When the measured value is within the tolerance range, measurement results will be displayed, and the [GO] of the tolerance judgment result goes on in green.
 	Take setting of the program segment to be 1, the tolerance upper limit 1mm, and the tolerance lower limit -1mm as an example. When the measured value is outside the tolerance range, the measurement results will be displayed, and the [HI] and [LO] of the tolerance judgment result goes on in red.

	When measurement is not possible/out of measurement range, measurement result is displayed as "-------." The result of the tolerance judgment remains to be the state before the measurement is impossible.

- Zeroing of measured value
  Reset the current measured value to zero, which is only valid when [ABS] is not checked.
- Flip the measured value and output the absolute distance of the measurement point
  Only used in a single channel.
  Check [Flip] to flip the measured value (usually used under the encoder).
  Check [ABS] to output the measured value as an absolute distance ([Zero] is disabled).
- Unit display: you can select the unit from [mm], [um] and [$\times 10^{-3}$in].
- Measurement mode: to change the measuring mode, you need to [Stop Measurement].
  Single-channel: distance mode and thickness mode.
  Dual-channel: thickness mode.
  Three-channel: warpage mode and flatness mode.
  Four-channel: average height mode.

2.3.10 Statistical results of the data area

- Data statistics (you can take statistics of the selected area/current window/all data)
- Statistical data: the maximum value/minimum value/peak-to-peak value/average value/standard deviation/number of points in the statistics

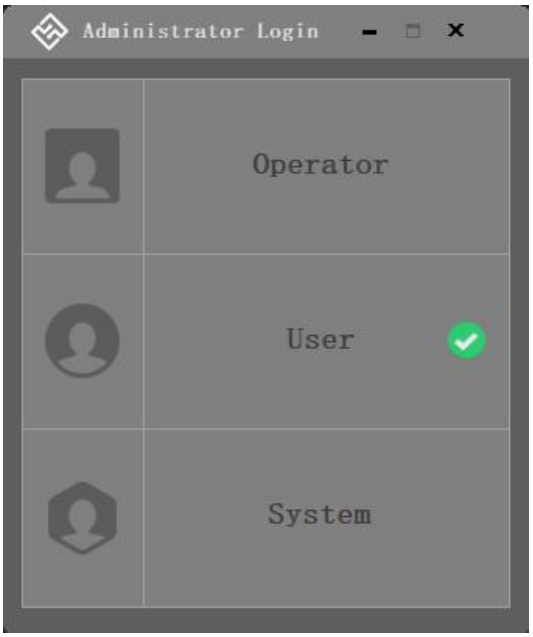


2.3.11 Cursor display

- Cursor display: disable/X axis (point)/Y axis (value)
- Selection control: cursor controlled by direction (R/G/R&G)
- Direction displacement and reset function (reset the cursor to both ends of the center of the window)
- Display of the red line value, green line value and the difference between the red and green lines.
- It is mostly used in curved surface measurement. It can measure the value and difference of two designated points; taking vibration test as an example, you can view the difference between any peaks in real time.

2.3.12 User mode switching

- User mode switching, including [Operator], [User] and [Administrator] modes. The default is the [Operator] mode. To enable more functions, enter the [User] mode. [User] mode requires the password [Hypersen]. All functions in this manual are operated in the [User] mode.



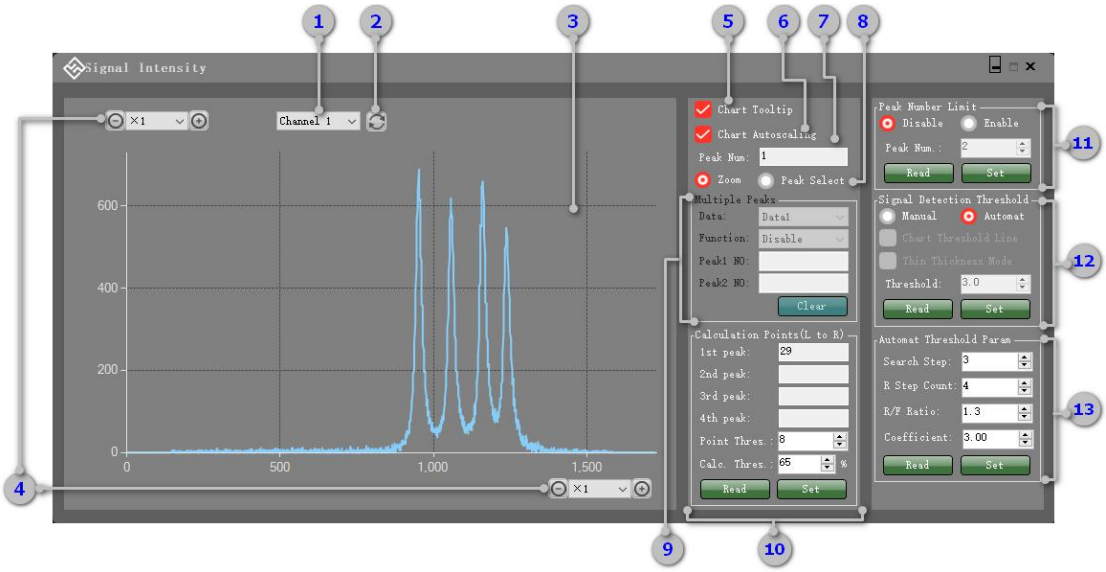
2.3.13 Information bar

- Device connection status: [Not connected] and [Connected].
- Serial number of controller: [CFxxxxJLxxxxxxxxxx] and [Unknown].
- Version of controller firmware: [20xx-xx-xx x.x.x] and [unknown].
- The number of available/existing channels for the current controller.
- The measurement rate of the current sensor (all channels).
- Device status: [Normal], [Abnormal Fan], [Abnormal Temperature] and [Abnormal Fan/Temperature].

Troubleshooting:

- When [Abnormal Fan], [Abnormal Temperature] and [Abnormal Fan/Temperature] showing the device status blink in red, stop the measurement and check whether or not the fan of the controller is operating.
- Check whether or not the measurement rate of a single channel is 6.3kHz.
  1. Disable the remaining channels' [Enable] of the controller, leaving only a single channel.
  2. In [Function Menu] => [Configuration] => [Basic Settings], set the integration time of [Sampling Settings (All Channels)] to be around [100us].

2.4 Names and functions of the parts of the signal interface



S/N	Name	Functions	Reference
1	Channel selection	Select any channel for viewing and setting	—
2	Reset/refresh	Reset the scaling ratio of the X-axis and the Y-axis/refresh the waveform chart	—
3	Signal waveform chart	• Reflect the current signal status of the object under test with a waveform chart • Effects of clicking with the mouse Scaling mode: left-click to scale up the	3.2.3

		clicked position by 2 times Click to restore the previous operations in the waveform chart Peak selection: left-Click to select a peak Right-click to cancel all peaks selected for the data	
4	Scaling button/scale of the X-axis and the Y-axis	Scaling is to scale up/down by 2 times/corresponding scale centered on the corresponding axis	—
5	Chart tool prompting button	When enabled, it will prompt the corresponding information when the mouse is moved above the waveform chart	—
6	Automatic chart scaling button	When it is enabled, the waveform chart will be automatically adjusted to a suitable angle of view according to the signal size	—
7	Number of spots	The number of light spots currently detected is related to [Distance Output Mode] and [Threshold Size]	3.1.2.2 3.1.2.3
8	Waveform Chart Clicking mode	Operating modes performed by left-/right-clicking on the waveform chart • Scaling mode (default) • Peak selection mode (used in case of multiple peaks)	—
9	Multi-peak selection	Used for the multi-peak situation in the single channel mode	3.2.3
10	Participate in calculating points	• Points occupied by each crest • Calculate points threshold • Proportion of peak participation in calculation	—
11	Limit on the number of crests	Enable: Enter the minimum number of detected peaks.	3.1.2.3
12	Setting of signal detection threshold	Related to multi-peak detection	3.1.2.3
13	Automatic signal threshold detection parameters	It is suitable for automatic threshold detection mode, and the corresponding peak can be detected by configuring appropriate parameters. The default parameters are suitable for most scenarios.	3.1.2.3

III. Measurement settings

This controller can use up to 4 sensor heads for simultaneous measurement. In addition, each sensor head can be individually configured with different measurement modes to perform measurements at the same time.

3.1 System settings

3.1.1 Configuration of sensor heads

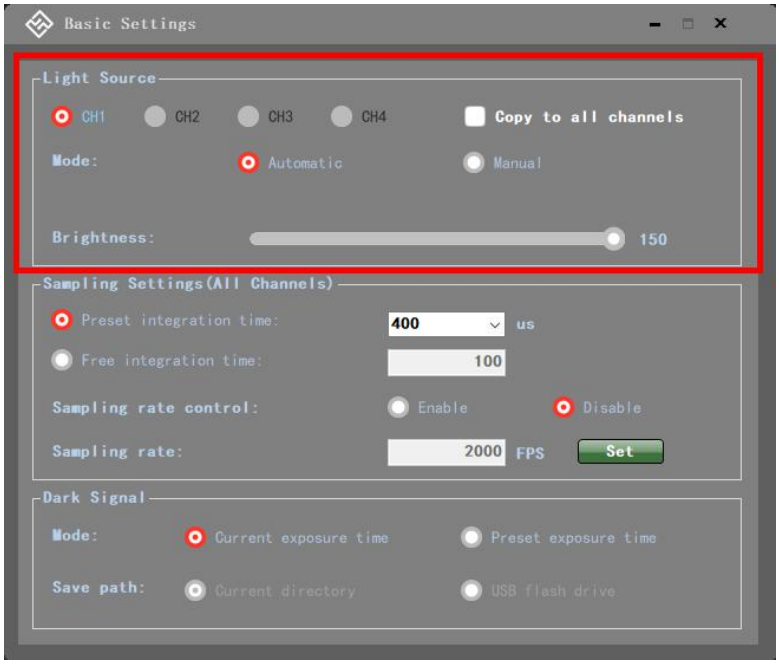
- Check whether or not the QR code serial number on the fiber optic cable of the sensor head is the same as that of the optical fiber board on the controller.
- After the controller is connected, you can configure enabled/disabled channels. Refer to [2.3.8 Channel enabling/disabling button].

3.1.2 Sampling settings

- Sampling refers to getting the photosensitive waveform and measuring the distance to the measured object.

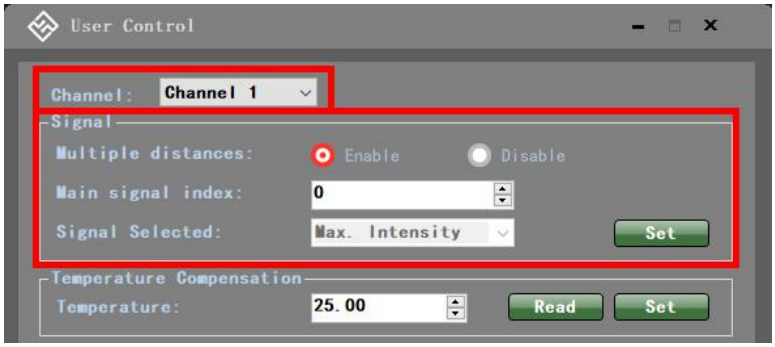
3.1.2.1 Adjustment of light source

- Set the optical signal intensity of the designated channel and adjust the light source mode: automatic adjustment and manual adjustment. Set it in [Function Menu]=>[Configuration]=>[Basic Settings]=>[Light Source].
- Manual adjustment: the intensity of the optical signal is dependent on the measured object. When the signal intensity is adjusted to be around 50%, the optimal measurement state can be achieved, which can be viewed in [Main Interface] => [Signal Intensity Display Area of the Designated Channel]. Affected by the material of the object, the signal intensity of some measuring surfaces may be low; however, as long as the signal intensity is higher than 20%, a correct measurement can be made.
- Automatic adjustment: automatically find the appropriate light intensity value. It can be enabled when the detection surface is changeable.
- Select the designated channel for mode configuration and check [Copy to All Channels]. The signal adjustment mode of all channels will be the same as that of the designated channel.



3.1.2.2 Distance output modes

- In the case of multi-peak measurement, it is necessary to set the distance output mode of the designated channel: single distance mode and multi-distance mode. In [Function Menu] => [Advanced Settings] => [User Control] => Select [Channel], and Set [Signal]. [Enable] multi-distance output is to enable the multi-distance mode, otherwise, it enables the single-distance mode.
- In the single distance mode, you can select the distance under the peak of the maximum signal intensity, the distance under the nearest peak, and the distance under the farthest peak.
- In the multi-distance mode, the peak index can be designated as the main signal output (in the case of multiple peaks, you need to select a suitable threshold to detect multiple peaks. Refer to 3.1.2.3 Setting of signal detection threshold). The main signal will be used as the analog output reference and the filter object of the filter.



3.1.2.3 Setting of signal detection threshold

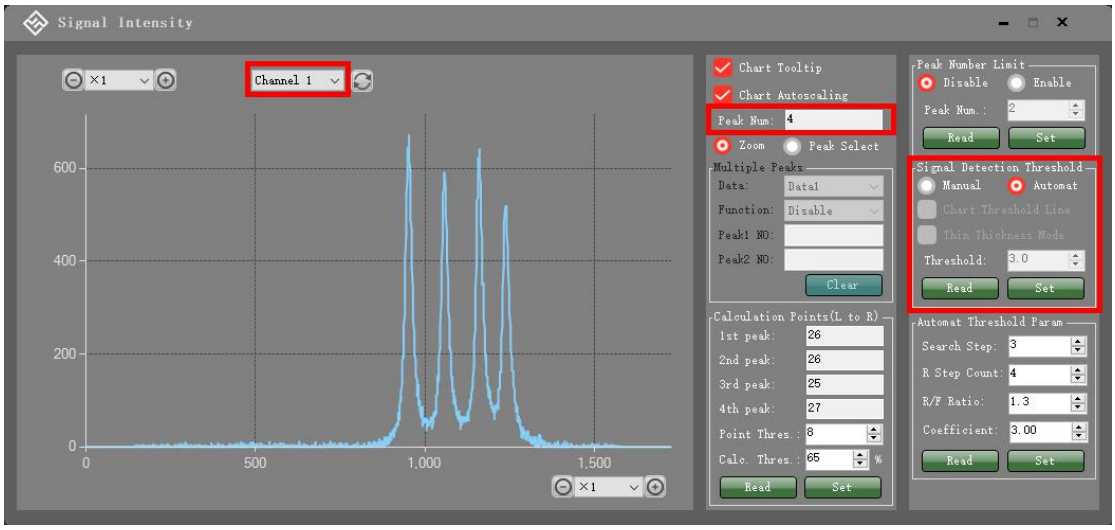
- For any distance output mode, the detection threshold needs to be set. The detection threshold mode can be selected to be: automatic detection and manual detection. [Function

Menu] => [Advanced Settings] => [Signal Waveform] => Select [Channel]. In [Signal Threshold Detection], select [Automatic detection], use default detection parameters, and click on [Set].

- In the automatic detection mode, enable or disable the corresponding number of peaks for searching. If the number of peaks to be detected is enabled, the specified number of peaks may not be found.

  1. The number of peaks detected by the current sensor head is less than the number of peaks found.
  2. The loud background noise of the detected object causes peak misjudgment and other problems.

- In the manual detection mode, you need to enter the corresponding threshold.Setting of peaks and thresholds. Check [Chart Threshold Line] for easy viewing, and go to [Number of Peaks] to view the number of detected peaks of the current object. Check [Ultra-thin glass detection mode] to detect ultra-thin transparent objects (applicable to 2 crests can be seen on the waveform graph, but no 2 crests can be detected after setting the threshold).

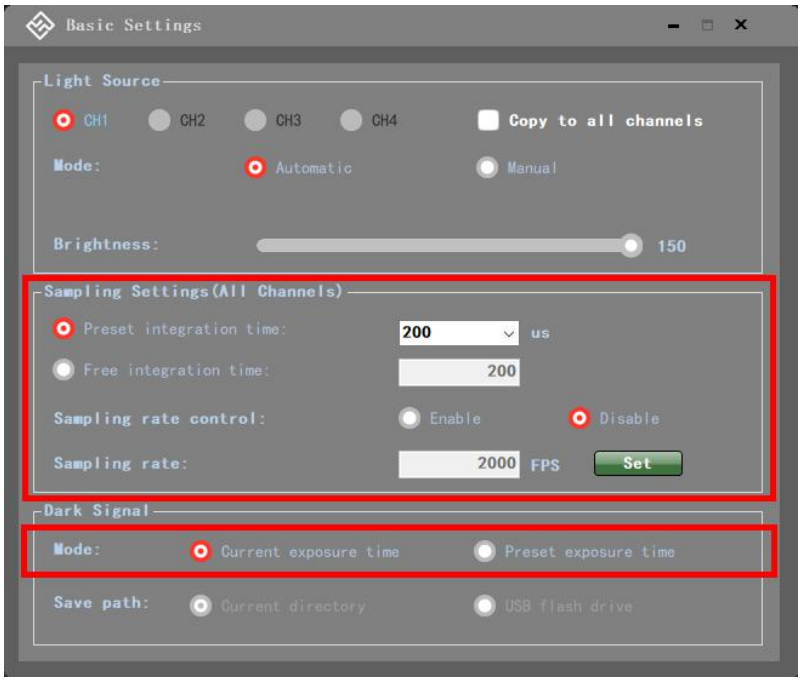


3.1.2.4 Setting of integration time and measurement rate

- In order to achieve measurement stability, a reasonable integration time needs to be set. The set integration time is dependent on the measured object. A higher integration time can be selected for measuring black objects, but a high integration time will reduce the measurement rate. Configure in [Function Menu] => [Configuration] => [Basic Settings] => [Sampling Settings (All Channels)].
- You can choose a preset integration time or self-define an integration time.
- Preset integration time: If the preset integration time has been [Dark] before, re-[Dark] is not required.
- Self-defined integration time: re-[Dark] is required. In [Function Menu] => [Configuration] => [Basic Settings] => [Mode] of [Dark Signal], select [Current Integration Time] and then proceed to [Dark].
- Setting of the measurement rate. If the measurement rate configuration is disabled, use the maximum sampling measurement rate of the controller as the current measurement rate; if the measurement rate configuration is enabled, enter an appropriate measurement rate.

The measurement rate is dependent on the integration time. A high integration time will reduce the measurement rate, and the input measurement rate may not be reached.

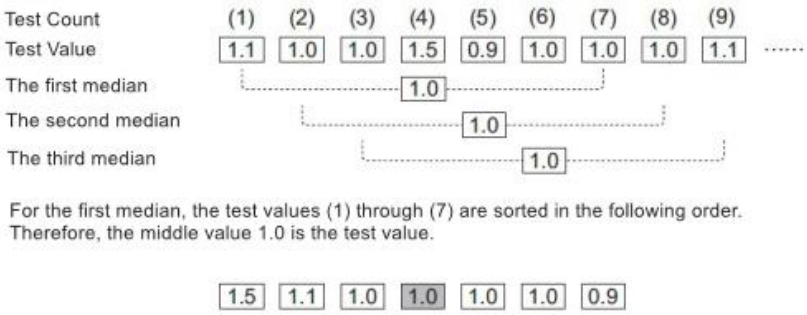
- Measurement rate. If the trigger mode is set to be [Timing Trigger/Encoder trigger/Extern trigger] in the [Trigger Setting], it will be sampled synchronously with [Timing trigger pulse/encoder pulse/external trigger pulse of Controller].



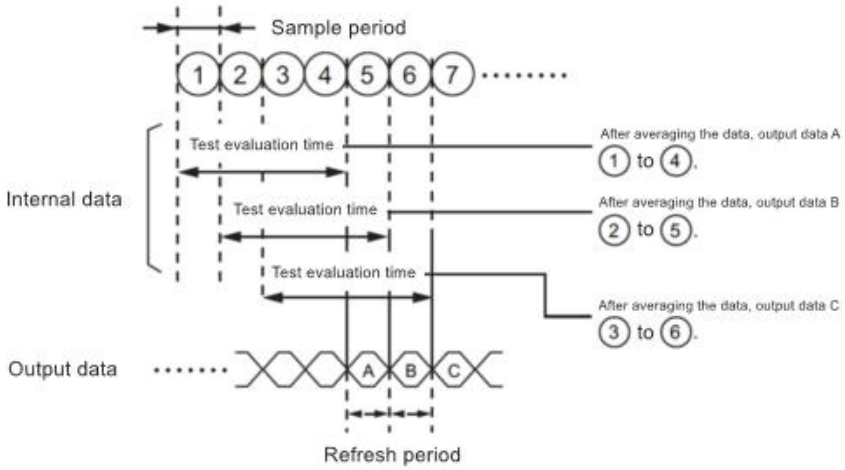
3.1.2.5 Filter setting

- The filter has moving median filtering, moving average filtering, Kalman filtering and abnormal data filtering. Select the designated channel for configuration. Configure in [Function Menu] = >[Configuration] = >[Filter].
- The filter setting is dependent on the trigger mode. In the [Internal trigger] mode, the filter can be configured; in the [Encoder trigger] mode, the median and average filters need to be closed; in the [Extern trigger] and [Timing trigger] modes, it depends.
- Moving median filter: This function uses a median filter of 7, 15 or 31 data records to prevent detection fluctuations by ignoring sudden changes in the detection value. This function is useful when the target is moving quickly.

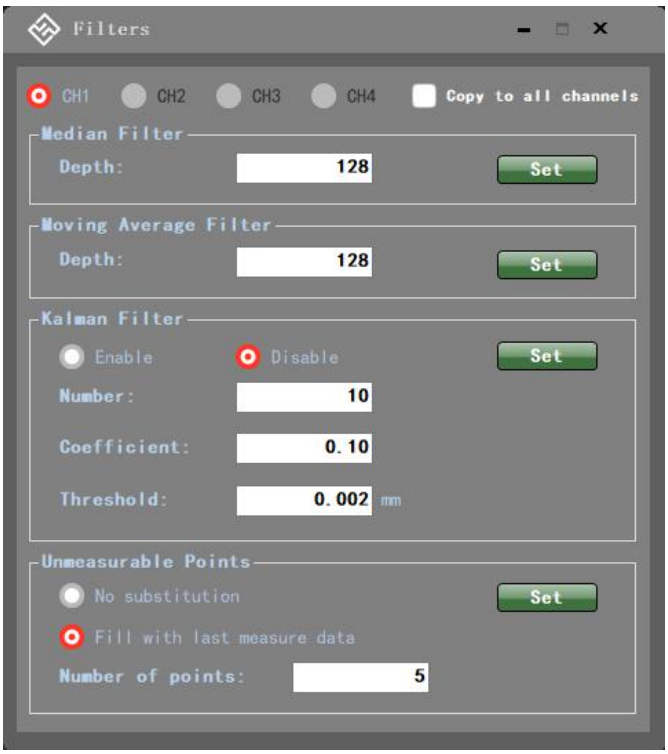
For example, when the median filter of 7 data results is used: The seven detection results are arranged in a numerical magnitude order, and the middle value is taken as the output of the detection values.



- Moving average filter: The average filter calculates the moving average of the detection values in the range of 1 to 4096 times. The following is an example of processing where the number of average detection times is set to be four.



- Kalman filter: the number of points involved in filtering, the Kalman coefficient K and the detection threshold can be configured.
- Abnormal data filter: if [Not replace] is selected, it is not enabled; if [Fill with the last measured data] is selected, it is enabled. Fill the abnormal data with the last measured data and the number of points where abnormal data is allowed can be configured.



3.2 Measurement modes

- There are 6 measurement modes.
- Measurement mode:

  Single channel: distance mode and thickness mode.

Dual-channel: thickness mode.
Three-channel: warp mode and flatness mode.
Four-channel: mean height mode.

