Laser Displacement Module
User's Manual

Product Name	**CLDM-150mm**

Approval	Notes

CMOS Sensor Inc	QA	PD	Check	Eng
USA： 20045 Stevens Creek Blvd., Suite 1A, Cupertino, CA., 95014 USA TEL：+1 (408) 366-2898 FAX：+1 (408) 366-2841 Taiwan： No. 6, Lane 276, Shiyuan Rd., Daxi District, Taoyuan City, 33551, Taiwan (ROC) TEL：+886 (3) 389-6633 FAX：+886 (3) 389-6655				

Issued	November 19, 2021	Revision	1.0

All specifications of this device are subject to change without notice

Revision History

Revision	Update	DCN No	Description	Designer
1.0	01/19/2022	Released	Preliminary	JM

CMOS Sensor Inc.

CLDM-150mm

Laser displacement Module (Triangulation)

1 Product introduction

1.1 Appearance

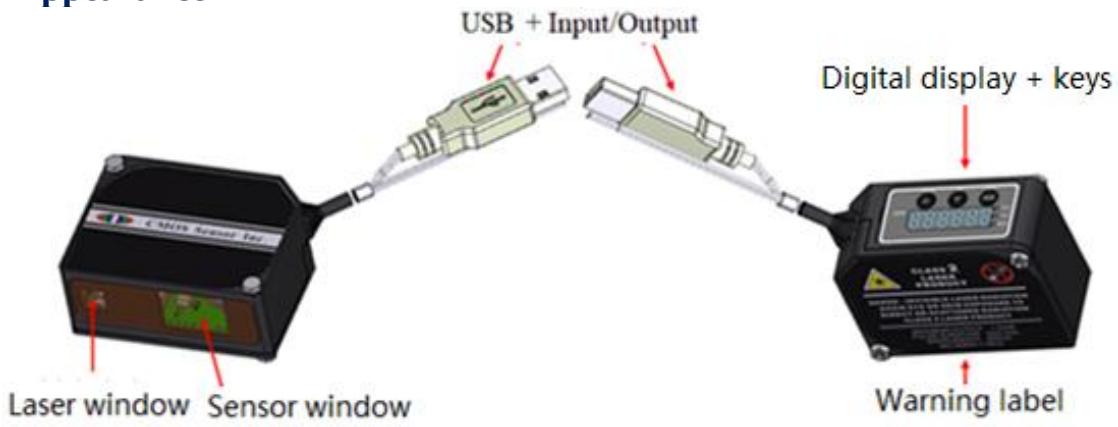


Figure 1. CLDM-150mm appearance diagram

1.2 USB and Input/Output line definition

1.2.1 Wire labeling

Connect USB 2.0 to the PC, use UI (User Interface) to observe the distance change and change the internal parameter settings (details in Chapter 3.2 Instructions for Use).

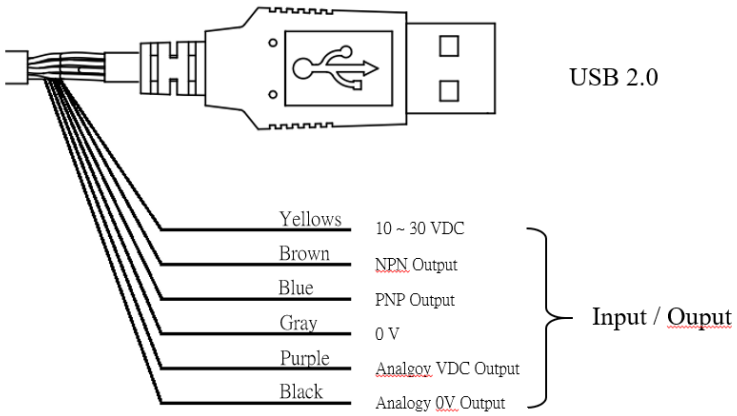
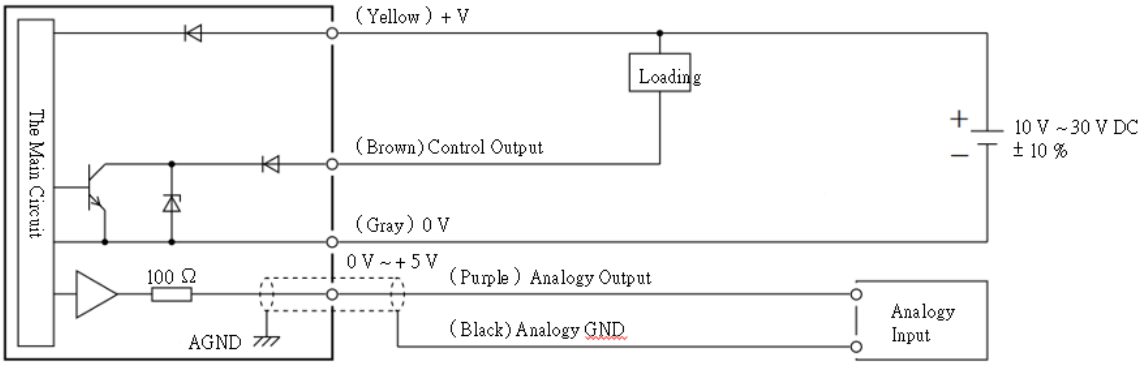