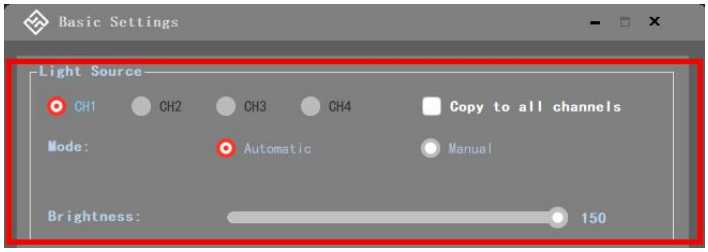
3.2.1 Distance mode

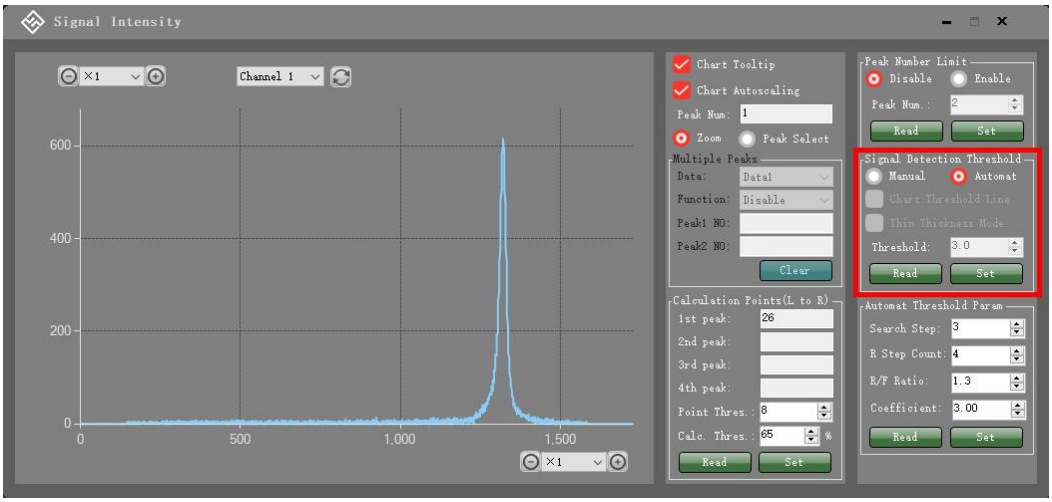
- The number of sensor heads required: at least one.
- To measure the height, displacement, positioning, vibration, bending, shape, etc. of an object (non-transparent object/transparent object), select [Function Menu] => [Single Channel] => Select the channel to be observed => Under this channel, select the measurement mode [Distance].

3.2.1.1 Measurement of the distance of non-transparent objects

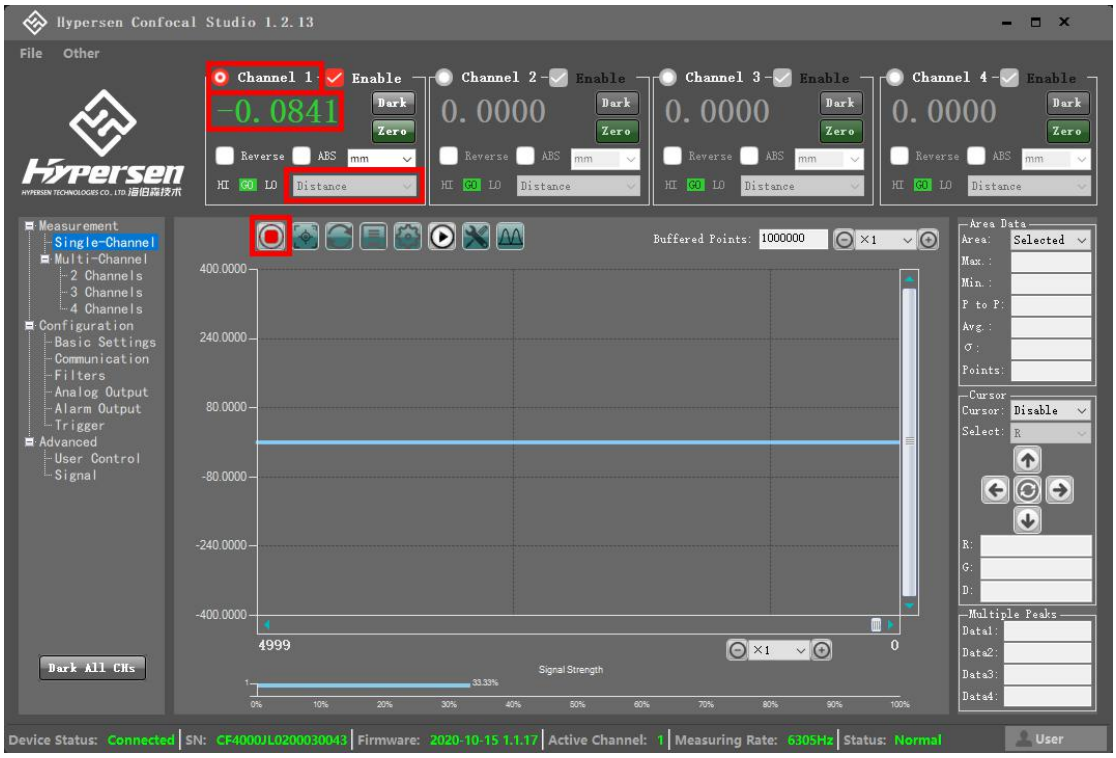
- Step 1: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].

- Step 2: Configure [Light Signal Intensity] (automatic light adjustment can be used) and [Signal Detection Threshold] (1 peak must be detected). Refer to [3.1.2 Sampling Settings].





- Step 3: Click on [Start] to make a measurement.
- Once the measurement surface is detected, the peak will be displayed.
- Select an appropriate [Unit] and configure an appropriate [Filter]. Refer to 3.1.2.5.



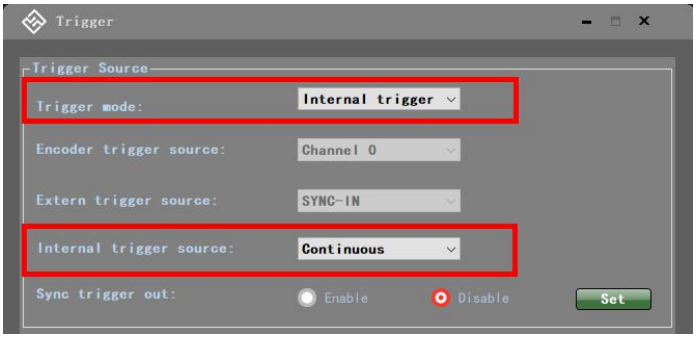
Troubleshooting:

- If no signal peak appears, it may be caused by the following reasons:

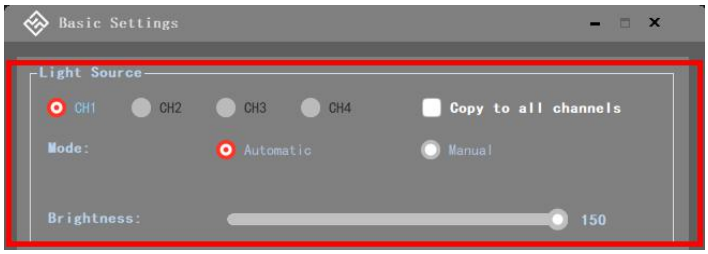
Reasons	Handling method
Measurement is not started	Click on [Start] to make a measurement
Insufficient optical signal intensity	Enable automatic light adjustment/increase the intensity of the light signal
The measurement object is outside the measurement range	Please confirm the position of the measurement object
The reflected light intensity of the measurement object is too low	Increase the integration time

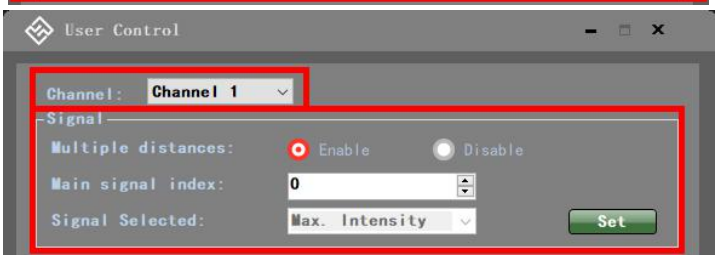
3.2.1.2 Measurement of the distance of transparent objects

- Step 1: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].

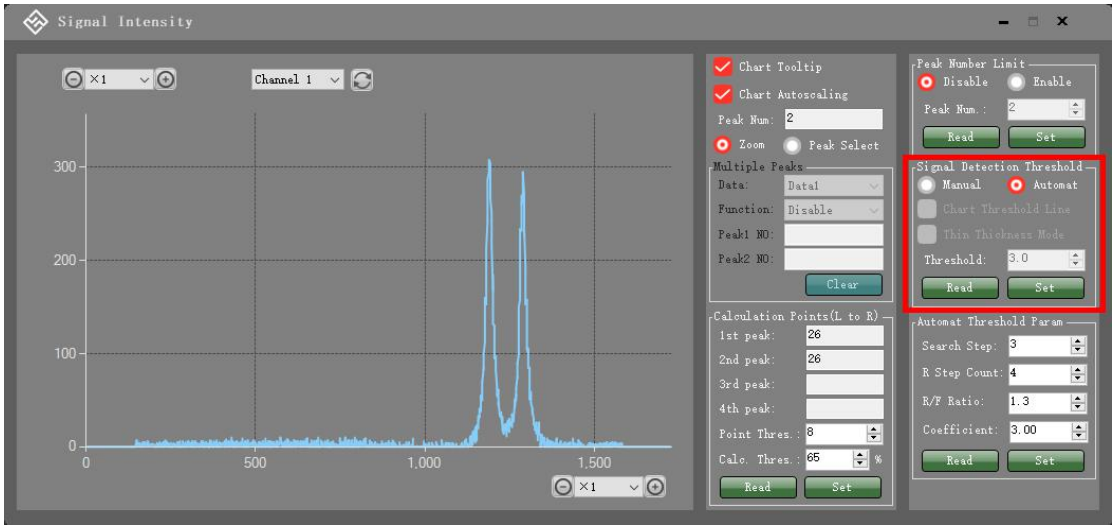


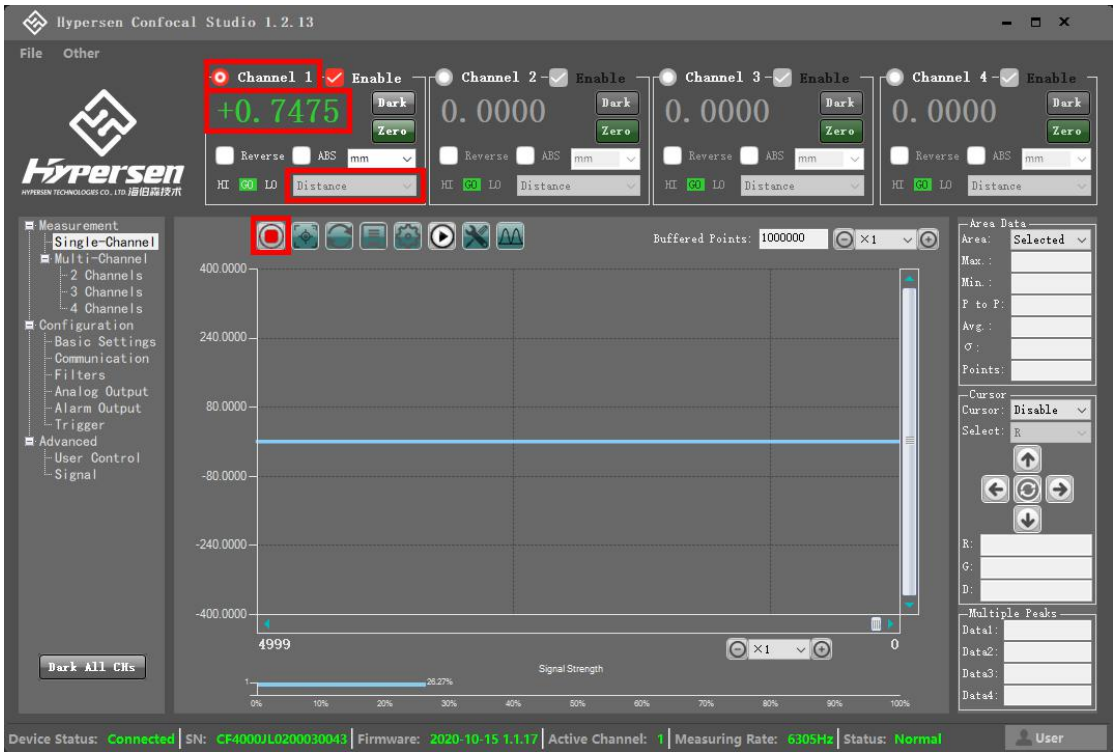
- Step 2: Configure [Light Signal Intensity] (automatic light adjustment can be used) and [Signal Detection Threshold] (1 peak must be detected), enable [Multi-distance Mode Output], and configure the [Main Output Index] of the measurement. Refer to [3.1.2 Sampling Settings].





- Step 3: Make sure that the measured object has been calibrated for the refractive index. This mode can be used only when [3.2.4 Calibration of Refractive Index] has been conducted.
- Step 4: Click on [Start] to make a measurement.
- Once the measurement surface is detected, the peak will be displayed.
- Select an appropriate [Unit] and configure an appropriate [Filter]. Refer to 3.1.2.5.





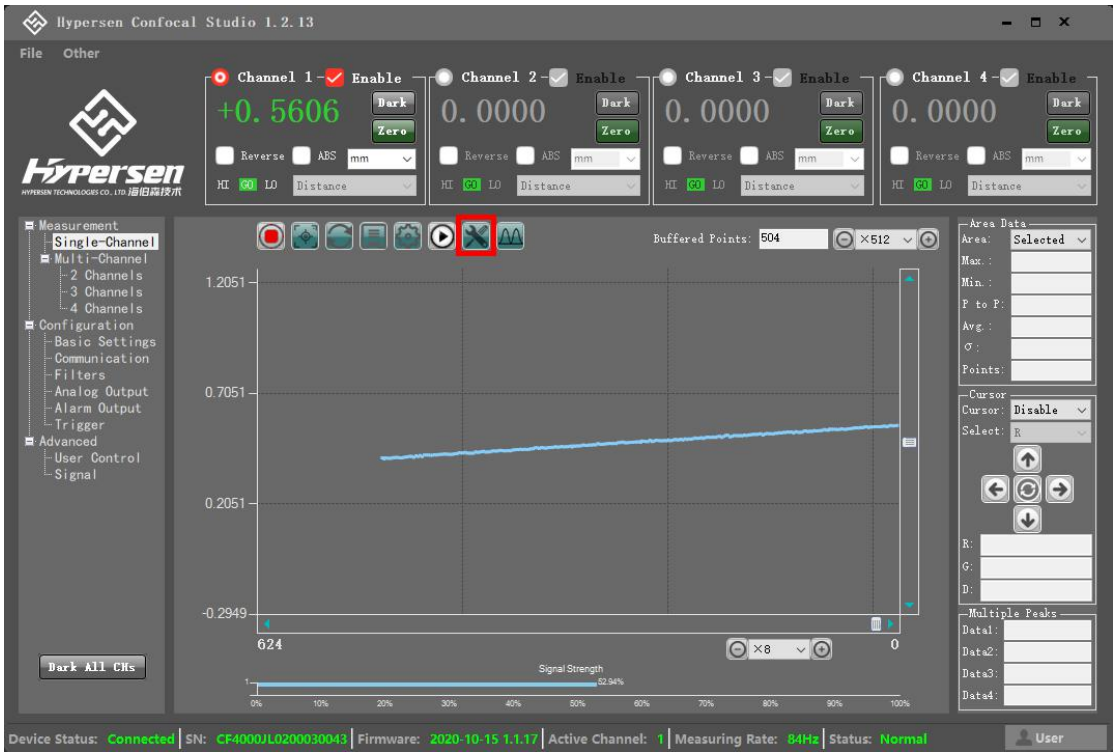
Troubleshooting:

- If no signal peak appears, it may be caused by the following reasons:

Reasons	Handling method
Measurement is not started	Click on [Start] to make a measurement
Insufficient optical signal intensity	Enable automatic light adjustment/increase the intensity of the light signal
The measurement object is outside the measurement range	Please confirm the position of the measurement object
The reflected light intensity of the measurement object is too low	Increase the integration time

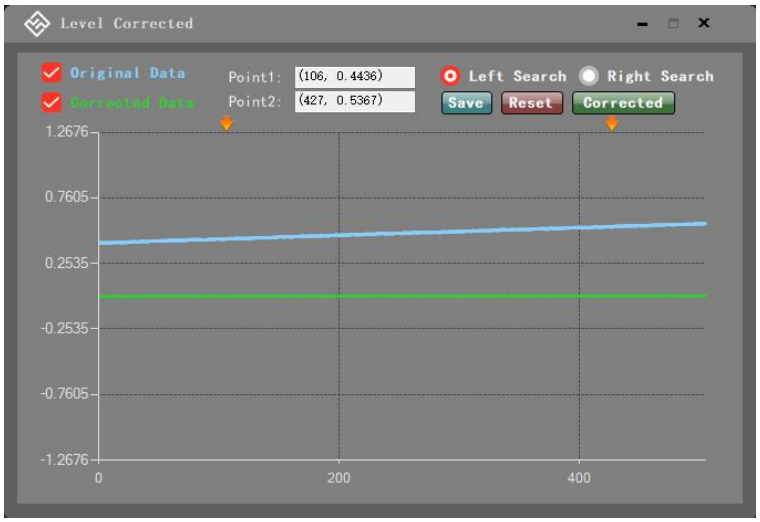
3.2.1.3 Level correction function

- This function can be used to analyze the scanned object contour. If the object is placed with a certain angle of inclination (this angle must be within the maximum measurement angle of the sensor head), this function can be used for correction analysis. Click on the [Main Interface] => [Measurement] => [Single Channel] => [Level Correction of Data] button to enter the level correction interface.
- You need to [Stop Measurement] before entering the interface.
- If an area is selected, the range of level correction is the value in the selected area; otherwise, the range of level correction is all the values in the current window.



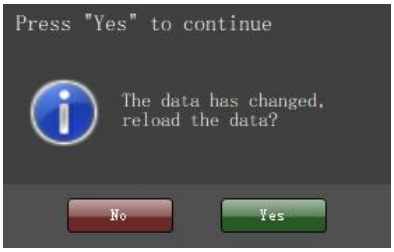
- Enter the level correction interface, left-click on the image to select two points as the baseline and click on the [Correction] button to make a correction.

Operations with the mouse	Functions
Left-click	• Select reference points whose number is at most 2 • If there are already two reference points, click again to re-select the second reference point
Right-click	• If there are already two reference points, cancel the second reference point • If there is one reference point, cancel the first reference point



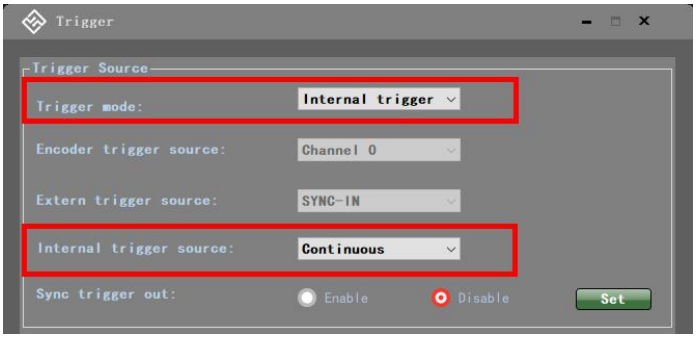
- Click on the [Reset] button to re-select the reference points for level correction.

- Click on the [Save] button to save and analyze the original data of level correction and the corrected data.
- If level correction is in progress, click on the [Level Correction] button again in the [Main Interface], a dialog box will pop up in the level correction interface, prompting [Data have been changed. Do you want to reload the data?】 Click on [Yes] to correct new data.

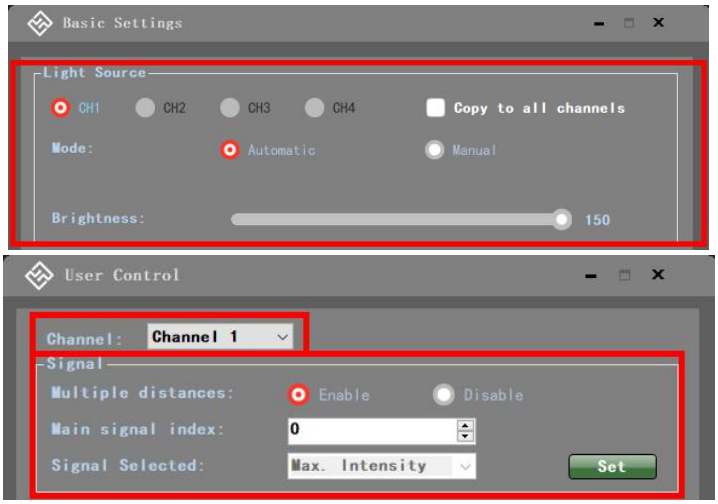


3.2.2 Measurement of the thickness of transparent objects

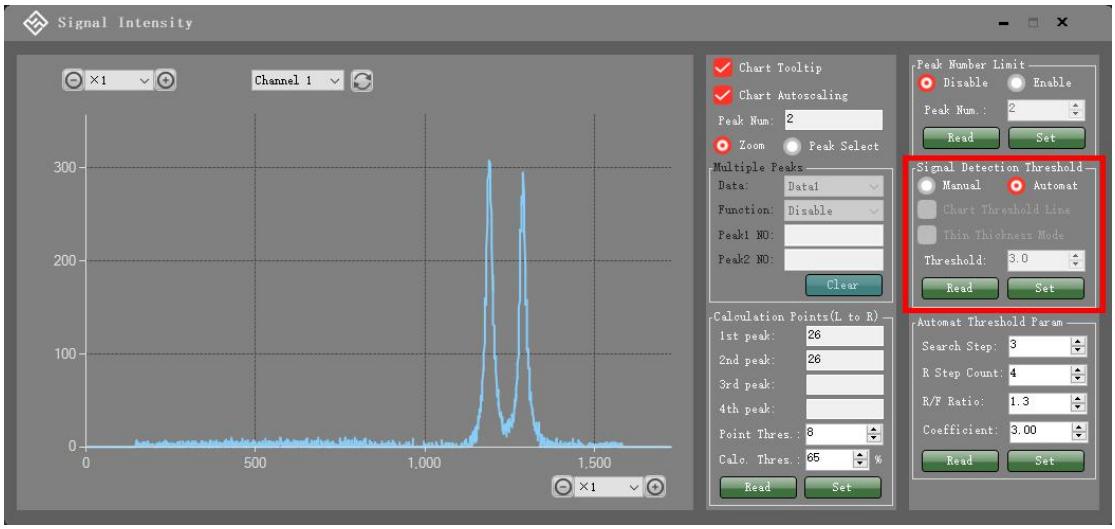
- The number of sensor heads required: at least one.
- To measure the thickness of a transparent object or the gap between the transparent object and the object inside it, etc., select [Function Menu] => [Measurement] => [Single Channel] => Select the channel to be observed => Under this channel, select the measurement mode [Thickness].
- Step 1: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].

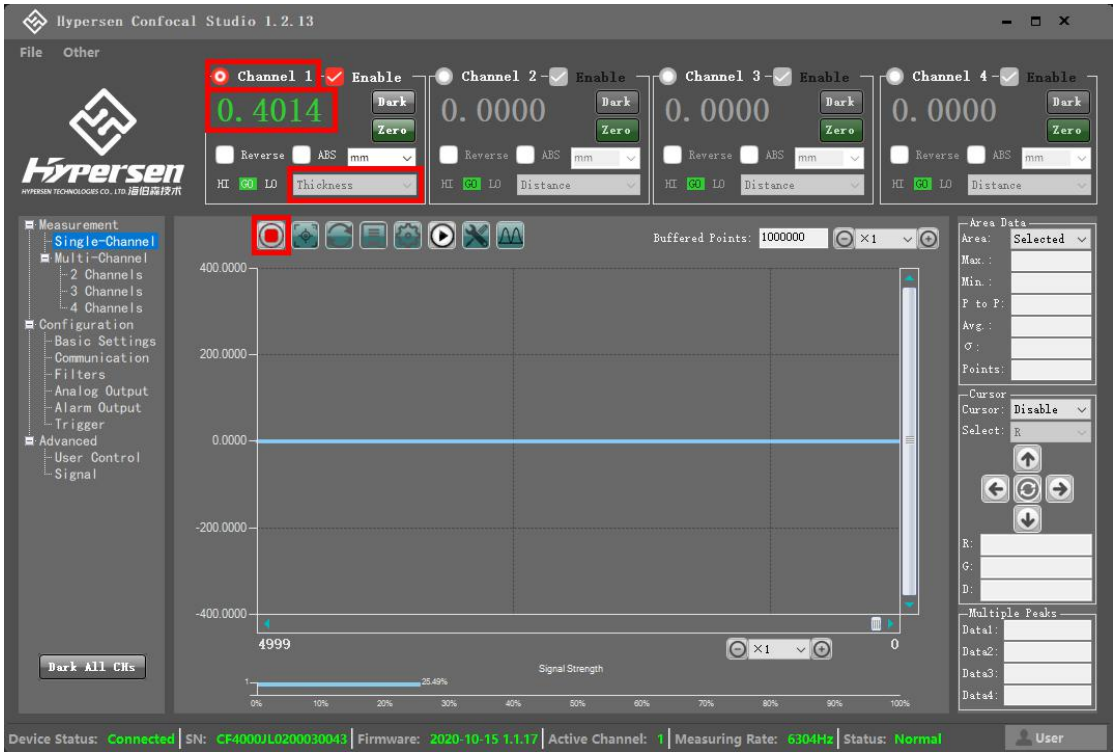


- Step 2: Configure [Light Signal Intensity] (automatic light adjustment can be used) and [Signal Detection Threshold] (1 peak must be detected), and enable [Multi-distance Mode Output]. Refer to [3.1.2 Sampling Settings].