Figure 2. Wire type and color

1.2.2 Input/Output wire circuit diagram

- NPN Output



- PNP Output

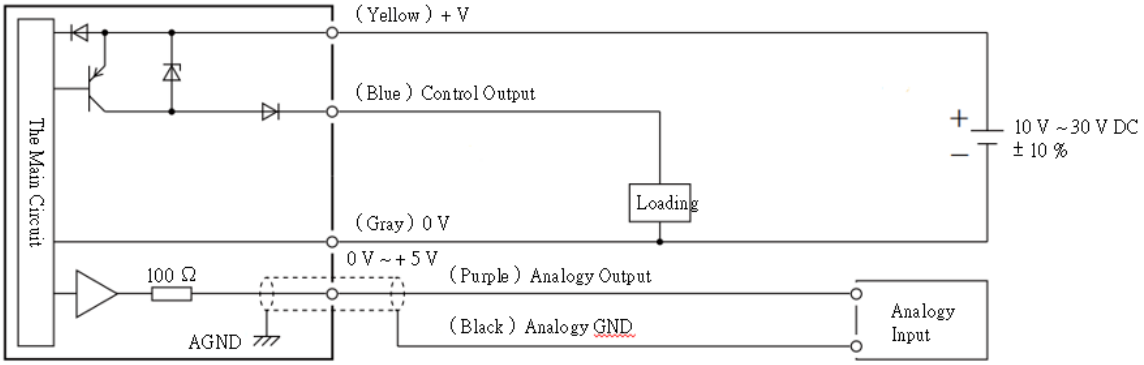


Figure 3. Input and output circuit diagram

1.3 Introduction to the display panel:

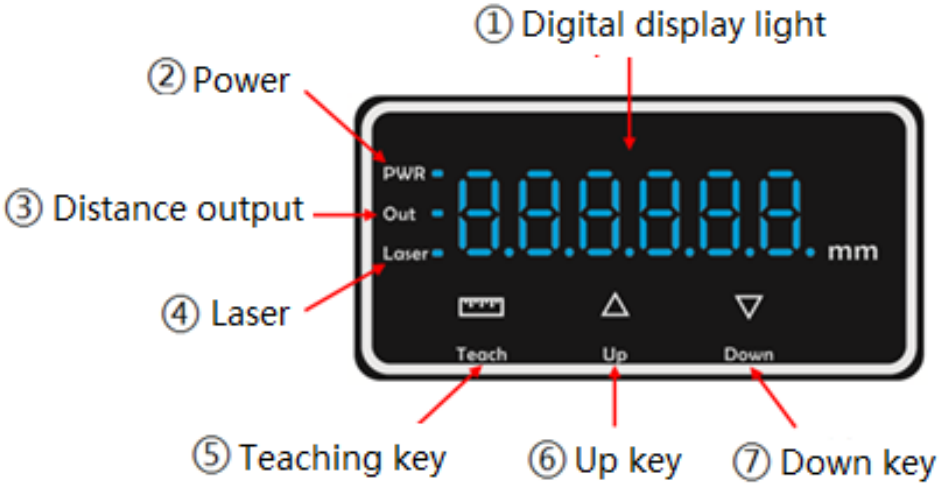


Figure 4. Display panel introduction diagram

① Digital display light: The 7-segment display shows the distance value, and the display can be switched via the up and down keys
FA + real-time value; FB + set value
② Power light: it is ON (red) when the power is connected.
③ Distance output light: it is ON (yellow) when the condition is met; it is OFF otherwise.
④ Laser light: it is ON (blue) when laser is on; it is off in sleep mode.
⑤ Teaching key: click to set; with up and down keys to switch modes.
⑥ Up key: click to go up from menu.
⑦ Down key: click to go down from menu.