- Step 3: Make sure that the measured object has been calibrated for the refractive index. This mode can be used only when [3.2.4 Calibration of Refractive Index] has been conducted.
- Step 4: Click on [Start] to make a measurement.
- Once the measurement surface is detected, the peak will be displayed.
- Select an appropriate [Unit] and configure an appropriate [Filter]. Refer to 3.1.2.5.
- For multiple peaks (more than 2), you can enable [3.2.3 Multi-peak Selection], select the predicted thickness and display it in [Multi-Peak] in the [Main Interface].





Troubleshooting:

- If no signal peak appears, it may be caused by the following reasons:

Reasons	Handling method
Measurement is not started	Click on [Start] to make a measurement
Insufficient optical signal intensity	Enable automatic light adjustment/increase the intensity of the light signal
The measurement object is outside the measurement range	Please confirm the position of the measurement object
The reflected light intensity of the measurement object is too low	Increase the integration time

3.2.3 Multi-peak selection

- This function is used for multiple peaks, which is convenient for viewing/monitoring the distance value or multiple thickness values of each peak.
- Under this function, an appropriate [Signal Detection Threshold] is required, [Multi-distance Mode Output] need to be enabled. Refer to [3.1.2 Sampling Settings]. [Calibration of Refractive Index] is required.
- This mode requires three interfaces.

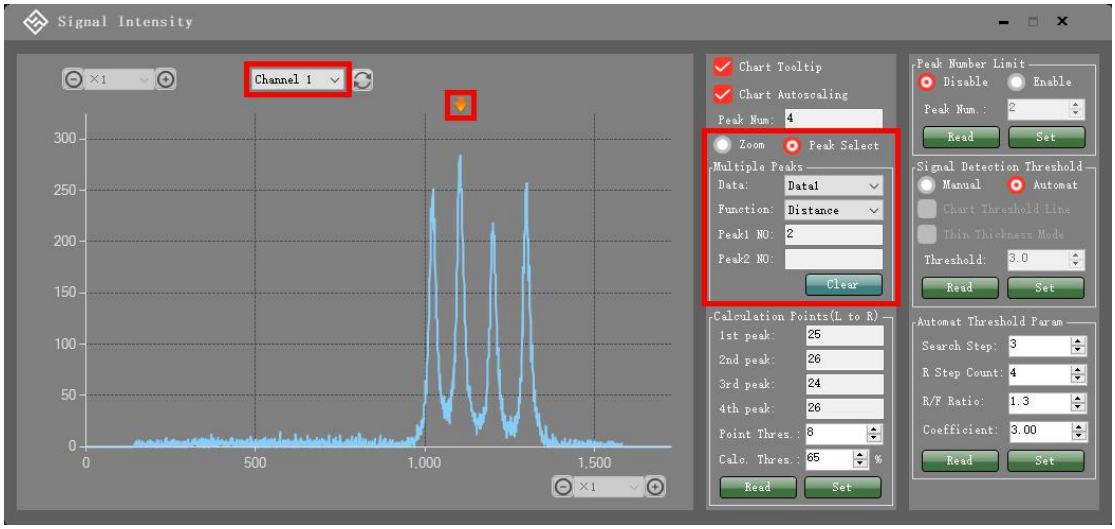
1. [Function Menu] => [Advanced Settings] => [Signal Waveform] interface.
2. From [Function Menu] => [Advanced Settings] => [Thickness Measurement] in the [User Control] interface, you can view the peak number used by the added layer thickness (only used in the single-channel thickness measurement mode). By default, the first layer is added as the thickness value of the first peak and the second peak.
3. [Main Interface] => [Multiple Peaks] View the detected distance value/thickness value.

- Multi-peak selection function: distance function and thickness function.
- Note: When the measurement mode is [Distance Mode], only the value of the distance function is displayed. When the measurement mode is [Thickness Mode], the data of thickness function and distance function can be displayed.

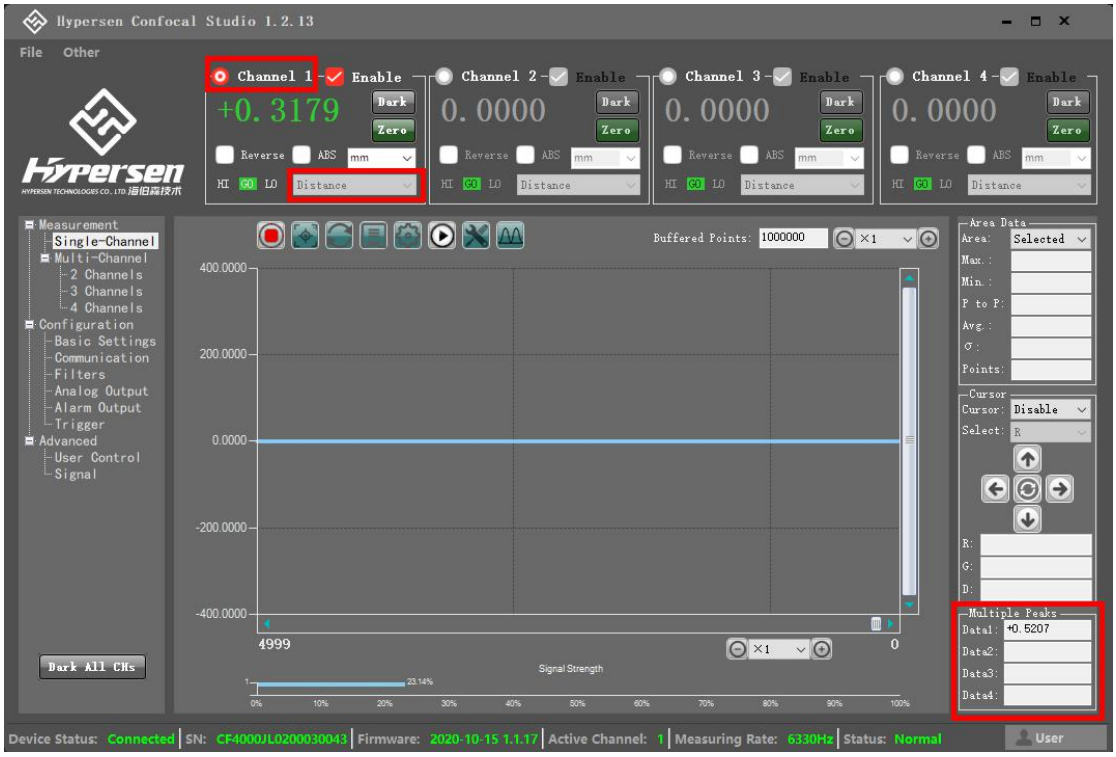
3.2.3.1 Distance function

- Step 1: Set an appropriate [Signal Detection Threshold] and enable [Multi-distance Mode Output].
- Step 2: Enter the [Signal Waveform] interface, select [Channel 1] and select [Peak Selection].
- Step 3: On [Multi-Peak], [Data1] is selected for [Data] and [Distance] is selected for [Function].
- Step 4: In the distance function, the waveform chart can only be left-clicked once. If you want to left-click it again, re-select the peak. Right-click to cancel the selection. The selected peak number is displayed on 【Peak 1】 and the selected peak direction is displayed above

the waveform chart.



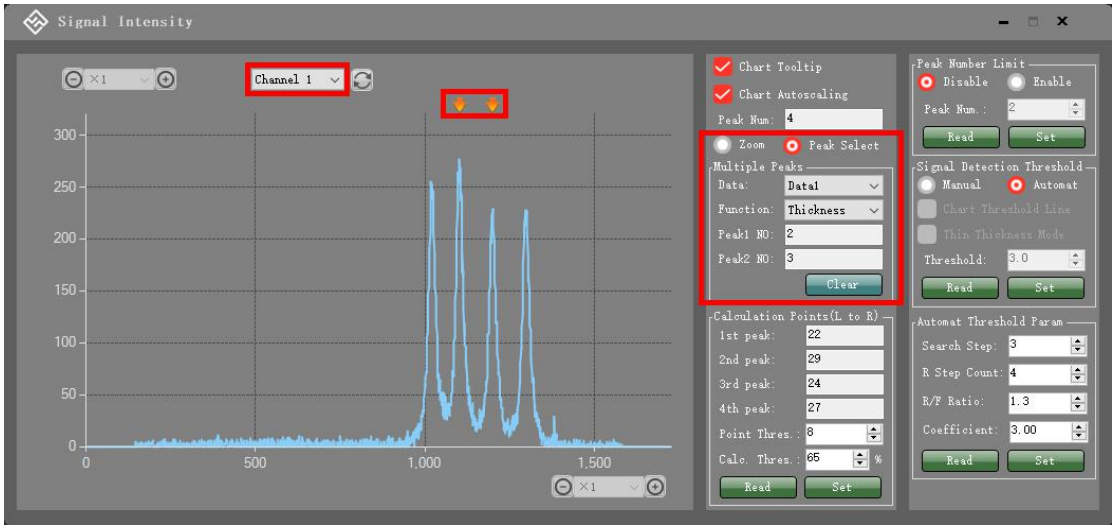
- Step 5: If [Channel 1] is selected for display on the main interface and the measurement mode of Channel 1 is [Distance], then in the [Main Interface] => [Data 1] of [Multi-Peak], the distance of the second peak selected in the [Signal Waveform] interface will be displayed.



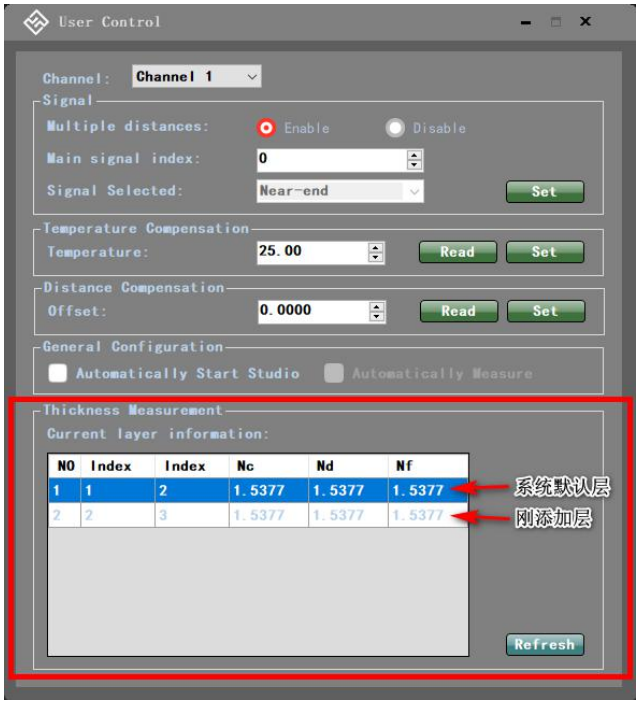
3.1.3.2 Thickness function

- Step 1: Set an appropriate [Signal Detection Threshold] and enable [Multi-distance Mode Output].
- Step 2: Enter the [Signal Waveform] interface, select [Channel 1] and select [Peak Selection].
- Step 3: On [Multi-Peak], [Data1] is selected for [Data] and [Thickness] is selected for [Function].
- Step 4: In the thickness function, the waveform chart can only be left-clicked twice. If you left-click again after having left-clicked twice, the second peak will be re-selected. Right-click

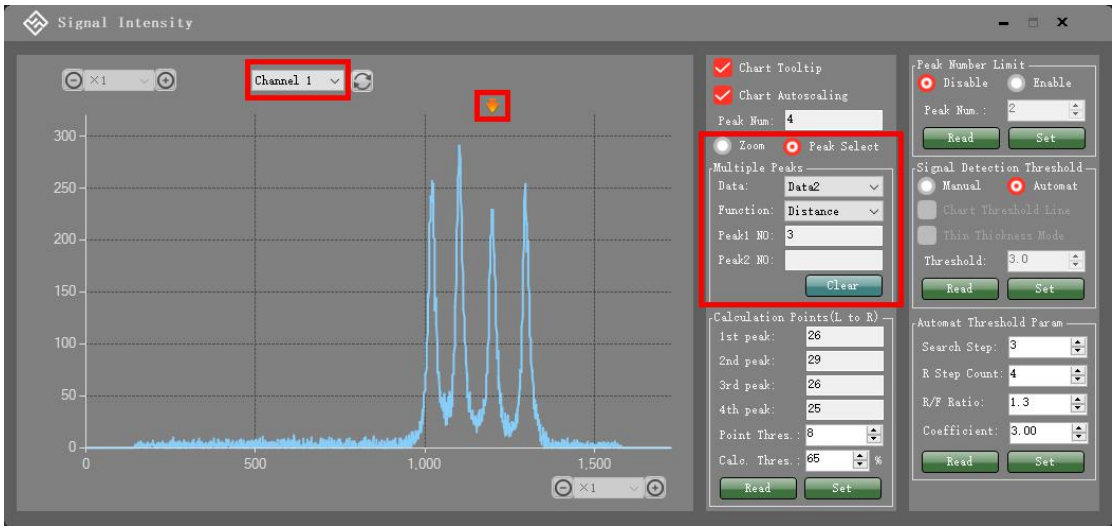
to deselect all. The selected peak number is displayed on [Peak 1] and [Peak 2] and the selected peak direction is displayed above the waveform chart. Note: The existing layer cannot be added repeatedly, that is, the two peak numbers are not allowed to be repeated.



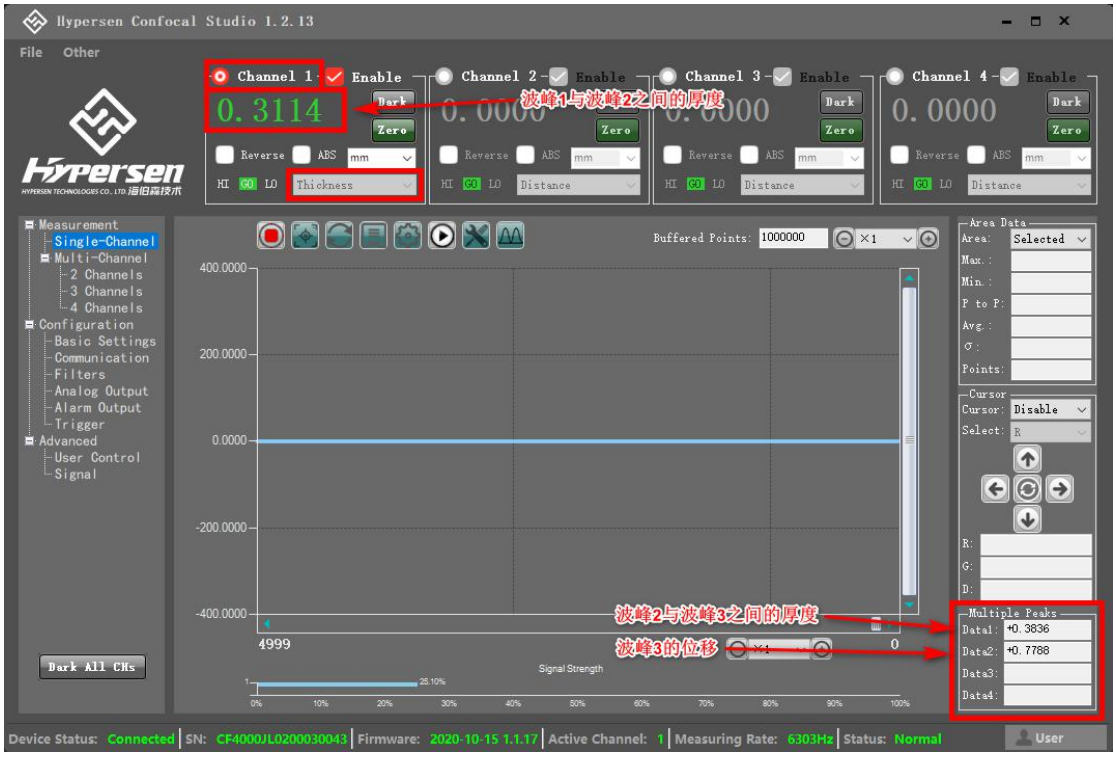
- Step 5: Under the [Thickness Measurement] of the [User Control] interface, you can view the peak number used by the added layer thickness.



- Expansion: On [Multi-Peak], [Data2] is selected for [Data] and [Distance] is selected for [Function]. Select the third peak on the waveform chart.



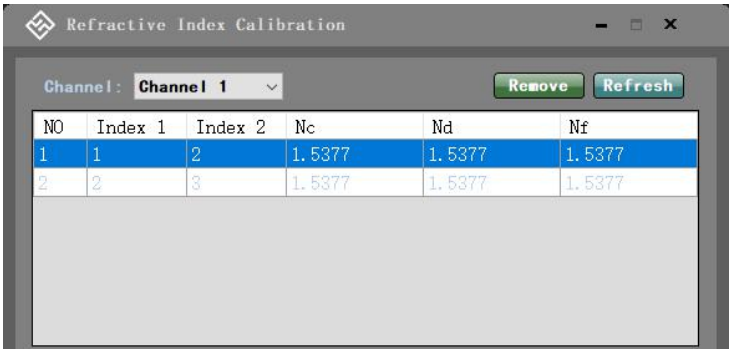
- Step 6: If [Channel 1] is selected for display on the main interface and the measurement mode of Channel 1 is [Thickness], then in the [Main Interface] => [Data 1] of [Multi-Peak], the thickness distance selected in the [Signal] interface will be displayed, and in [Data 2], the distance value of the third peak selected will be displayed.



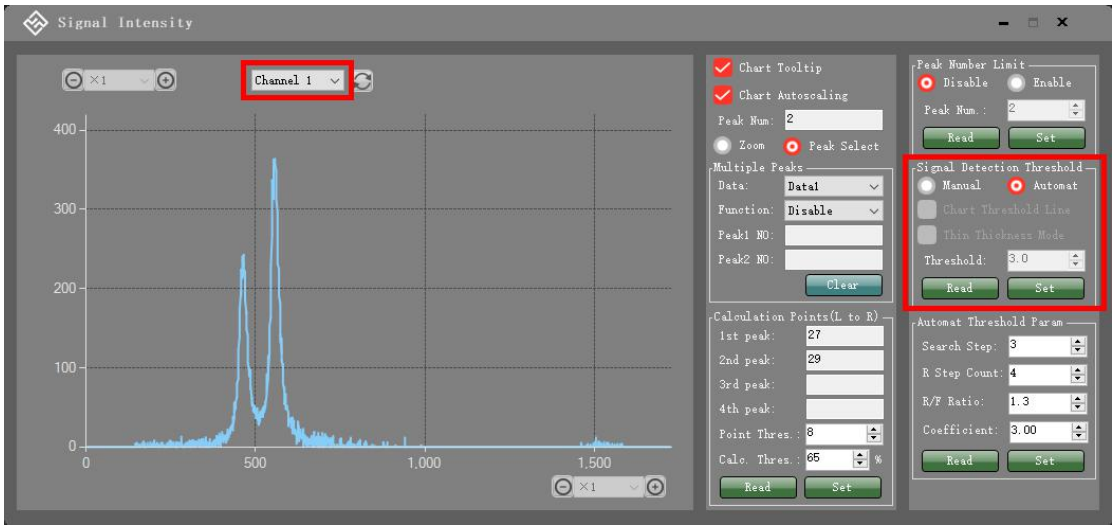
3.2.4 Calibration of refractive index

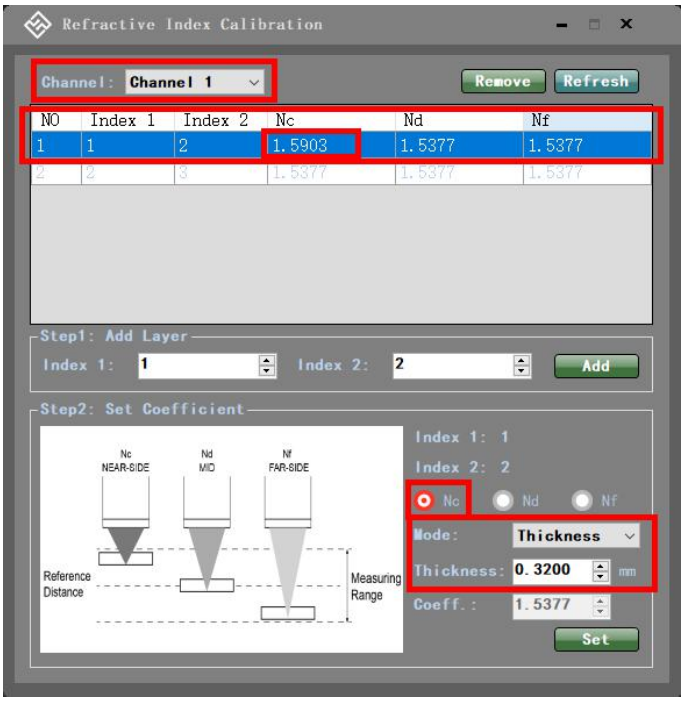
- When light enters another transparent medium obliquely from one transparent medium, the direction of propagation generally changes.
- To measure the distance and thickness of transparent objects, it is necessary to calibrate the refractive index of transparent objects.
- Before calibrating the refractive index, go to the [Signal Waveform] interface and [Clear] the multi-peak function.

- In [Function Menu] => [Measurement] => [Single Channel] => Select [Channel 1] => [Thickness] mode => Click on the [Refractive Index Calibration] button to perform calibration of the refractive index.
- Two interfaces are needed for the calibration of refractive index: the position of the signal is viewed in the [Signal Waveform] interface; and the refractive index is calibrated in the [Calibration of Refractive Index] interface.
- Step 1: Set an appropriate [Signal Detection Threshold] and enable [Multi-distance Mode Output] in the [Signal Waveform] interface.
- Step 2: In the [Calibration of Refractive Index] interface, add a layer. If it already exists, you don't need to add it again (you will be prompted if you add it repeatedly).
- Step 3: Measure the standard thickness of the transparent object to be calibrated with a high-precision measuring instrument, and record it.
- Step 4: Click to Select the layer to be calibrated in the [Calibration of the Refractive Index] interface.

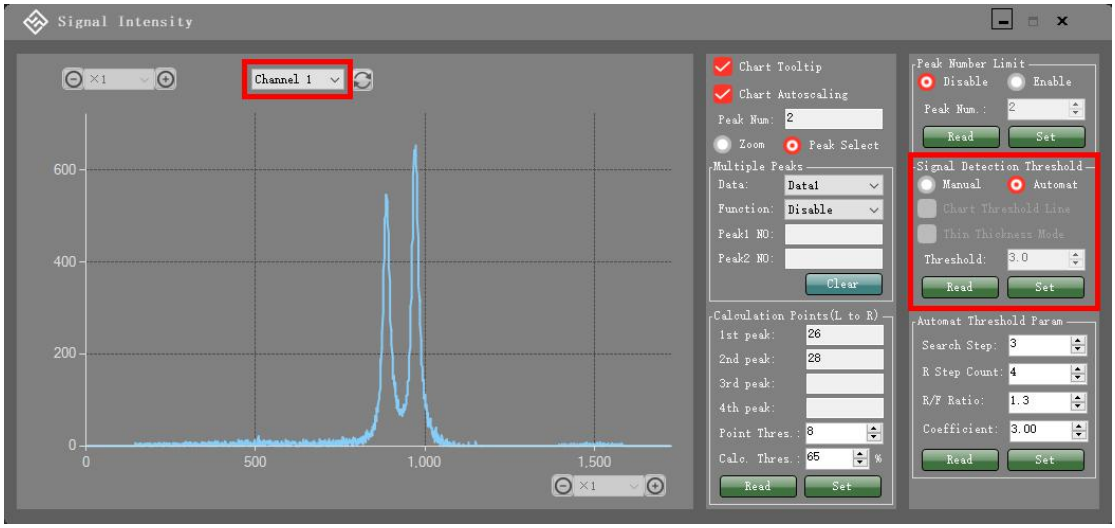


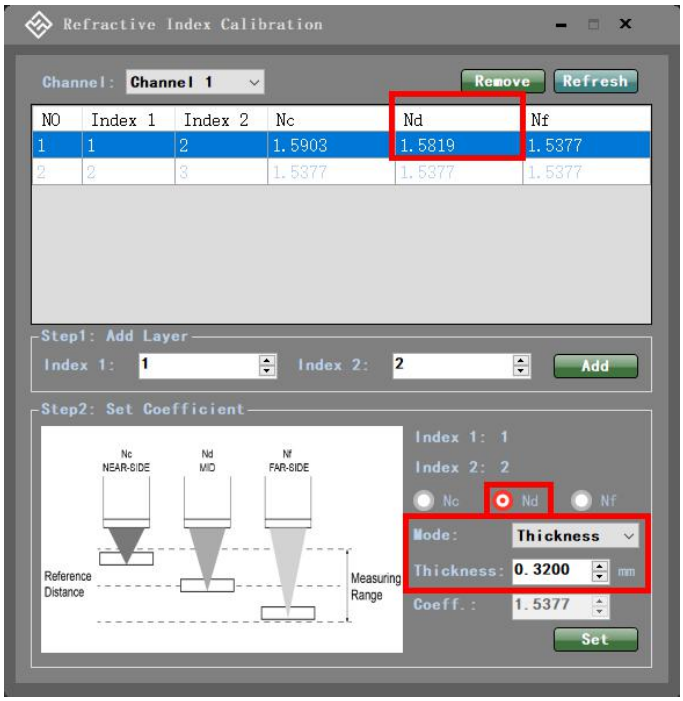
- Step 5: Select Nc, move the Z axis of the sensor head so that it is close to the transparent object to be calibrated. The two peaks on the left can be detected in the [Signal Waveform] interface. Enter the thickness of the transparent object just measured and calibrated and click on [Set]. (The signal must be moved to be close to the left edge and two peaks can be detected, otherwise an error will be prompted)



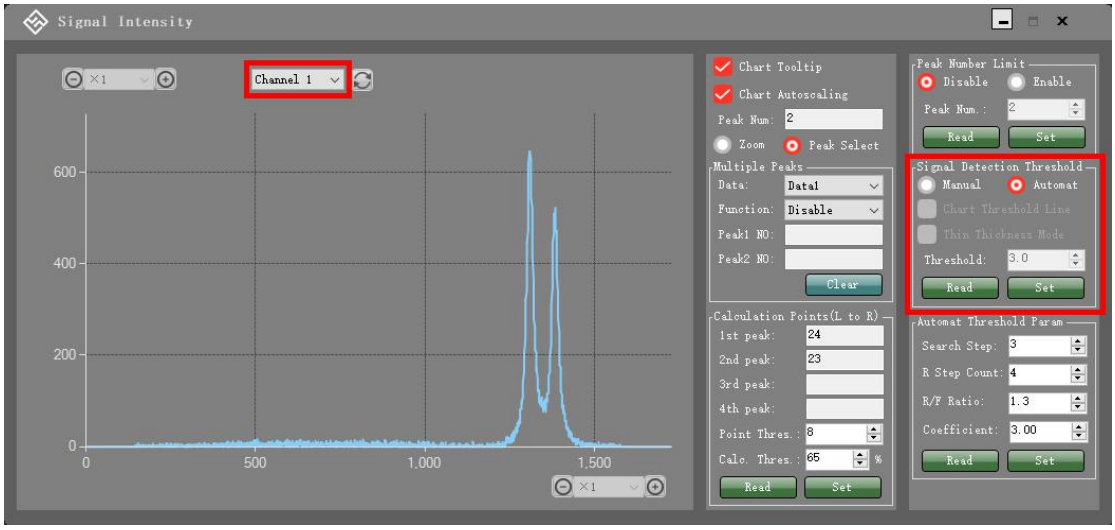


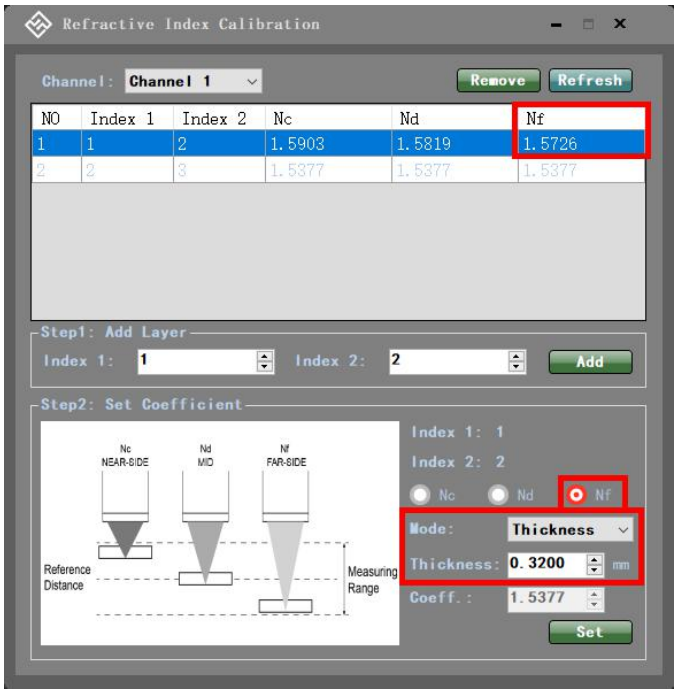
- Step 6: Select Nd, move the Z axis of the sensor head so that the middle of the two peaks of the transparent object to be calibrated is near the middle of the sensor head range. The two peaks in the middle can be detected in the [Signal Waveform] interface. Enter the thickness of the transparent object just measured and calibrated and click on [Set]. (The signal must be moved close to the middle and two peaks can be detected, otherwise an error will be prompted)





- Step 7: Select Nf, move the Z axis of the sensor head so that it is away from the transparent object to be calibrated. The two peaks on the right can be detected in the [Signal Waveform] interface. Enter the thickness of the transparent object just measured and calibrated and click on [Set]. (The signal must be moved to be close to the right and two peaks can be detected, otherwise an error will be prompted)





- Note 1: If the transparent object to be calibrated is relatively thick (above 2mm), only calibrating Nd will suffice.
- Note 2: If the layers with index 2 and 3 are calibrated, more than 3 peaks must be detected in the [Signal Waveform] interface at the time of calibration, otherwise the calibration will fail.

3.2.5 Measurement of thickness (2 sensor heads)

- The number of sensor heads that need to be used is at least 2 and the serial number of the sensor heads must be such that Channel 1 and Channel 2 as well as Channel 3 and Channel 4 are paired.
- This function is used when the thickness of an object is measured. This function needs to be used with the mounting fixture of the sensor heads. For the installation method of the firmware fixture, refer to the [Installation Method of the Adjustment Fixture for Double-head Thickness Measurement] in [Appendix].
- Preparations for measurement:

  1. Install the mounting fixture of the sensor head.

  2. Make a Double-head calibration.

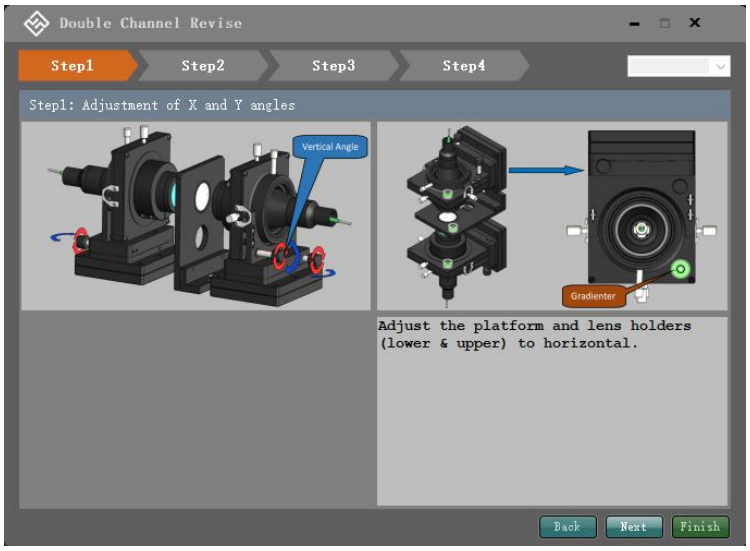
  3. If there are multiple peaks, select the main peak of the corresponding channel for measurement (application: measurement of the thickness of the film inside the glass).

3.2.5.1 Double-head calibration function

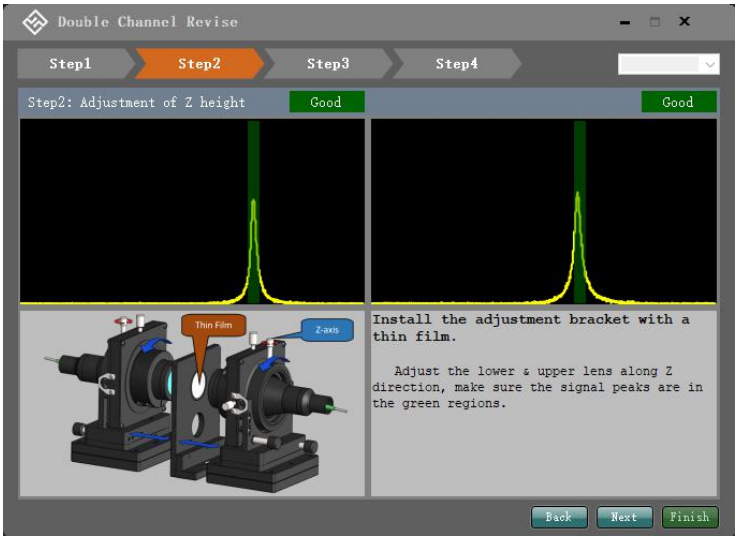
- Double-head calibration interface provides convenience for adjustment of double-head beaming. In [Main Interface] => [Function Menu] => [Measurement] => [Multi-channel] => [Dual-channel] => Click on [Dual-channel Calibration] to enter the dual-channel calibration interface, and follow the steps in the interface to complete each step. After all steps are

completed, click on [Finish].

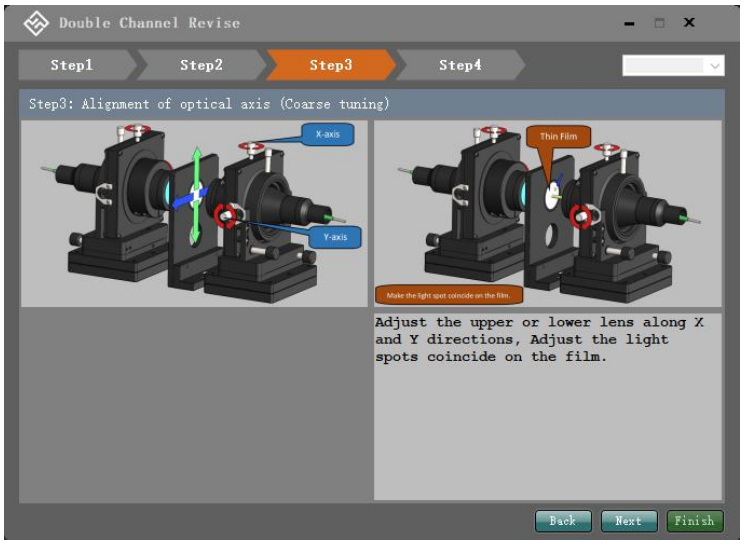
- Before measurement, you can check the measurement surface with the [Level Meter] to ensure that it is level.
- Step 1: The two sensor heads are perpendicular to the measurement surface and use the [Level Meter] for checking.



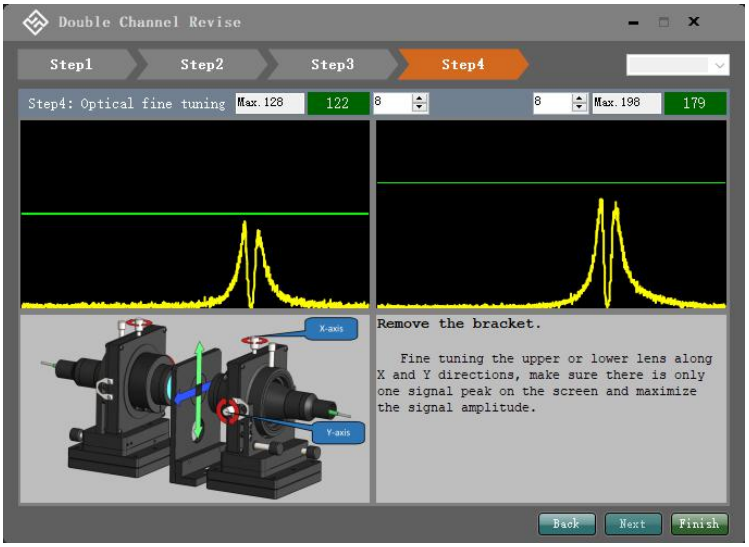
- Step 2: Apply the film, adjust the measurement range, turn the Z-axis knob on the adjustment fixture and adjust it to the [Red Box] until it changes to a [Green Box]. At this point, the status box prompts [Good].

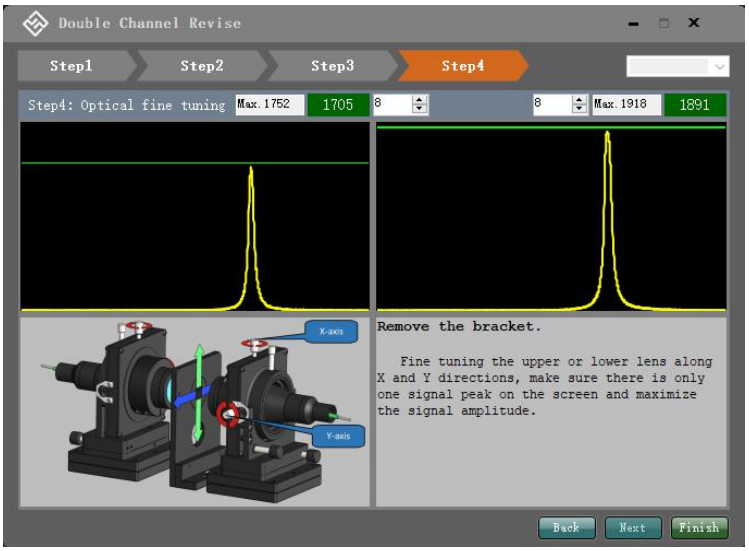


- Step 3: Apply the film, align the optical axis of the two sensor heads (coarse adjustment), turn the X/Y axis knob on the adjustment fixture until the two light spots roughly coincide.



- Step 4: Remove the film, make the two sensor heads opposite to each other, align the optical axis (fine adjustment), slightly turn the X/Y axis knob on the adjustment fixture, and adjust the two signals to be close to the [Green Maximum Value Line]. The maximum value line varies with the maximum value of the signals (the maximum value will vary depending on the sensor head/optical fiber model).

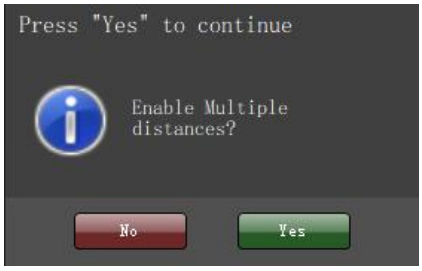




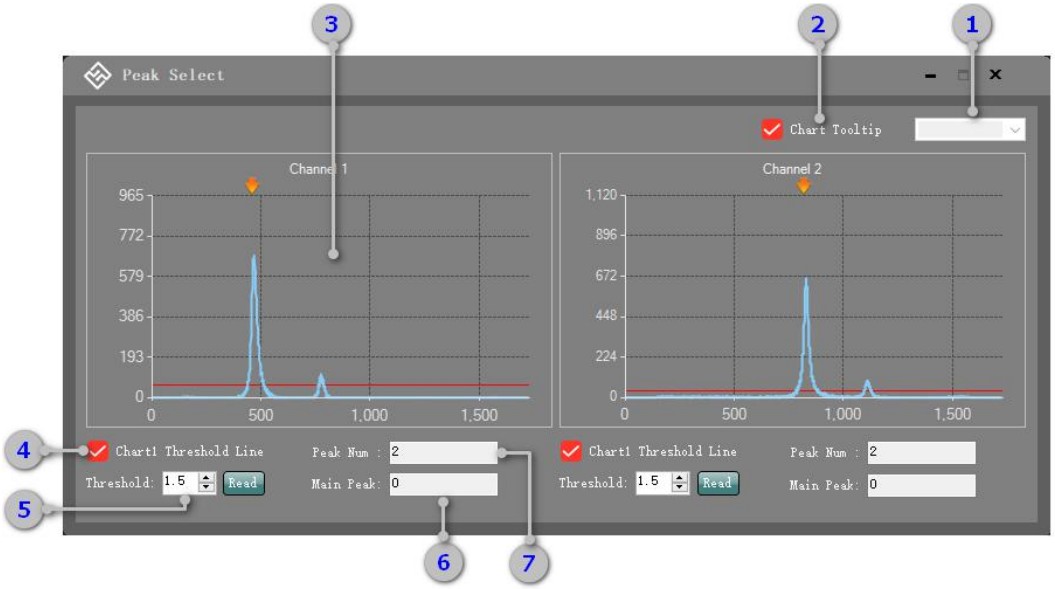
- Step 5: When Steps 1 to 4 are completed, click on [Finish]. At the time of completion, the previous signal intensity configuration will be restored automatically and the Zeroing will be performed.

3.2.5.2 Selection of the main peak for double-head thickness measurement

- The main peak of double-head thickness measurement is selected to provide convenience for measuring the thickness of the film inside the glass.
- Before using this function, check whether or not the sensor head mounting fixture is adjusted properly to align the optical axis. Check whether or not the multi-peak output is enabled.
- In [Main Interface] => [Function Menu] => [Measurement] => [Multi-channel] => [Dual-channel] => After [Start] the measurement, click on the [Peak Selection] button to enter the selection interface of the main peak for double-head thickness measurement. If multi-peak output is not enabled for the enabled channel, it will prompt whether or not to enable multi-peak output. Click on [Yes].



- Names and functions of the parts of the selection interface of the main peak



S/N	Name	Functions
1	Selection of Double-head thickness measurement group	A Double-head thickness measurement group can be selected for selection of the main peak • Group 1 (Channel 1 and Channel 2) • Group 2 (Channel 3 and Channel 4)
2	Chart tool prompting	When enabled, it will prompt the corresponding

	button	information when the mouse is moved above the waveform chart
3	Signal waveform chart	• Reflect the current signal status of the object under test with a waveform chart • Click with the mouse to select the peak (there can only be 1 main peak, which exists by default); Left-click to reselect the peak
4	Threshold line display button	When it is enabled, the threshold line is displayed in the chart
5	Threshold setting and getting	• Click on [Read] to get the threshold of the current channel • Enter the threshold (1~50), and press [Enter] to set the threshold
6	Main peak index	• Display the currently selected main peak index (starting from 0) (which cannot be entered) • Same as that in [Signal] in the [User Control] interface
7	Number of spots	The number of light spots currently detected (which cannot be input) is dependent on the [Distance Output Mode] and [Threshold Size]

- Example of the main peak selection interface: Measurement of the thickness of the black silica gel on two pieces of glass.
- Measure the thickness with a micrometer:
  Total thickness: 2.515mm
  Glass thickness: the thickness of the first piece of glass is 1.041mm, and the thickness of the second piece of glass is 1.043mm
  Film thickness: 2.515-1.041-1.043 = 0.431mm

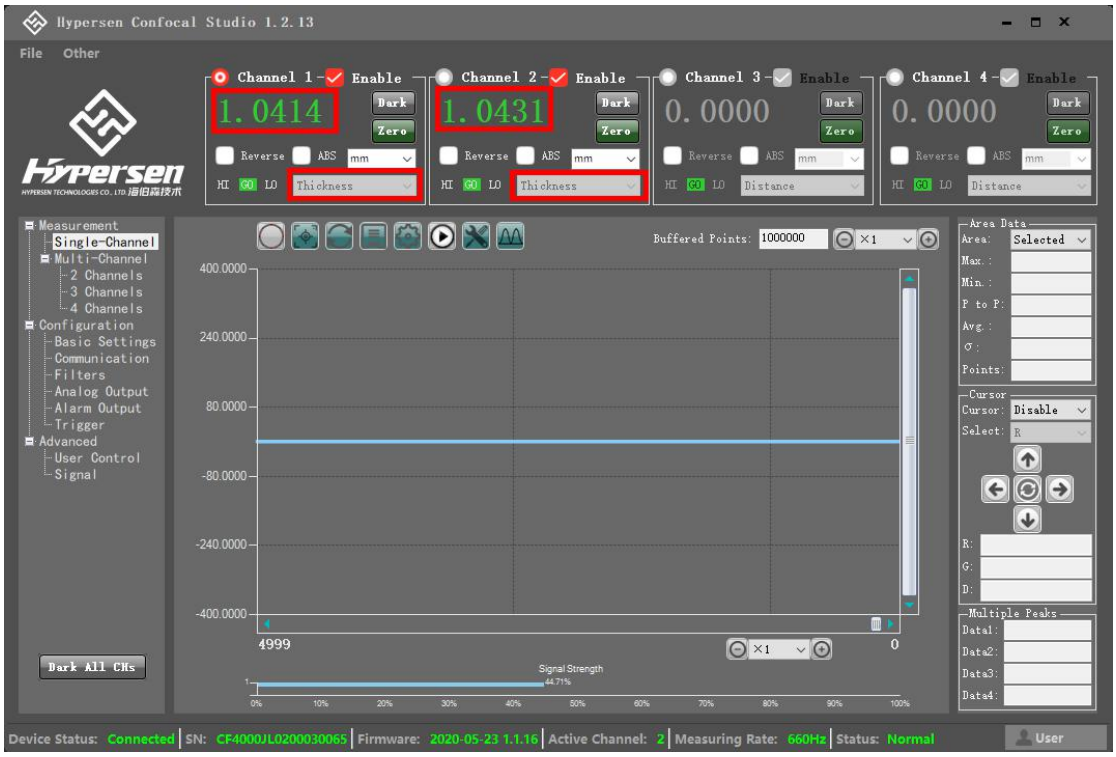
- Double-head measurement of Chromatic Confocal Sensor HPS-CFL040:

Total thickness: 2.515mm

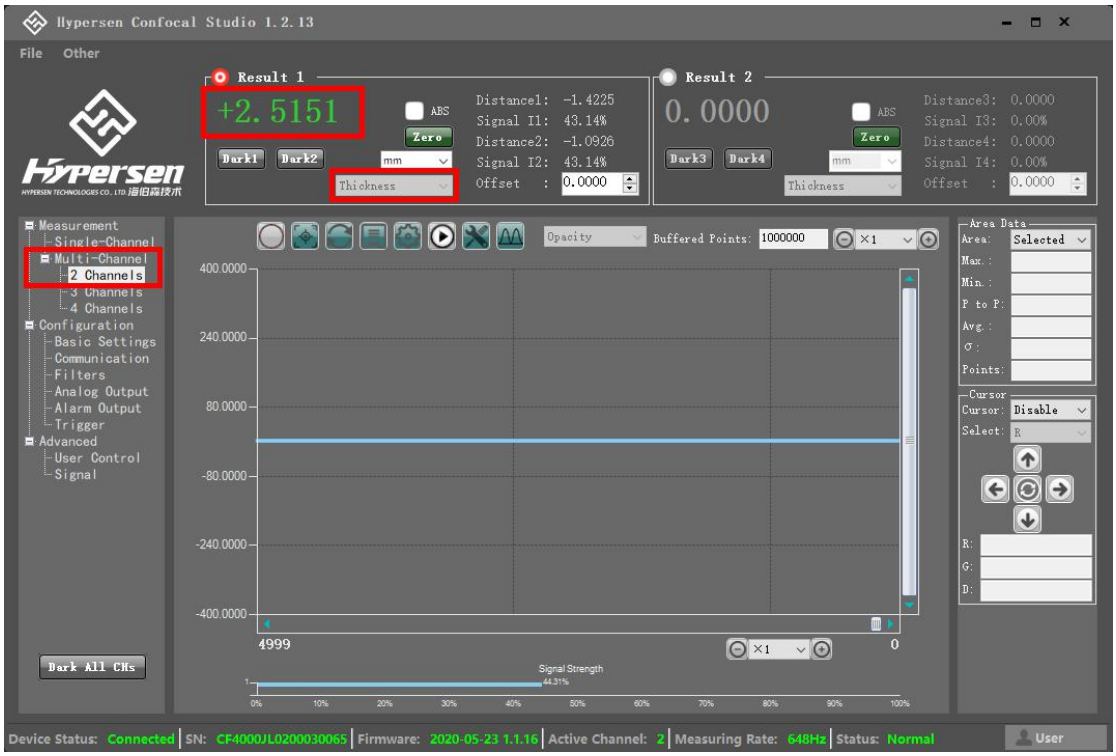
Thickness of the two pieces of glass: the thickness of the first piece of glass is 1.0414mm and the thickness of the second piece of glass is 1.0431m

Film thickness: 0.4314mm

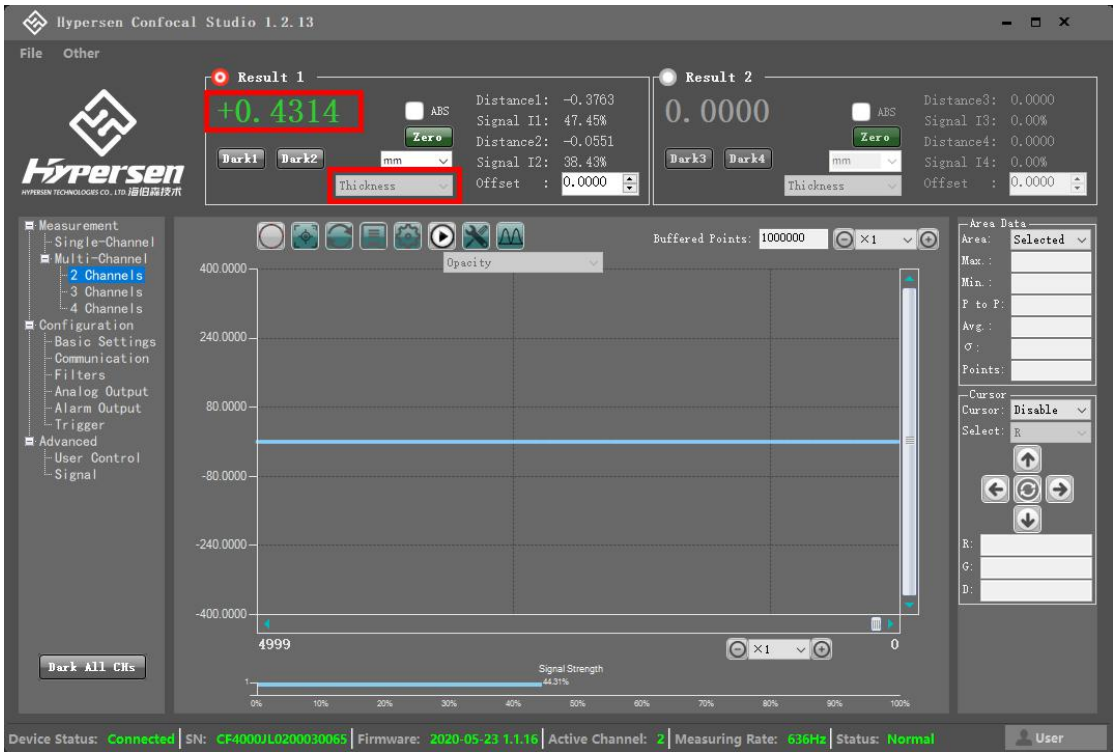
- Due to the measurement of black silica gel objects, the integration time is set to 1500us. Before measurement, check whether or not the glass coefficients of the two channels have been calibrated. Click on [Single Channel] => Open the glass thickness measurement mode to measure the thickness of the two pieces of glass.