1.4 Installation instruction

1.4.1 Product fixing

When installing this product, please use M3 screws to fix it on the corresponding bracket.

Figure 5. Product fixing diagram

1.4.2 Installation direction

To ensure the reliability of the detection and the correct direction of the target, the positions of the detector are recommended and shown below.

1.4.2.1 Relative to the moving direction of the objects

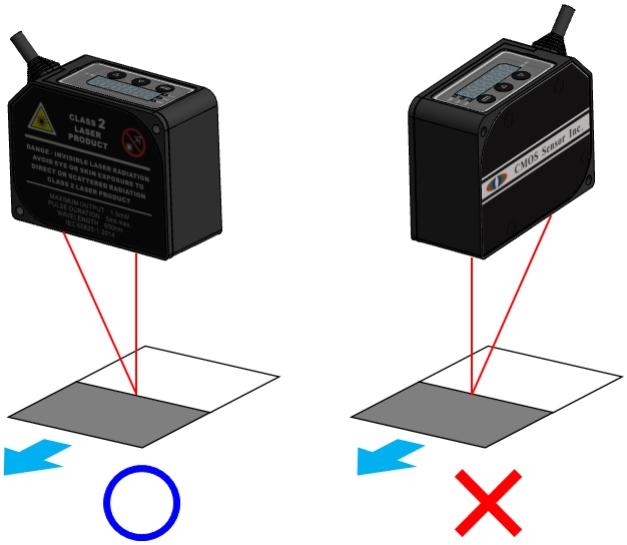


Figure 6. Install in the direction of the object with chromatic aberration and movement.

1.4.2.2 Measure rotating objects

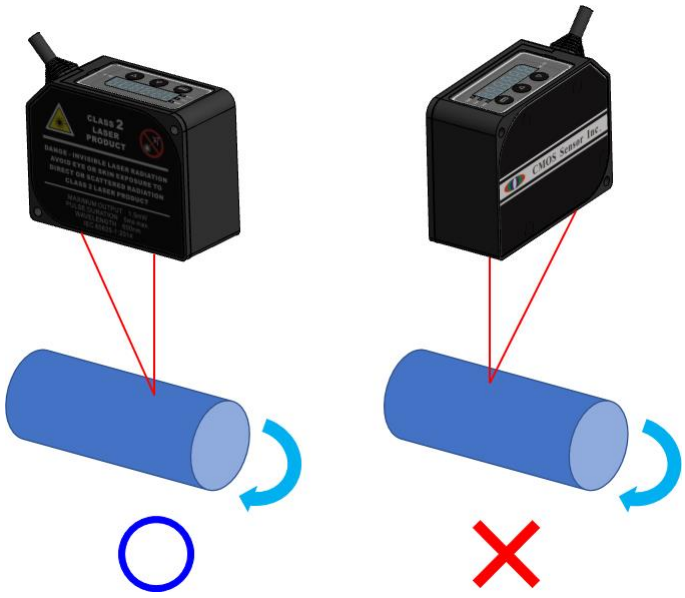


Figure 7. Install in the direction of rotation of the object.