- In the main peak selection interface, set the appropriate signal threshold, [Click to Select] the peak index 0 for both channels and the measured result gotten is the total thickness.

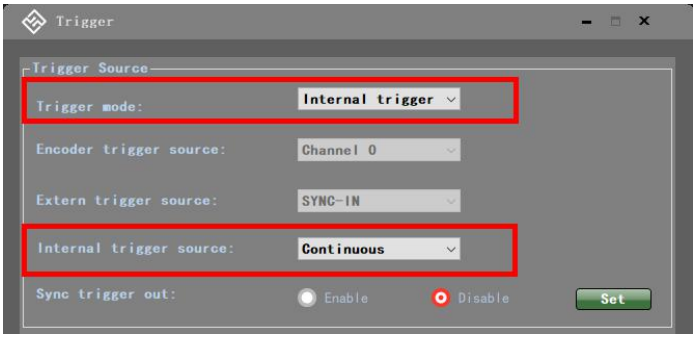


- In the main peak selection interface, [Click to Select] the peak index 1 for both channels and the measured result gotten is the total thickness of the black silica gel.

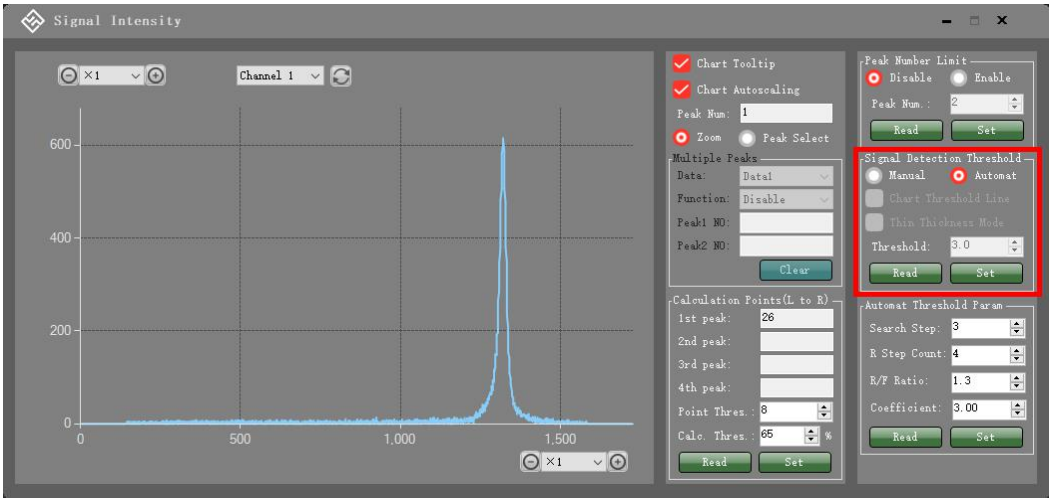


3.2.5.3 Measurement of thickness (Opaque object)

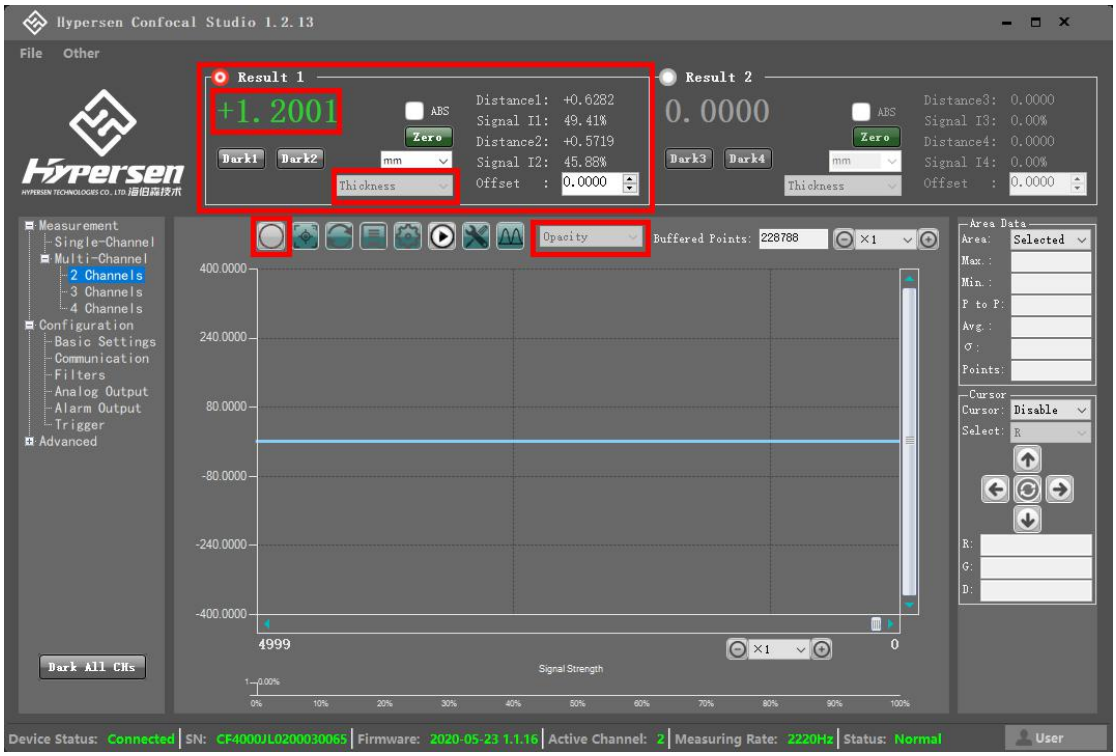
- Before measurement, check whether or not the sensor head mounting fixture is adjusted properly to align the optical axis. Check whether or not the main peak selection is as predicted.
- Step 1: Select [Function Menu] => [Measurement] => [Multi-channel] => [Dual-channel] => Select the channel result to be observed => Under this channel result, select the measurement mode [Thickness].
- Step 2: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].



- Step 3: Configure [Light Signal Intensity] (automatic light adjustment can be used) and [Signal Detection Threshold] (It must be ensured that at least 1 peak is detected in both channels) of each channel. Refer to [3.1.2 Sampling Settings].

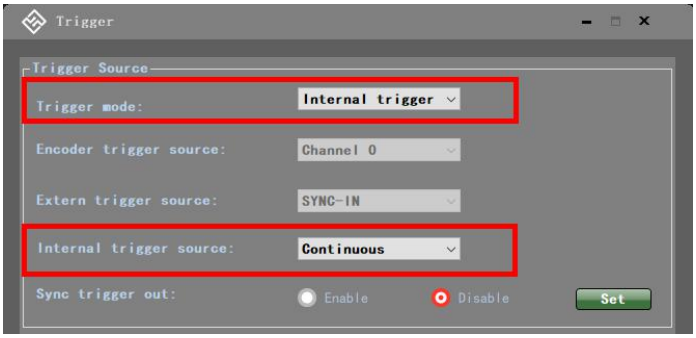


- Step 4: Select [Opacity] mode on the main interface to switch to opaque object measurement mode (default).
- Step 5: Click on [Start] to make a measurement.
- Select an appropriate [Unit] and configure an appropriate [Filter] for each channel. Refer to 3.1.2.5.
- The measurement results and the distance and signal intensity, etc. of the two channels are displayed in the main interface. If the firmware fixture is adjusted incorrectly and the fixed deviation is caused, you can use [Offset] to correct it.
- The signal intensity difference between the two channels should not be too large and the result output by a too large difference is [————————]. When it is set to automatic light adjustment, it is normal that the signal intensity of one of the two channels is 100%.
- Here below is the thickness value of a standard block with a measured thickness of 1.20mm.

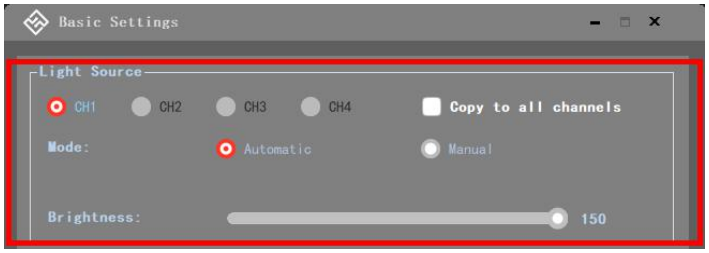


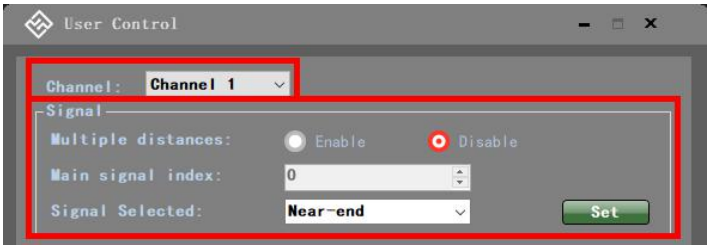
3.2.5.4 Measurement of thickness (Translucent objects/transparent objects)

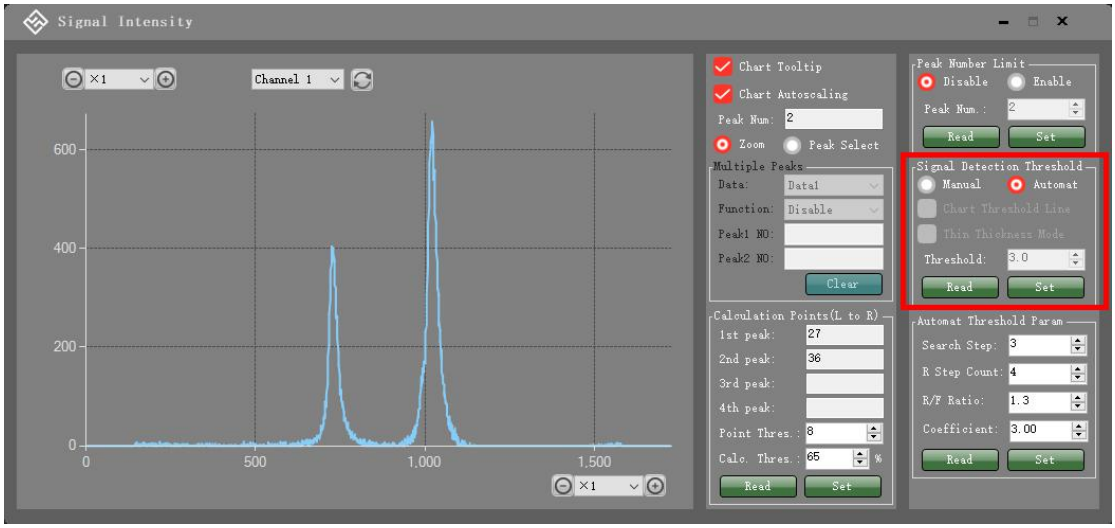
- Before measurement, check whether or not the sensor head mounting fixture is adjusted properly to align the optical axis. Check whether or not the main peak selection is as predicted.
- Step 1: Select [Function Menu] => [Measurement] => [Multi-channel] => [Dual-channel] => Select the channel result to be observed => Under this channel result, select the measurement mode [Thickness].
- Step 2: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].



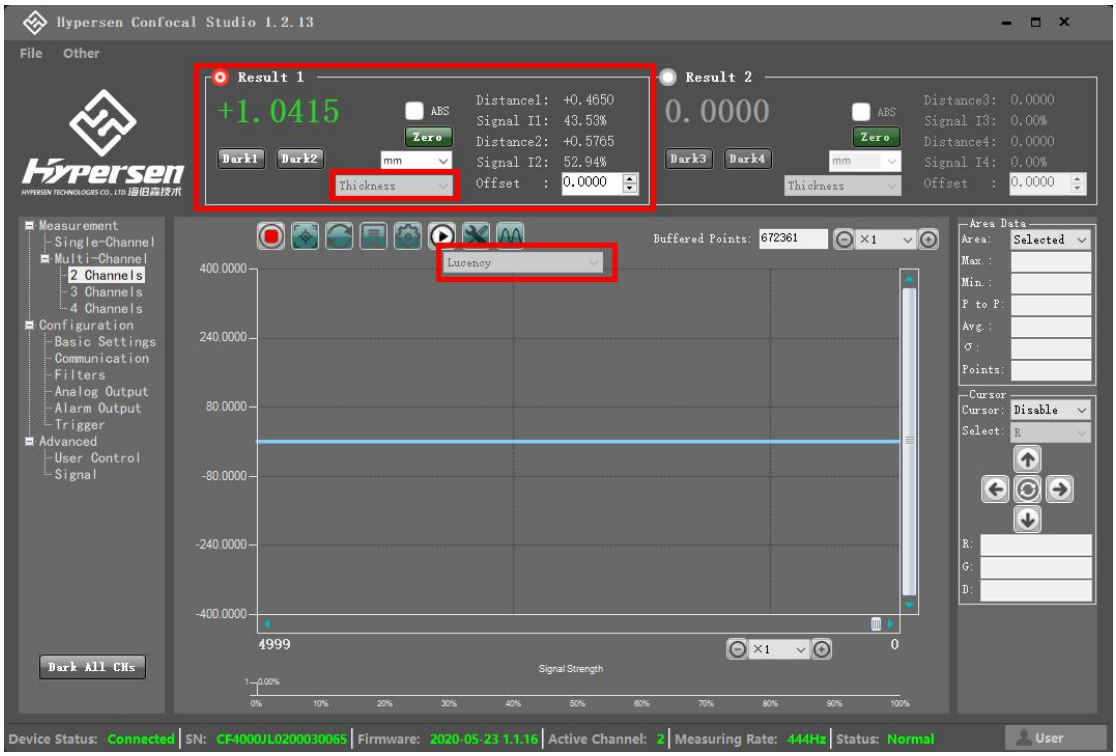
- Step 3: Configure [Light Signal Intensity] (automatic light adjustment can be used), [Signal Detection Threshold] (Must ensure that the predicted peak is detected) and [Distance output mode] (If measuring the nearest peak or the first peak, you can configure all channels to be disabled and select Near-End) of each channel. Refer to [3.1.2 Sampling Settings].





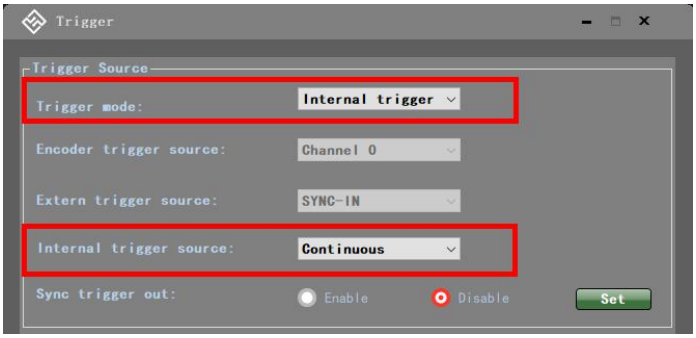


- Step 4: Select [Lucency] mode on the main interface to switch to transparent object measurement mode.
- Step 5: Click on [Start] to make a measurement.
- Select an appropriate [Unit] and configure an appropriate [Filter] for each channel. Refer to 3.1.2.5.
- The measurement results and the distance and signal intensity, etc. of the two channels are displayed in the main interface. If the firmware fixture is adjusted incorrectly and the fixed deviation is caused, you can use [Offset] to correct it.
- The signal intensity difference between the two channels should not be too large and the result output by a too large difference is [————————]. When it is set to automatic light adjustment, it is normal that the signal intensity of one of the two channels is 100%.
- Here below is the thickness value of a standard block with a measured thickness of 1.0415mm.

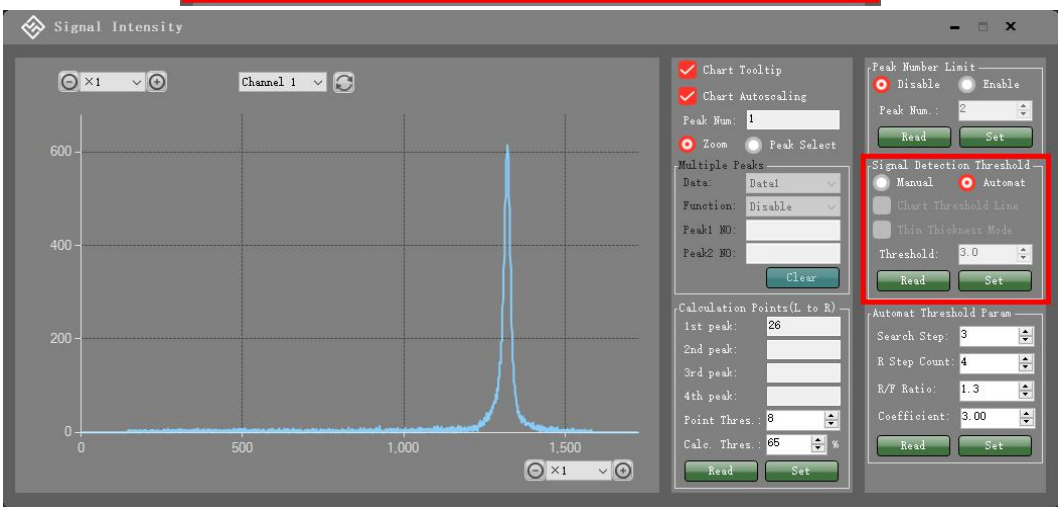


3.2.6 Measurement of warpage (3 sensor heads)

- The number of sensor heads that need to be used is at least 3, and the serial number of the sensor heads must be such that Channel 1, Channel 2 and Channel 3 are paired.
- This function is used when the warpage, deformation, etc. of an object is measured.
- Step 1: Select [Function Menu] => [Measurement] => [Multi-channel] => [Three-channel] => Select the Measurement Mode [Wash Back].
- Step 2: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].

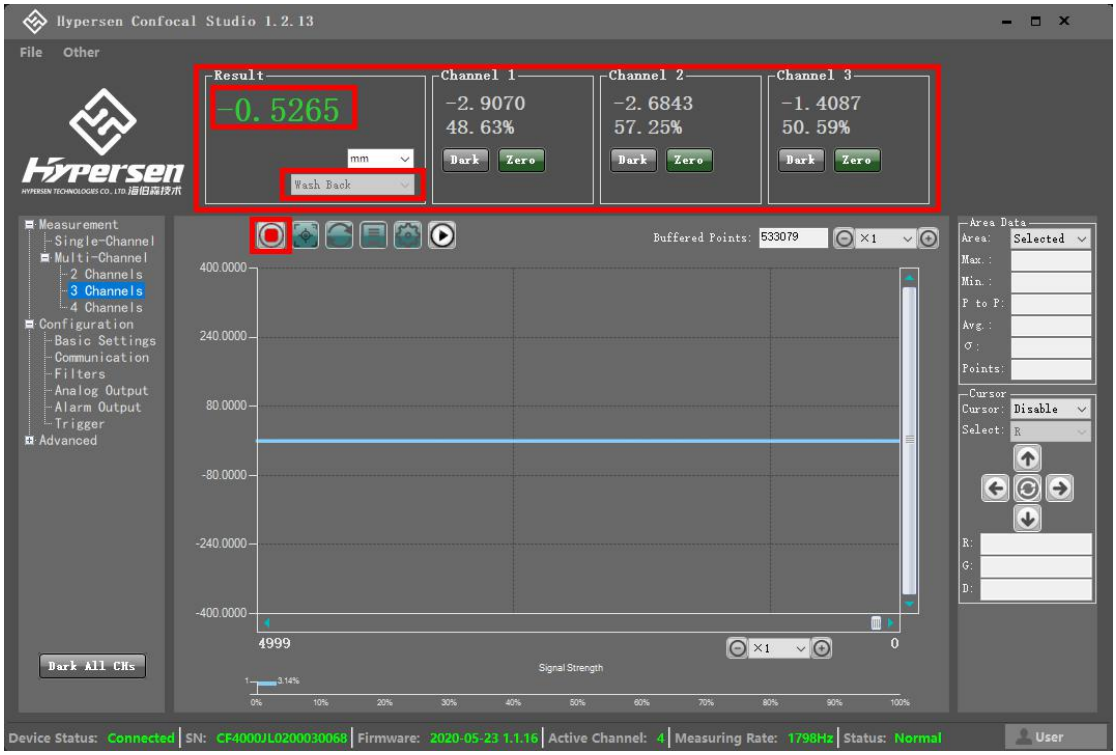


- Step 3: Configure [Light Signal Intensity] (automatic light adjustment can be used) and [Signal Detection Threshold] (It must be ensured that at least 1 peak is detected in both channels) of each channel. Refer to [3.1.2 Sampling Settings].



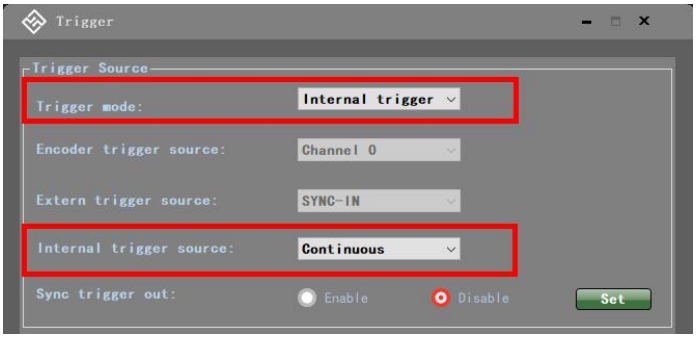
- Step 4: Click on [Start] to make a measurement.
- Select an appropriate [Unit] and configure an appropriate [Filter] for each channel. Refer to 3.1.2.5.
- The measurement results and the distance and signal intensity, etc. of the three channels are displayed in the main interface.
- Definition: The distance value of the first channel, the second channel and the third channel is D1, D2 and D3 respectively.

  Calculation of measurement results: Result = D2-(D1 + D3) / 2

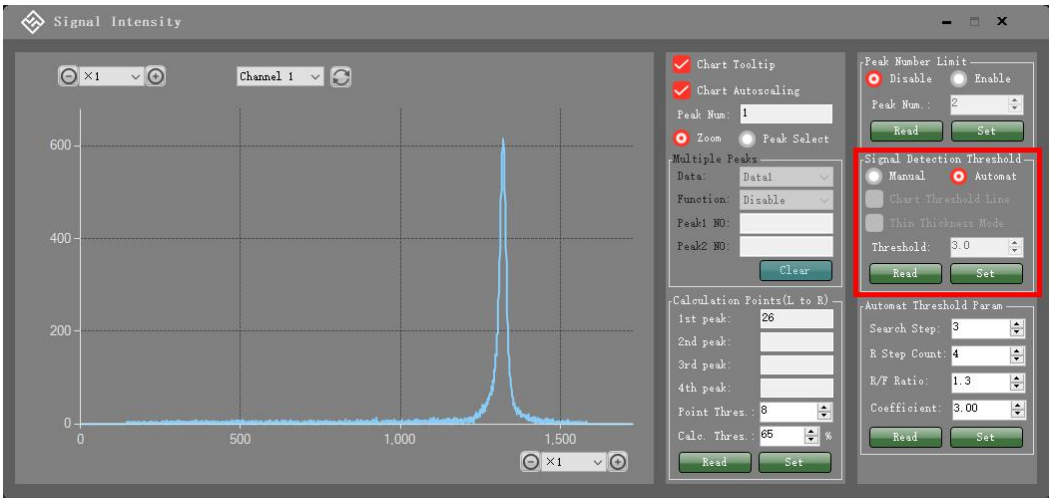


3.2.7 Measurement of flatness (3 sensor heads)

- The number of sensor heads that need to be used is at least 3, and the serial number of the sensor heads must be such that Channel 1, Channel 2 and Channel 3 are paired.
- This function is used when the flatness, planeness, etc. of an object is measured.
- Step 1: Select [Function Menu] => [Measurement] => [Multi-channel] => [Three-channel] => Select the Measurement Mode [Flatness].
- Step 2: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].

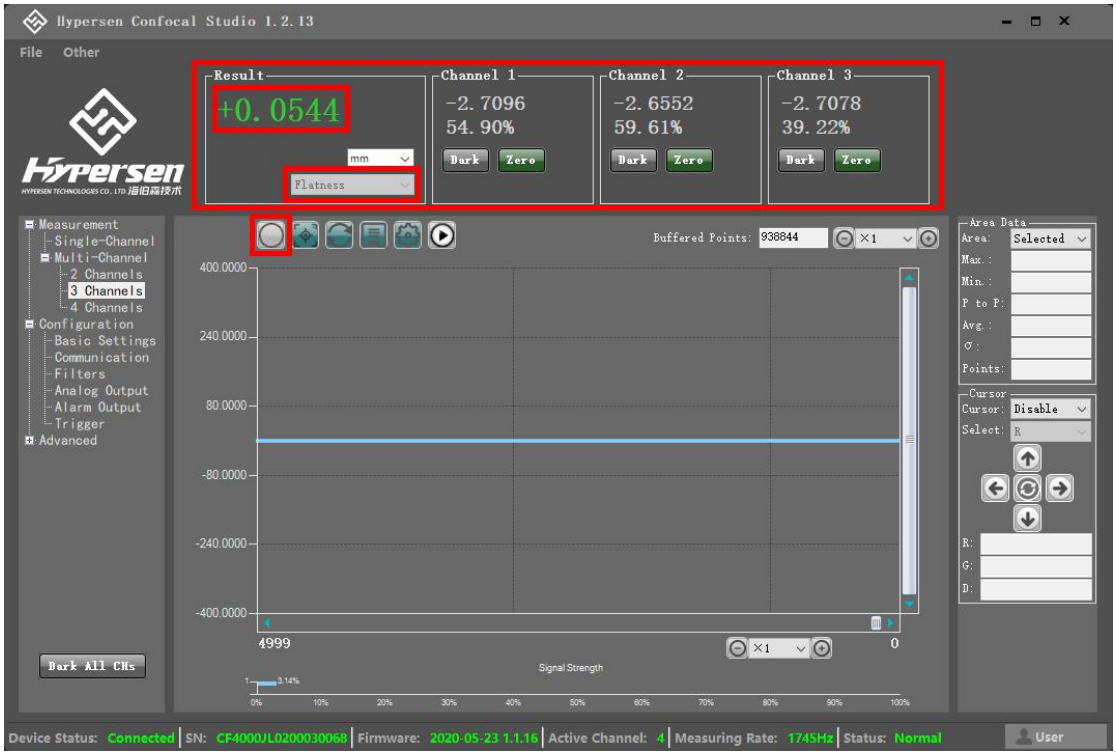


- Step 3: Configure [Light Signal Intensity] (automatic light adjustment can be used) and [Signal Detection Threshold] (It must be ensured that at least 1 peak is detected in both channels) of each channel. Refer to [3.1.2 Sampling Settings].



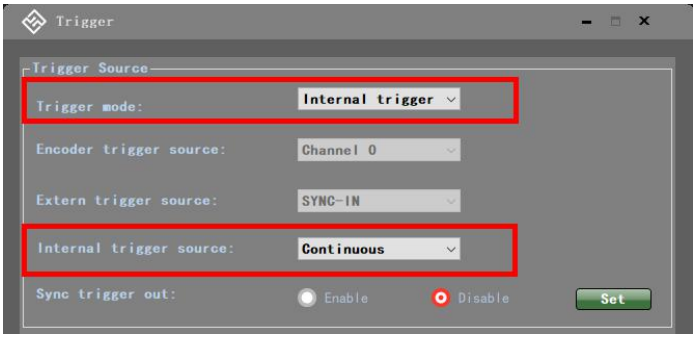
- Step 4: Click on [Start] to make a measurement.
- Select an appropriate [Unit] and configure an appropriate [Filter] for each channel. Refer to 3.1.2.5.
- The measurement results and the distance and signal intensity, etc. of the three channels are displayed in the main interface.

- Definition: The distance value of the first channel, the second channel and the third channel is D1, D2 and D3 respectively.
  Calculation of measurement results: Result = Max (D1, D2, D3) – Min (D1, D2, D3)

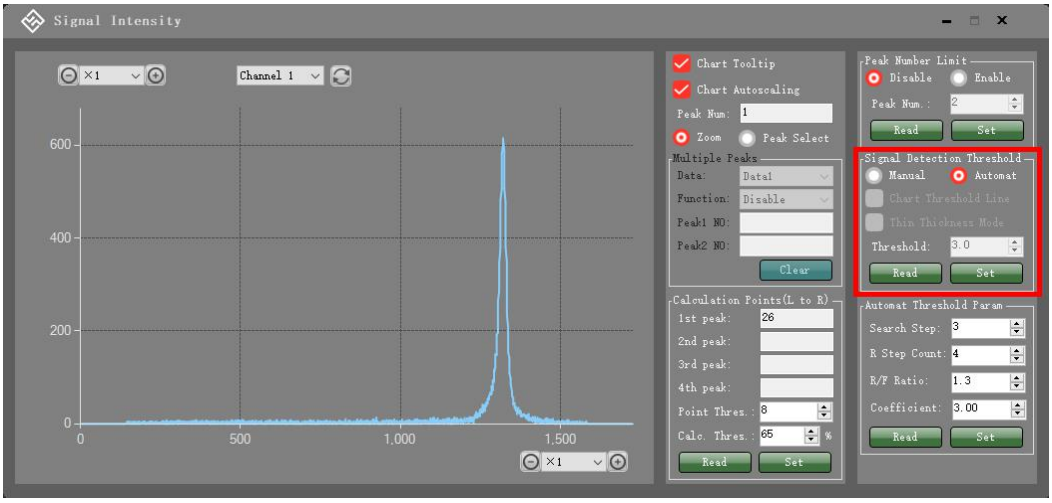


3.2.8 Measurement of mean height (4 sensor heads)

- The number of sensor heads required: 4.
- This function is used when the mean height, etc. of an object is measured.
- Step 1: Select [Function Menu] => [Measurement] => [Multi-channel] => [Four-channel] => Select the Measurement Mode [Mean Height].
- Step 2: Check whether or not the [Trigger Mode] is in the [Continuous] mode under the [Internal Trigger] mode. Refer to [4.1.2 Setting of Trigger Mode].

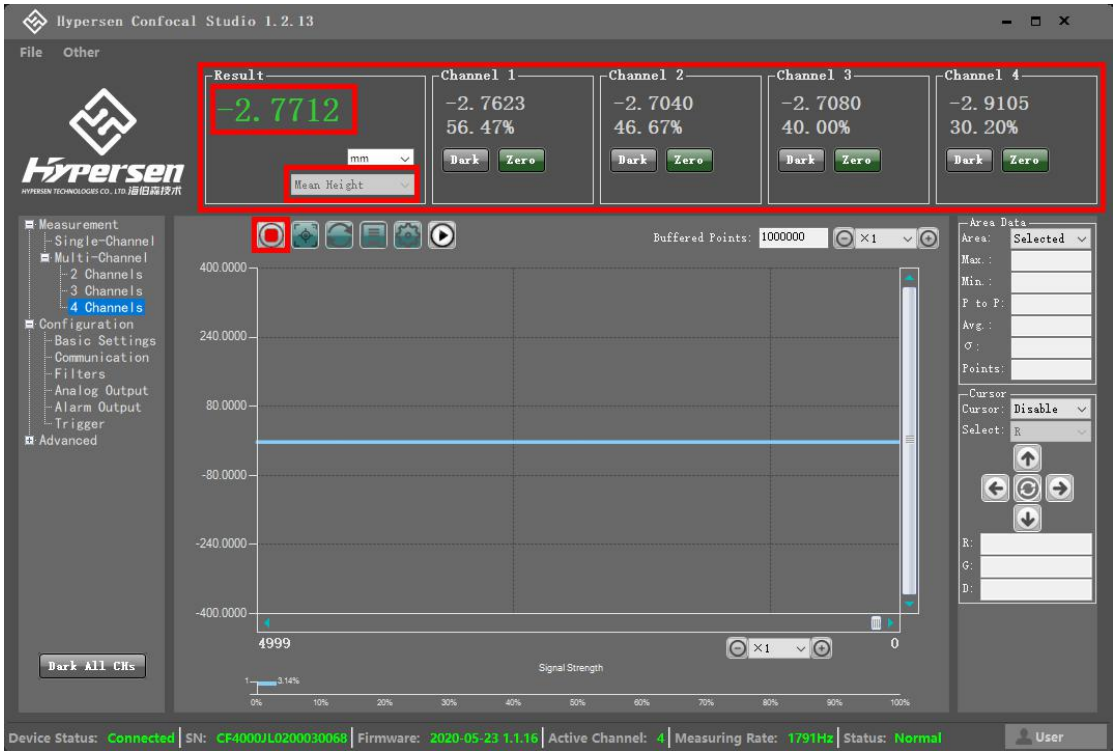


- Step 3: Configure [Light Signal Intensity] (automatic light adjustment can be used) and [Signal Detection Threshold] (It must be ensured that at least 1 peak is detected in both channels) of each channel. Refer to [3.1.2 Sampling Settings].



- Step 4: Click on [Start] to make a measurement.
- Select an appropriate [Unit] and configure an appropriate [Filter] for each channel. Refer to 3.1.2.5.
- The measurement results and the distance and signal intensity, etc. of the three channels are displayed in the main interface.
- Definition: The distance value of the first channel, the second channel, the third channel and the fourth channel is D1, D2, D3 and D4, respectively.

  Calculation of measurement results: Result = Ave (D1, D2, D3, D4)

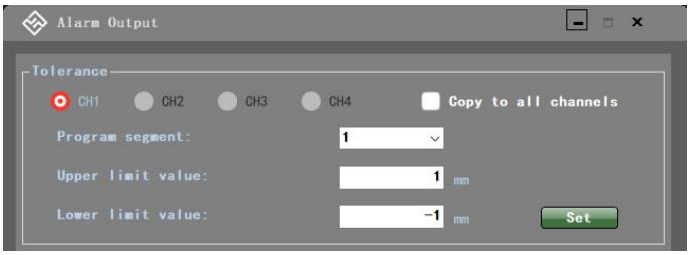


3.3 Setting of judgment output

- There are multiple I/O outputs on the controller for judgment of measurement results.
- I/O ports, including four-channel analog outputs, four alarm outputs, synchronous measurement pin outputs, etc.

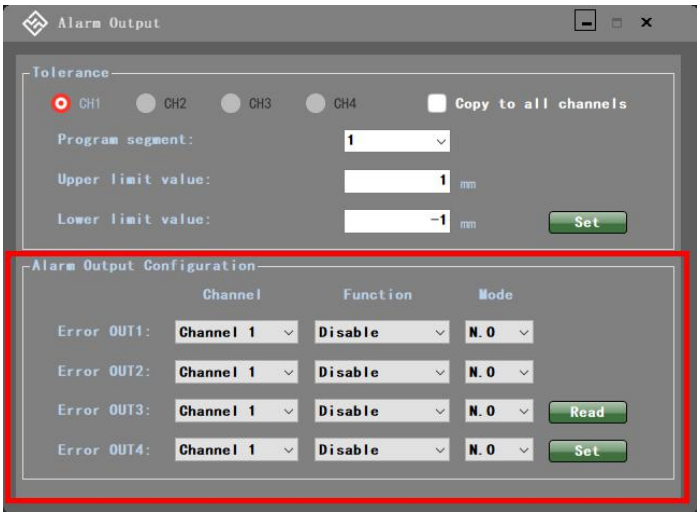
3.3.1 Setting of program segment/tolerance

- Each channel has its own 8 program segments. The program segment contains program segment ID (1~8), tolerance upper limit and tolerance lower limit. The enabled program segment is Program segment 1 by default and the upper and lower limits of the tolerance are ± 99mm by default. Set it in [Function Menu] =>[Configuration]=> [Alarm Output] =>[Tolerance].
- Select the [Designated Channel], then select [Enabled Program Segment ID/Program Segment with Tolerance].
  If the tolerance is configured, enter the upper and lower limits of the tolerance.
  To enable the program segment ID of this channel, then select the program segment from the pull-down list.
  When the configuration is done, click [Set].
- When the setting of the program segment ID is done, check [Copy to All Channels], then each channel will be set with the current program segment ID and program segment tolerance.



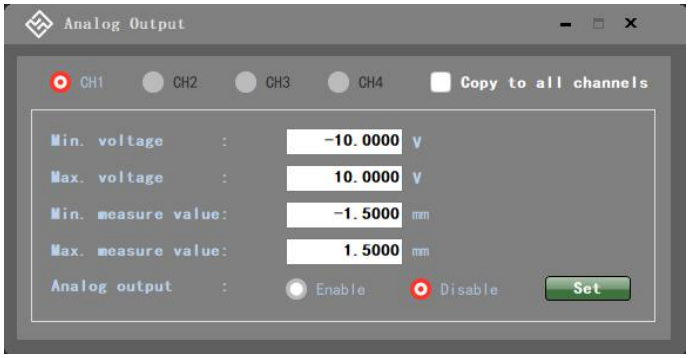
3.3.2 Alarm output

- Each I/O alarm output port can be bound to any channel, any function under the designated functions, and the initial state of the output with a high flexibility. The I/O alarm output ports are optocoupler output.
- Set it in [Function Menu] => [Configuration] => [Alarm Output] => [Alarm Output Configuration] => [Tolerance].
- Example: four alarm outputs are used, which correspond to the four status of Channel 1. The four status is being higher than the upper limit of tolerance [HI], being lower than the lower limit of tolerance [LO], weak signal reflection and signal saturation. The default initial output status is normally opened photocoupler.



3.3.3 Analog output

- Each channel is equipped with 1-channel analog output. The maximum range of the analog voltage of the controller is [-10V~10V], and the [Mapping Relationship Between Voltage and Measured Value] is configured as needed. Whether or not to enable the analog output can be set. Set it in [Function Menu] => [Configuration]=> [Analog Output].
- Select the designated channel, enter the mapping relationship between the analog voltage range and the measured value, and select [Enable] => Click [Set].



IV. General settings and functions

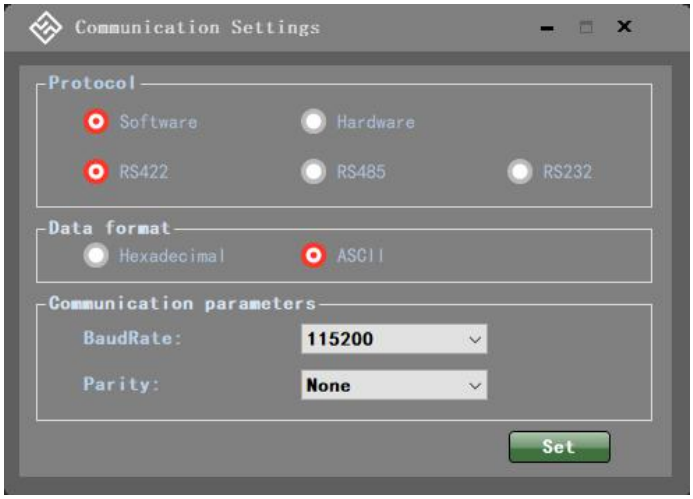
4.1 Environment setting

- The main communication interface of the chromatic confocal controller is a USB communication interface. RS485/RS422/RS232 communication interfaces, which are for auxiliary communications, can be configured with/get some simple parameters.
- Setting of trigger mode
  Internal trigger of controller: consecutive trigger mode and single trigger mode

Timing trigger of controller.
Encoder trigger: 3-channel encoder trigger (optional)
External trigger

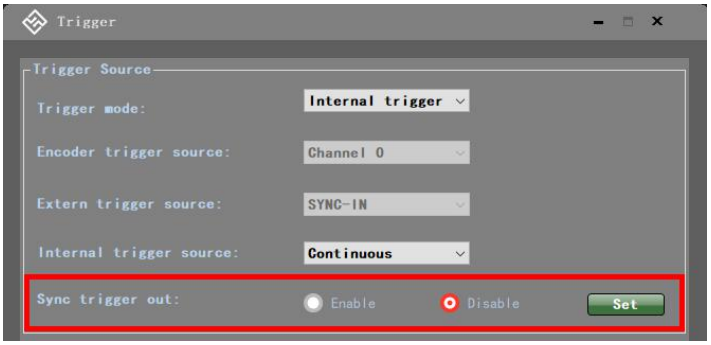
4.1.1 Setting of RS485/RS422/RS232 communication

- RS485/RS422/RS232 communication configuration is carried out in [Function Menu] => [Configuration] => [Communication].
- The communication configuration will be saved after [File] => [Save Current Configuration] and will be automatically loaded when it is started next time.
- RS485/RS422/RS232 communication can be set with/get some simple parameters of the controller. For communication commands, refer to [Chromatic Confocal Sensor-RS422-RS232-RS485-Communication Protocol Configuration and Command Manual].



4.1.2 Setting of trigger mode

- In each trigger mode, the output signal of [Synchronous Trigger of Pins] can be enabled. In [Function Menu] => [Configuration] => [Trigger Setting].

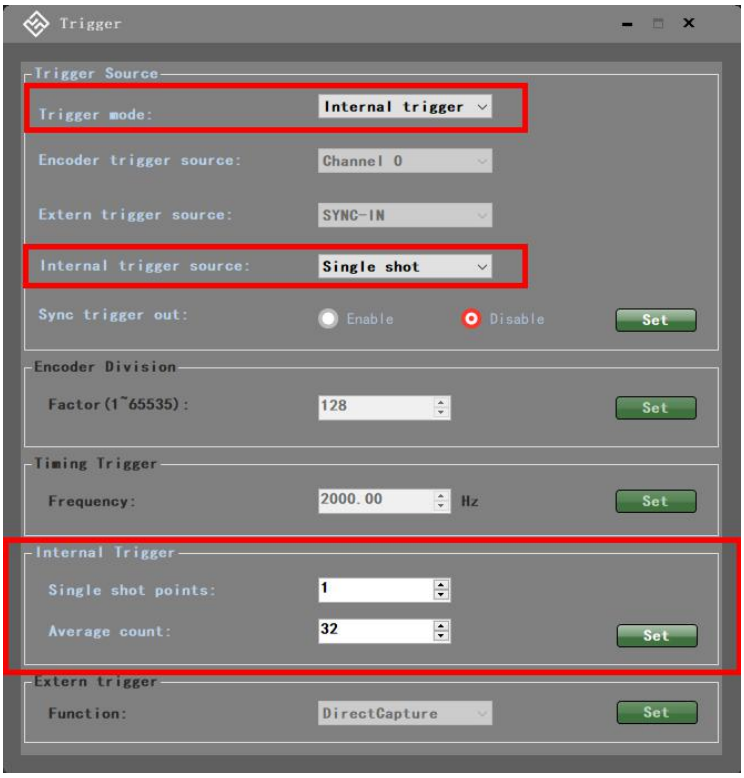


4.1.2.1 Internal trigger of controller

- Internal trigger mode of controller: consecutive collection mode and single collection mode.

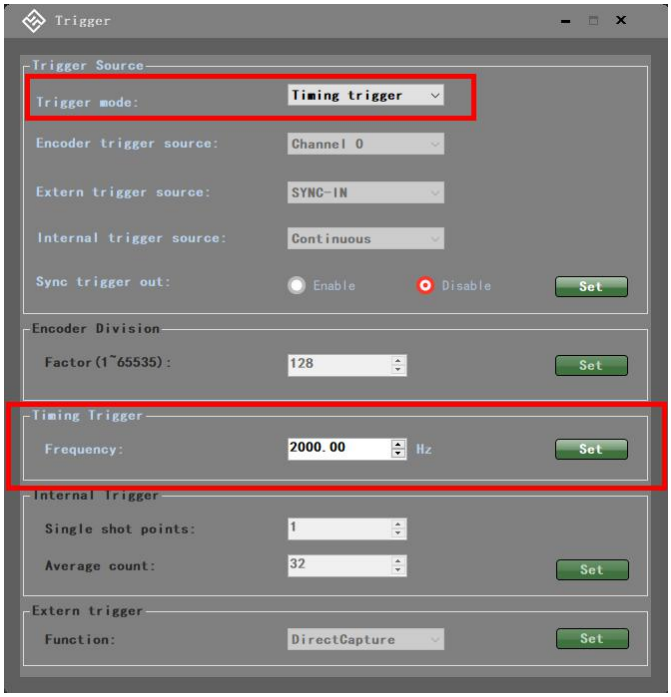
- In the consecutive collection mode (the default collection mode of the system), the measurement rate is determined by the controller, and the configuration is shown below.

- In the single collection mode, you can set the number of points for a single collection and each output data is the average of samples taken. The configuration is as follows (the output is 1 value by default, which is obtained by averaging 32 samples).



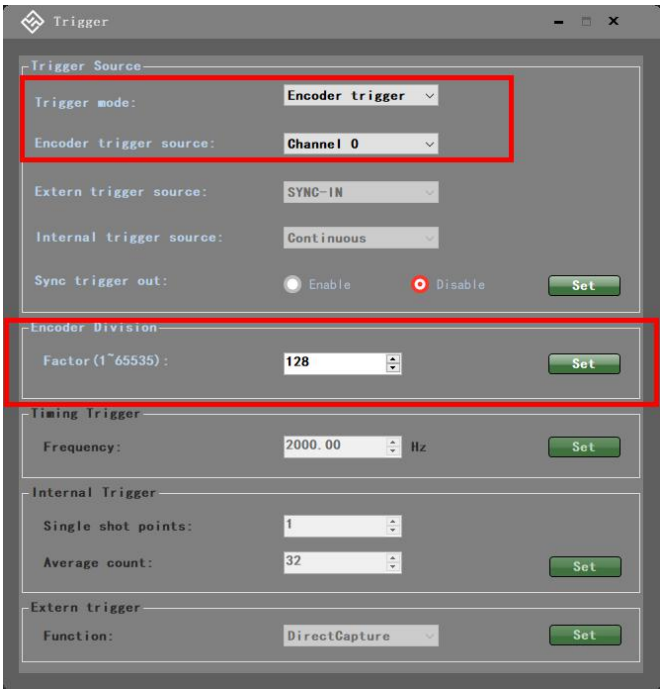
4.1.2.2 Timing trigger of controller

- In the timing trigger of controller, the measurement rate is determined by the controller and can be set. If the set measurement rate exceeds the maximum measurement rate currently supported by the controller, the controller will take measurements at the highest measurement rate. (The factors that affect the measurement rate: the number of channels that are connected and enabled, the integration time, etc.).



4.1.2.3 Encoder trigger

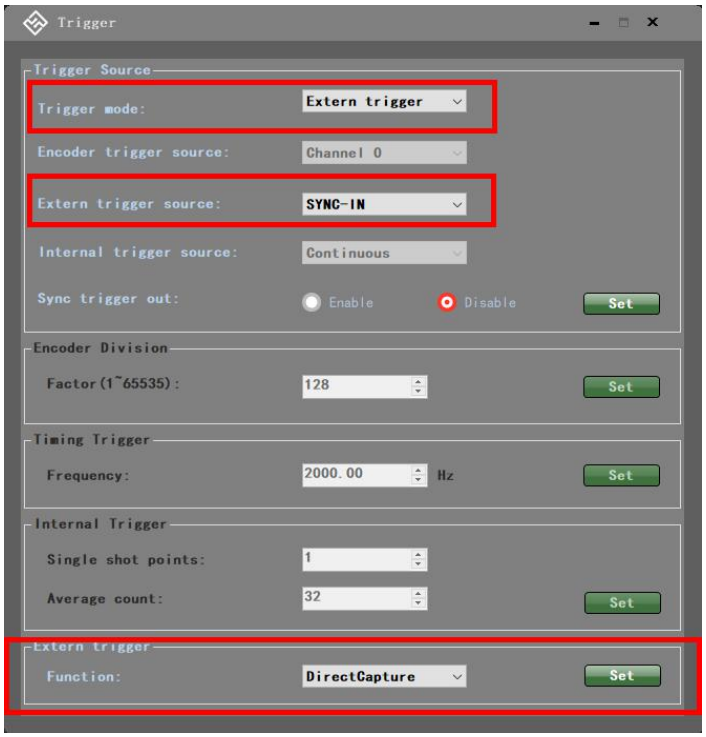
- In the encoder trigger mode, a trigger source (3 encoder trigger sources are available for selection) is selected. The measurement rate is determined by external encoder pulses and can be controlled by adjusting the steps of the encoder. If the set measurement rate exceeds the maximum measurement rate currently supported by the controller, the controller will take measurements at the highest measurement rate.
- Encoder steps (the minimum is 64), that is, one collection is triggered only when the set number of pulses is received. Purpose: To avoid too many pulses and exceeding the maximum measurement rate.



- **When the encoder trigger is used, the median/average filter needs to be disabled.**
- **In case of single-channel measurement and scanning a transparent test object, the multi-distance output needs to be enabled and the index of the main output shall be selected.**

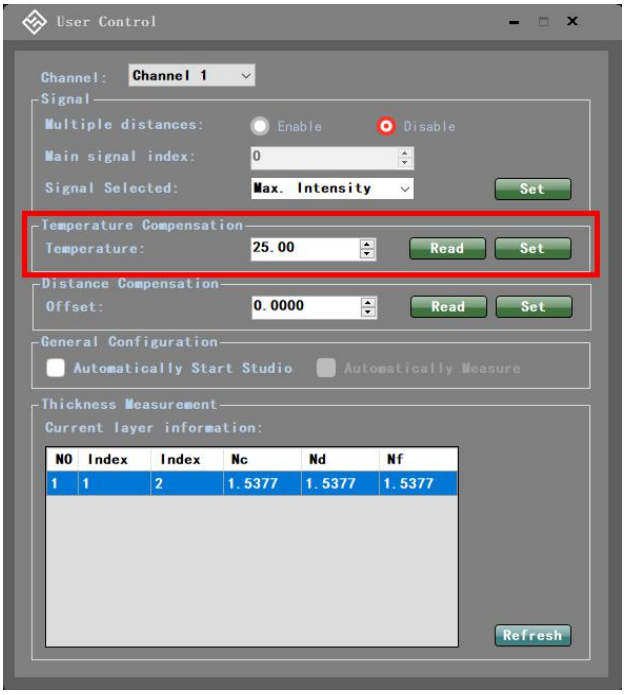
4.1.2.4 External trigger

- In the external trigger mode, the external trigger source [Synchronous Input Pin Trigger] shall be selected. The measurement rate is determined by the pulses of external synchronous input pins and can be controlled by adjusting the pulse frequency of the synchronous input pins. If the set measurement rate exceeds the maximum measurement rate currently supported by the controller, the controller will take measurements at the highest measurement rate.



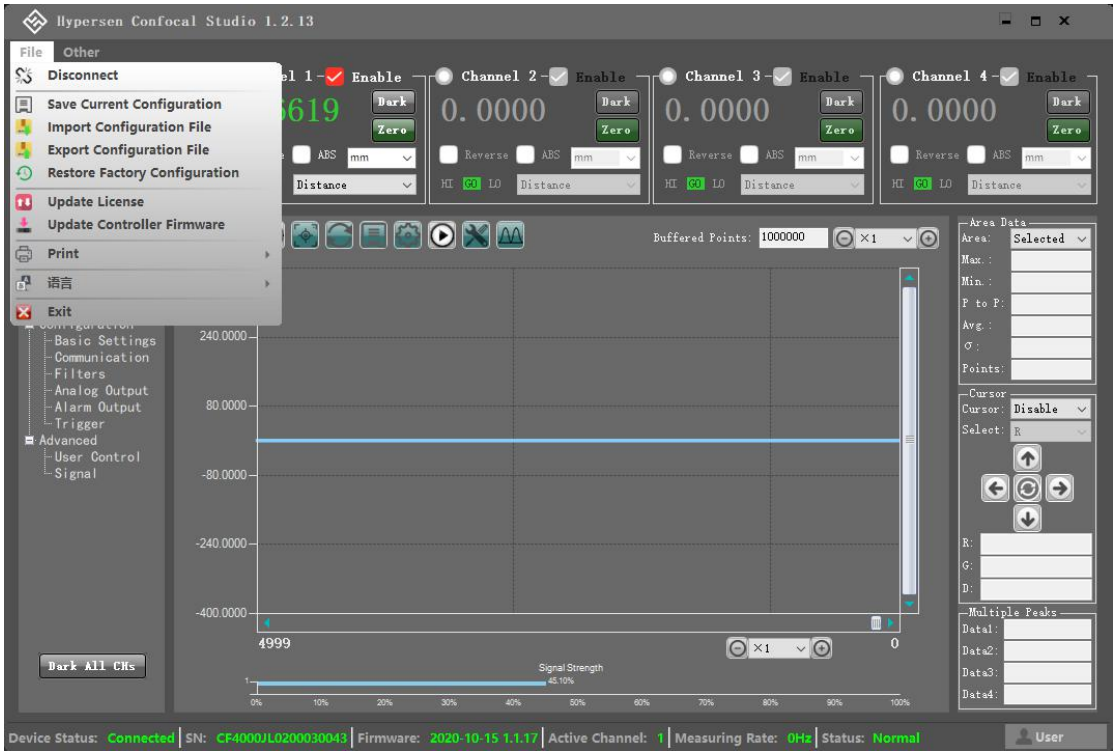
4.2 Temperature compensation

- Temperature compensation is for the temperature (constant) of the current working environment of the designated sensor heads. Perform temperature compensation in [Function Menu] => [Advanced Settings] => [User Control] => [Temperature Compensation (Sensor Head)]. Just enter the ambient temperature where the sensor heads are currently located.



4.3 Setting of configuration file

- The setting of the configuration file is highly flexible. The user's current configuration of the controller (excluding the configuration on the client software) can all be saved. When adjustment for each measurement mode is done, the configuration file can be exported and imported into another controller to achieve unified configuration. If the configuration has errors, just restore the factory configuration.



4.3.1 Save the current configuration

- Click on [Main Menu] => [File] => [Save the Current Configuration] to save the current configuration of the controller.

4.3.2 Import the configuration file

- Click on [Main Menu] => [File] => [Import the Configuration File] to import the configuration file to a controller.

4.3.3 Export the configuration file

- Click on [Main Menu] => [File] => [Export the Configuration File] to export the current configuration of the controller to the configuration file.

4.3.4 Restore the factory settings

- Click on [Main Menu] => [File] => [Restore the Factory Settings] to restore the current configuration of the controller to the factory configuration.

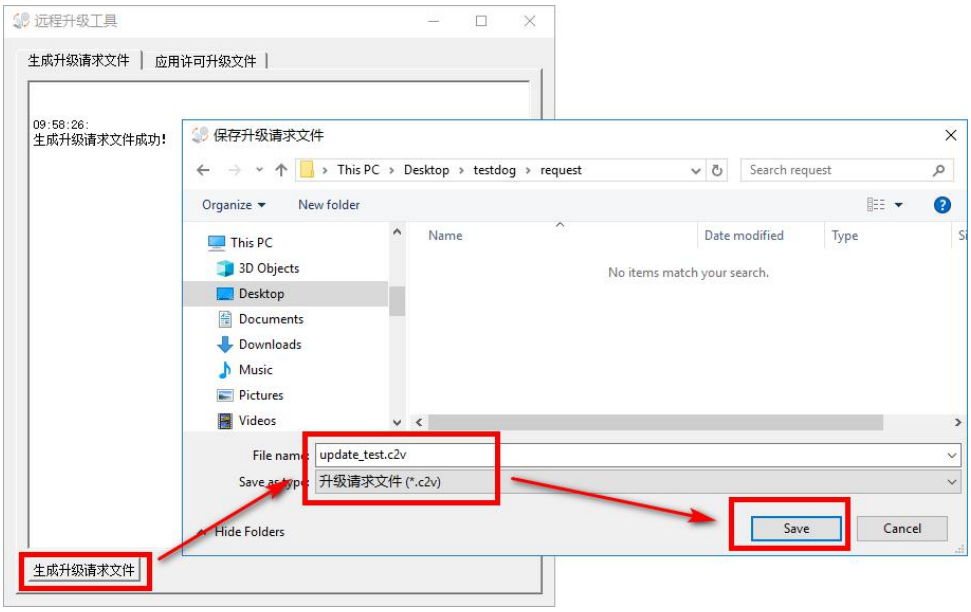
4.4 Update the license

- When the connection to the controller fails, an error of [NoFoundDog]/about [License] is reported. The failure may be caused by the following:

Reasons	Handling method
NofoundDog/License loading failed	Please confirm whether the USB cable is correctly connected (USB3.0 port)
License expired	[4.4 Update the License] operation is required

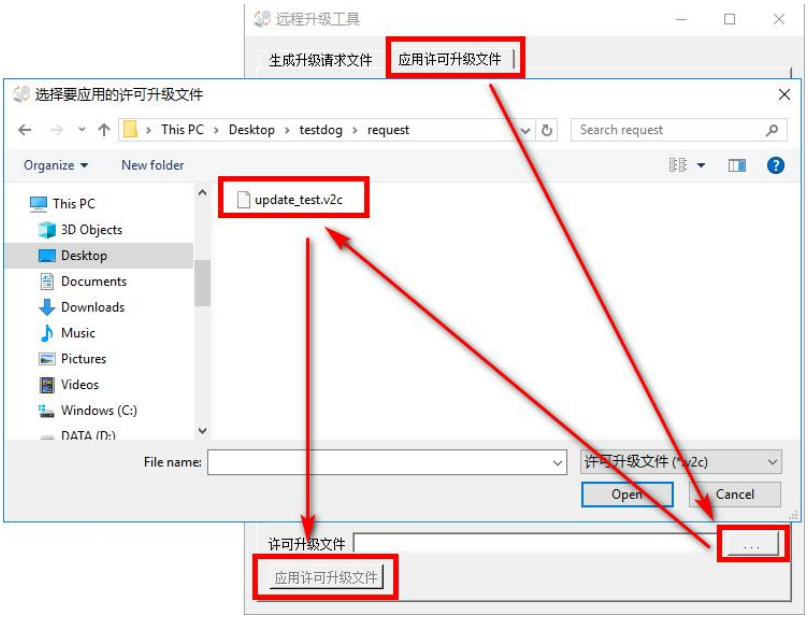
4.4.1 Generate the upgrade request file

- Connect the controller to the PCUSB3.0 interface and open [Main Menu] => [File] => [Update the License] to upgrade the license.
- Click on "Generate the Upgrade Request File", save it in the "*.c2v file" format and send the generated "*.c2v file" to the relevant after-sales personnel of our company (contact Hypersen Technologies Co., Ltd., sales@hypersen.com).



4.4.2 Apply the license upgrade file

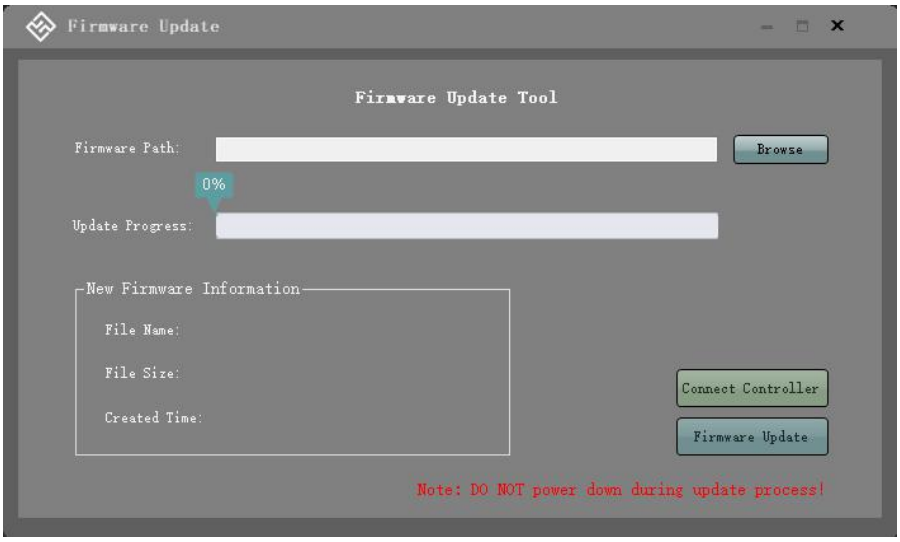
- After receiving the "*.v2c" file sent back by our company, please connect the [Original Controller] to the PCUSB3.0 interface, and open [Main Menu] => [File] => [Update the License] to upgrade the license.
- Select "Apply the License Upgrade File," browse the license upgrade file, and click on "Apply the License Upgrade File."



4.5 Update the controller firmware

- Before updating the controller firmware, you need to connect it to the controller.
- Update in [Main Menu] => [File] => [Update the Controller Firmware]. Once you are in the [Firmware Update Tool] interface, the entire controller will be automatically disconnected and only the channel to be upgraded will be opened. Click [Browse] => Find the designated firmware, and click on [Open] => Some information about the new firmware (firmware name/size of firmware file/creation time of firmware) will be displayed in the interface => Click on [Firmware Update] to update the firmware.
- **During the update, do not disconnect the power! Do not perform any operations to avoid update failure.**
- **If an update fails, you can update it again, but do not disconnect the power.**
- When the update is successfully done (and the success mark is shown), disconnect the

power and restart the controller.

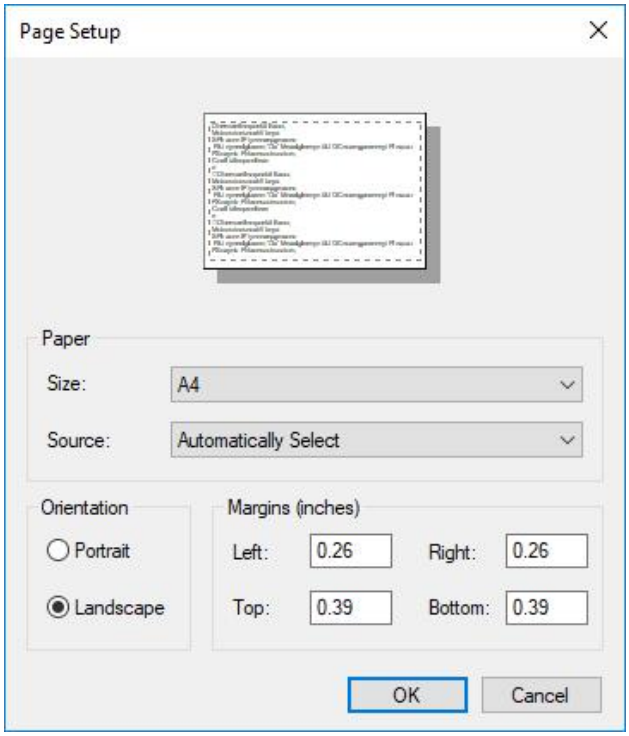


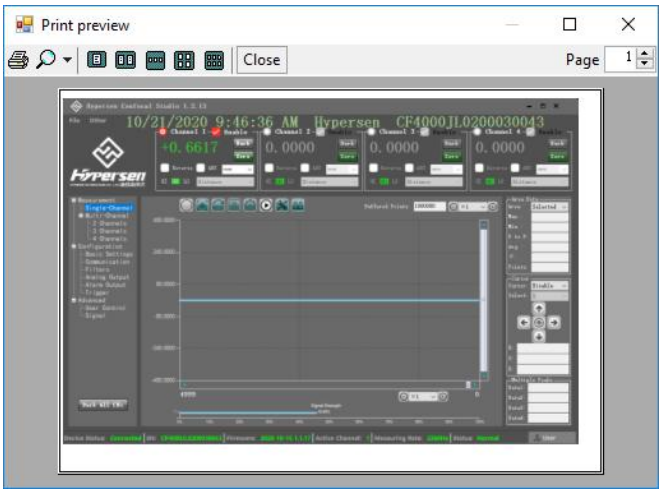
Troubleshooting:

- If it prompts [Controller connection failed] when you open the [Firmware Update Tool] interface, click on [Connect the Controller] in the interface to reconnect it.

4.6 Print

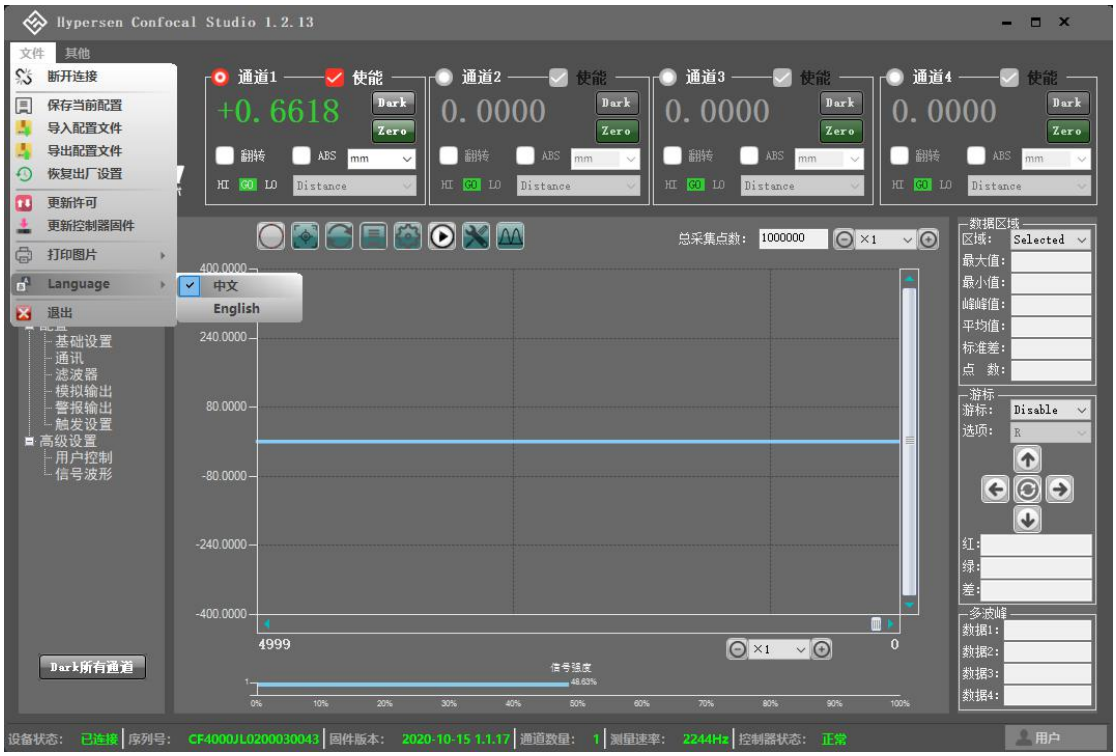
- In [Main Menu] => [File] => [Print Picture], print the picture of the entire client interface at this time.
- Print: Page setup/print preview/print.





4.7 Language

- In [Main Menu] => [File]=> [Language] => [中文], you can switch between Chinese and English.

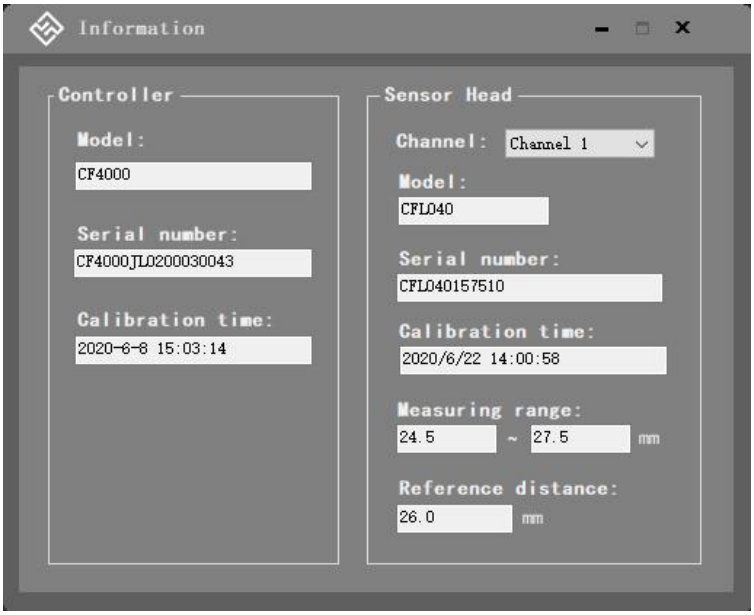


4.8 Others

4.8.1 Product details

- In [Main Menu] => [Others] => [Details], you can view the details of this controller.
- Controller: model, serial number and calibration time.

- Sensor head: model, serial number, calibration time, measurement range and reference distance (installation distance).



4.8.2 Help document

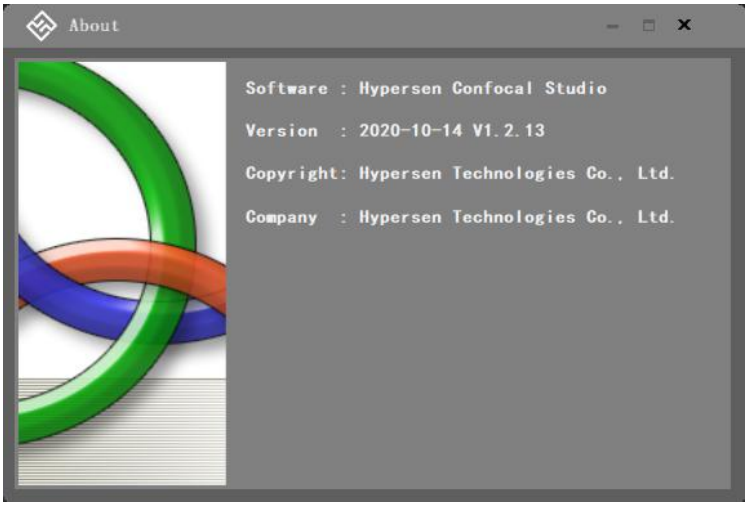
- In [Main Menu] => [Others] => [Help], view the Help document (User manual of client software), invoke and display the document that controls the internal U disk (Install tools such as WPS/PDF reader before use).

Troubleshooting:

Reasons	Handling method
USB not found	Confirm whether or not the USB cable is correctly connected and check whether or not it exists under the system drive letter
The system cannot find the designated file	Go to the system drive letter and find the user manual

4.8.3 About

- In [Main Menu] => [Others] => [About], view some details of this software, including software name, software version, copyright and company name.



Revision history

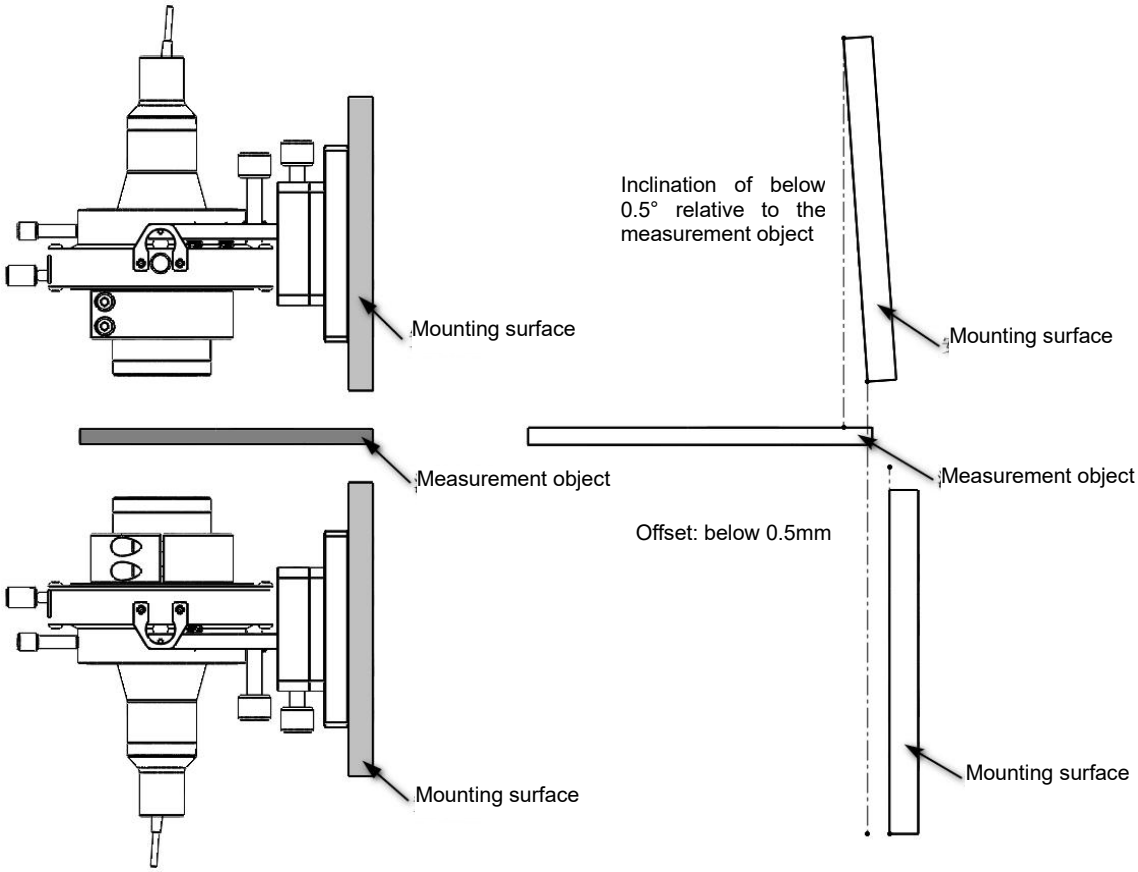
Date	Version	Description
10/20/2020	1.1	Initial version.
12/08/2021	1.2	Update installation images.
03/25/2022	1.3	Added CF2000 related configuration.

Appendix

Installation Method of the Adjustment Fixture for Double-head Thickness Measurement

Notes

- The adjustment fixture for thickness measurement is used for precise adjustment during the "optical axis alignment" for thickness measurement.
- If the installation error exceeds the value shown in the figure below, it may result in the inability to align the optical axis within the adjustment range or cause a fixed deviation in measurement results.
- Please confirm the installation environment.
- Turn the Z-axis knob to the center. For the distance from the center of the measurement object to the end face of the fixture, refer to the reference distance in the [Data Manual of Sensor Head] for installation. It is preferable to install it to the center of the range of the sensor head.

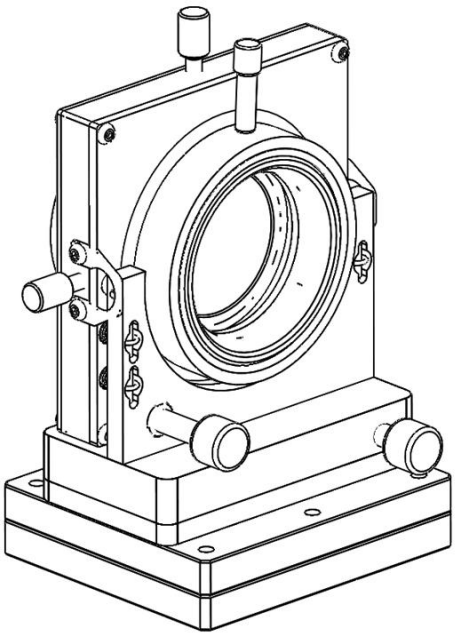


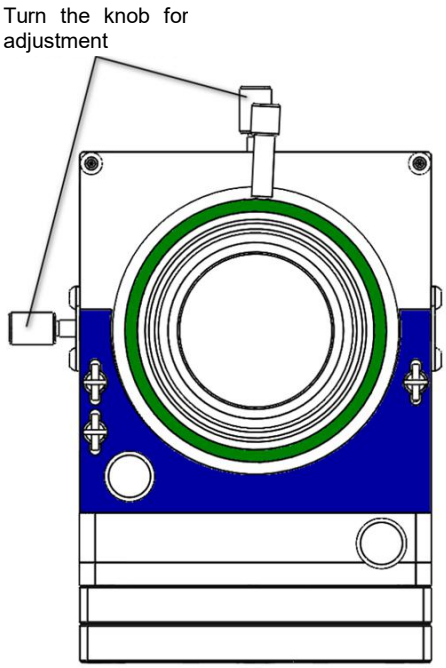
Simply align the origin before installation

- The origin of the adjustment fixture for thickness measurement has been adjusted in the factory.
- In the case of reinstallation after use, etc., align the origin as described below. Subsequent adjustments will be easier.

1. Simply align the origin for the X/Y axis

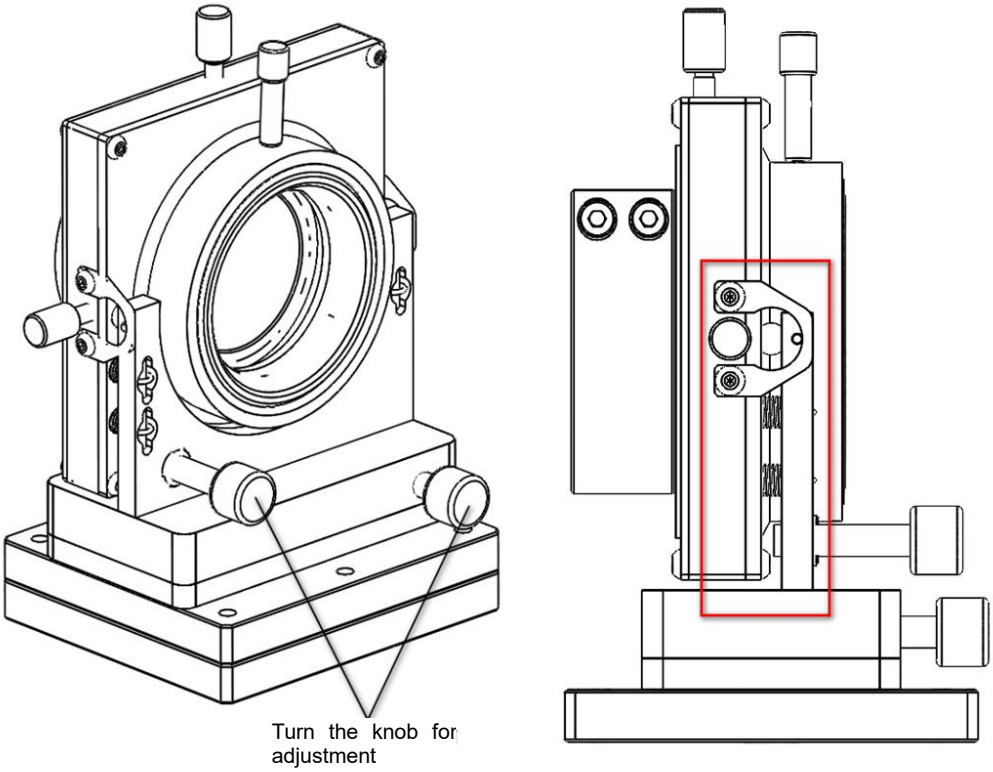
- Turn the knob of the X/Y-axis direction so that the blue area and the green area are in a concentric circle.





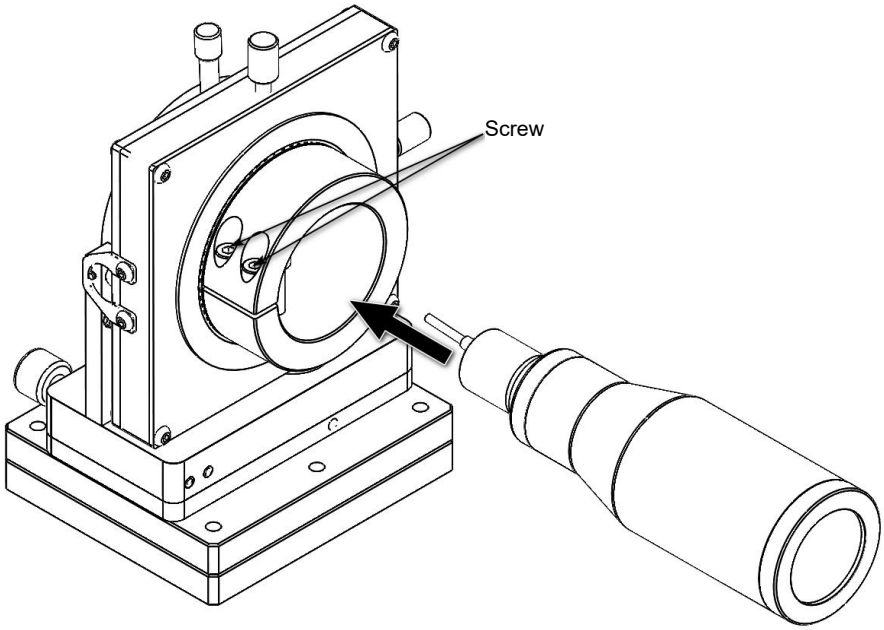
2. Simply align the origin in case of tilting

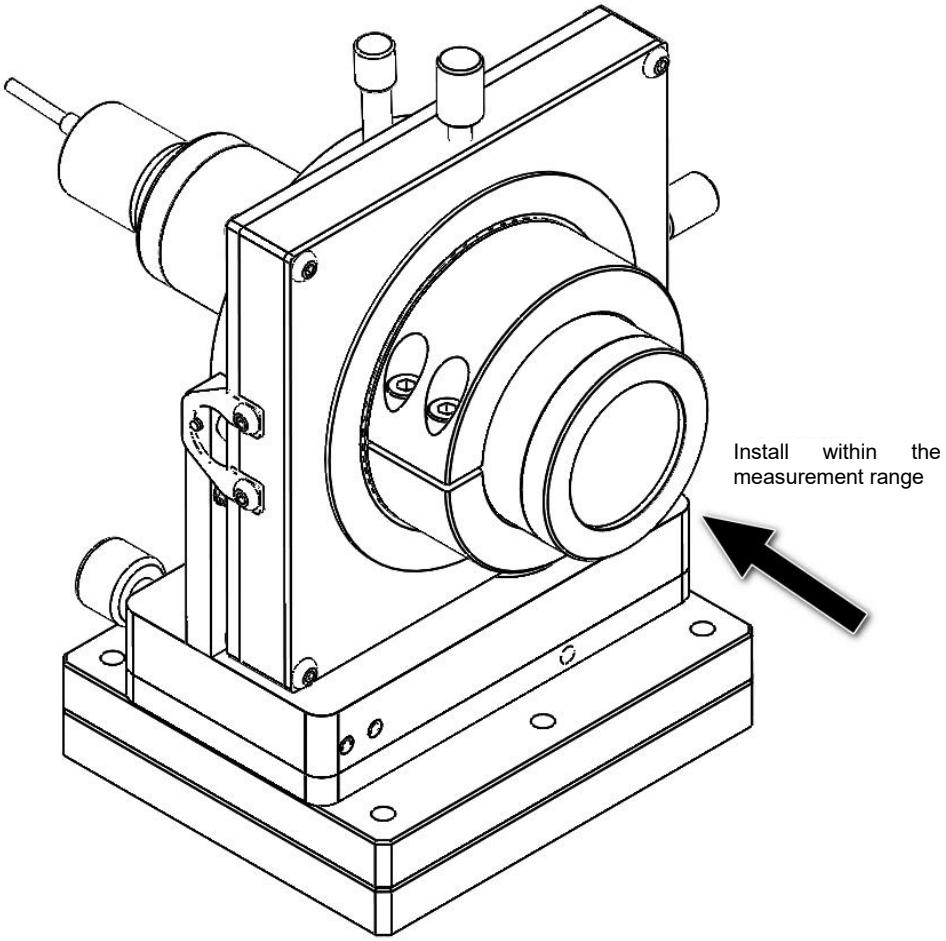
- Turn the Z-axis vertical knob so that the gaps in the red box are parallel.
- You can view them with a level meter.



Install the sensor head

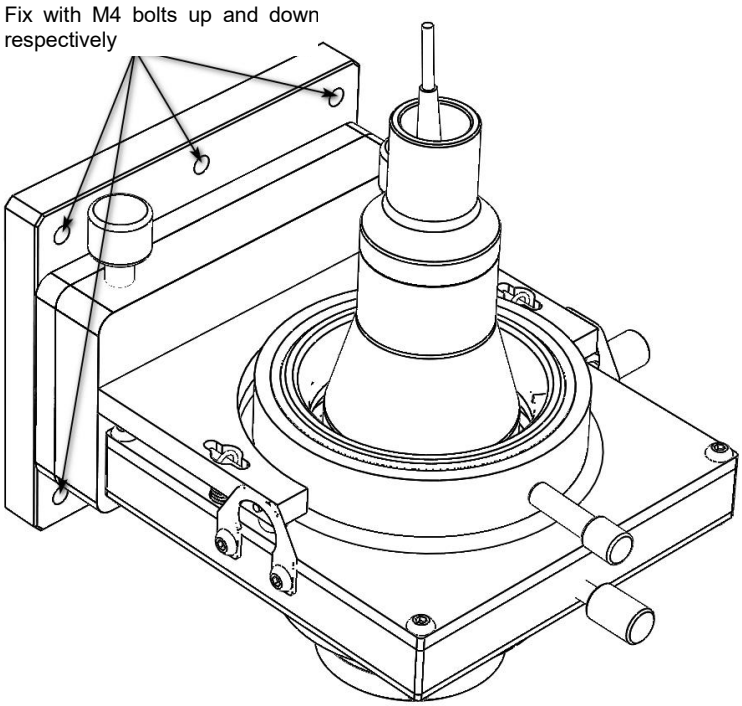
- Loosen the screws (2) and install the sensor head on the fixture.
- Note that the sensor head must be installed within the detection range, otherwise the [Double-head Calibration] may not be performed.

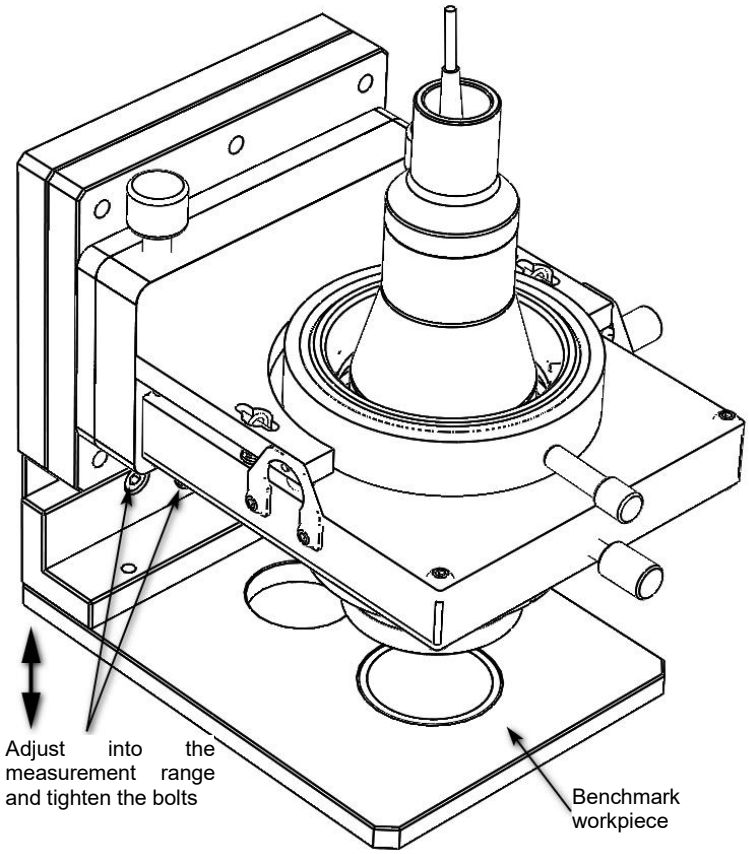


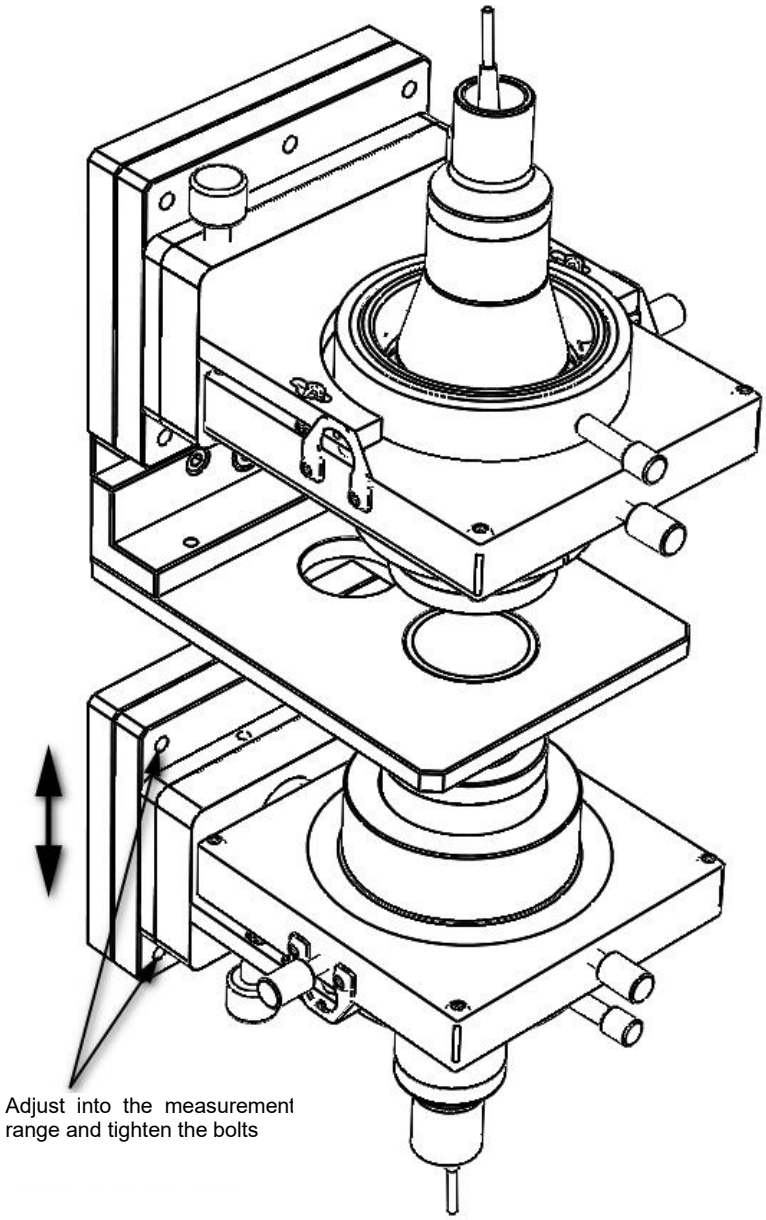


Install the fixture

- Use 6 M4 screws to fix the fixture to the mounting surface.
- Pay attention to the angle between the fixture and the mounting surface. Note that the sensor head must be installed within the detection range, otherwise the [Double-head Calibration] may not be performed.
- When the installation is done, you can perform the double-head calibration. Refer to [3.2.5.1 Double-head Calibration Function].


Fix with M4 bolts up and down respectively


Adjust into the measurement range and tighten the bolts
Benchmark workpiece


Adjust into the measurement
range and tighten the bolts

Troubleshooting

When the measured value is unstable or incorrect

Phenomenon	Contents to be checked	Handling method
The measured value is shown with a deviation	Is the filter set?	Please set the filter correctly.
	Is there dust or dirt on the glass in front of the lens?	Please wipe off the dust and dirt.
	Are there scratches or cracks on the glass of the lens?	The glass in front of the lens needs to be replaced. Please contact Hypersen Technologies Co., Ltd.
	Is there any dust on the surface of the optical fiber connector?	If any dust, wipe it off with a cotton swab wetted with alcohol.
	Are there water drops, oil drops or other droplets in the operating environment?	Please remove droplets with a gas curtain.
	Has mutual interference occurred?	• Please use the mutual interference prevention function or the light emission control function. • Please change the installation position of the measurement part.
	Is there any strong interference light?	Please block out the interference light.
	Does the measurement object or measurement part vibrate?	Please take anti-vibration measures.
	Is a correct measurement mode set for the sensor head?	Please set the measurement mode correctly.
The measured value is shown with an offset	Does the measurement object have an inclination or position offset?	Please put the measurement object into the measurement range correctly.
	Are the settings for the refractive index correction correct?	Please set the measurement mode correctly.
	Is there a great temperature change in the operating environment?	• Please keep the temperature in the operating environment stable. • Set the temperature compensation for the sensor head.

When a fault is suspected

Phenomenon	Contents to be checked	Handling method
The POWER/STATUS LED does not turn on after the controller is connected to the power supply.	Is the power cable connected correctly?	Please connect the power cable correctly.
	Is a power supply used within the rated value range?	Please use a power supply which is within the rated value range.
The STATUS LED of the controller is on red.	Is the USB cable disconnected abnormally?	Please reconnect the USB cable.
	Are the PC software and SDK disconnected abnormally?	Please follow the steps to operate the software correctly.
The sensor head does not emit light.	Are the PC software and SDK correctly connected to the controller?	Please connect it to the controller correctly.
	The controller [Trigger] is set to the encoder mode. Has the encoder pulse signal been received?	• Change the trigger mode of the controller. • Please input the encoder pulse signal correctly.
The controller cannot be connected.	Is the driver installed correctly?	Please refer to [1.3] for driver installation.
	Check if the USB cable is loose? Is it connected to the USB3.0 port on the PC?	Please connect the USB cable correctly and make sure that it is not loose. Please connect it to the USB3.0 interface on the PC.
	Check whether or not the license has expired?	Please contact Hypersen Technologies Co., Ltd.
The measured value is shown as [------].	Is the measurement object within the measurement range of the sensor head?	Please place the measurement object within the measurement range.
	Please confirm the display of the signal waveform. Does the signal peak become lower?	• When the light adjustment mode is [Manual], please change it to [Automatic]. • Please confirm whether or not there is some reflected light blocked out by obstacles? • Please set a reasonable detection threshold. • Please increase the integration time. • Please perform [Dark] again.

	Please confirm the display of the signal waveform. Is the signal peak highly saturated?	• When the light adjustment mode is [Manual], please change it to [Automatic]. • Please perform [Dark] again.
	Please confirm whether or not the main peak index is set?	It may be that the signal waveform does not have the main peak index set. Please set the main peak index correctly.
	Is automatic light adjustment selected under Double-head thickness measurement?	In the case of cross beaming, [------] will appear. If there is an object to be measured, the thickness value will be displayed.
The control input is not applied correctly.	Is the input cable connected correctly?	Please check the port introduction in the data manual. Please rewire the input terminals that do not have correct change.
It is judged that the output is not correct.	Is the output cable connected correctly?	Please check the port introduction in the data manual. Please rewire the output terminals that do not have the correct charge.
Cannot have RS232/RS422/RS485 communication with the external device.	Is the communication cable connected correctly?	Please connect the communication cable correctly.
	Please confirm whether or not the controller is correctly configured with communication parameters?	Refer to [4.1.1] for communication parameters configuration.