1.4.2.3 When there is a height difference.

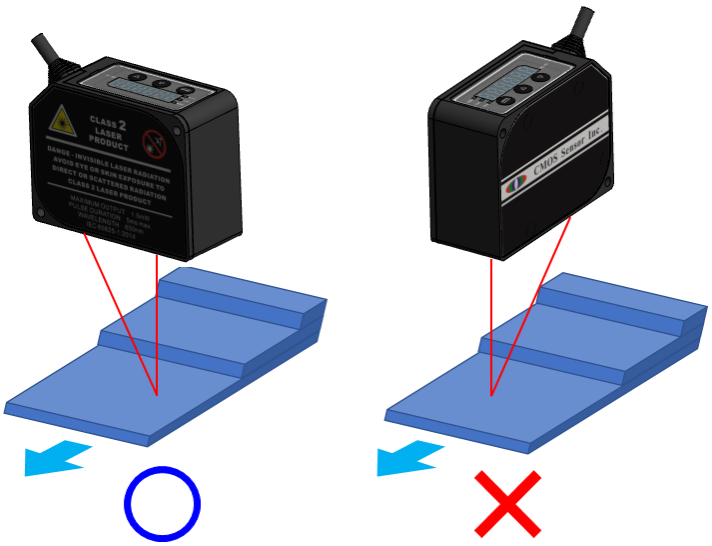


Figure 8. Install in the direction of height variation of the object.

1.4.2.4 Measuring in narrow or recessed sections

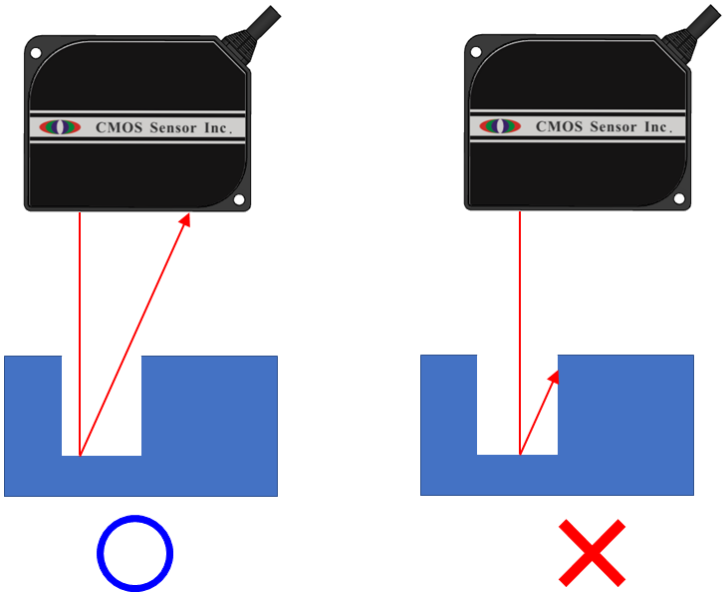


Figure 9. Install in a narrow or recessed direction.

1.4.2.5 When installed on the wall

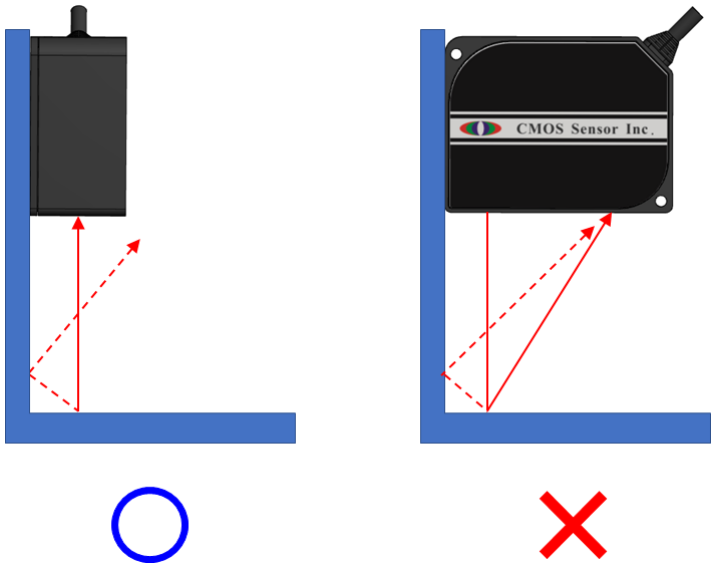


Figure 10. Install in the direction against the wall.

2 Setting and teaching

The setting and teaching can be done by using the keys on the display panel of the sensor, or using the UI interface after connected the sensor via USB 2.0 to the computer. Let's start with the key settings on the display panel.

2.1 Description of display panel key setting

2.2.1 Overview of setting mode switching

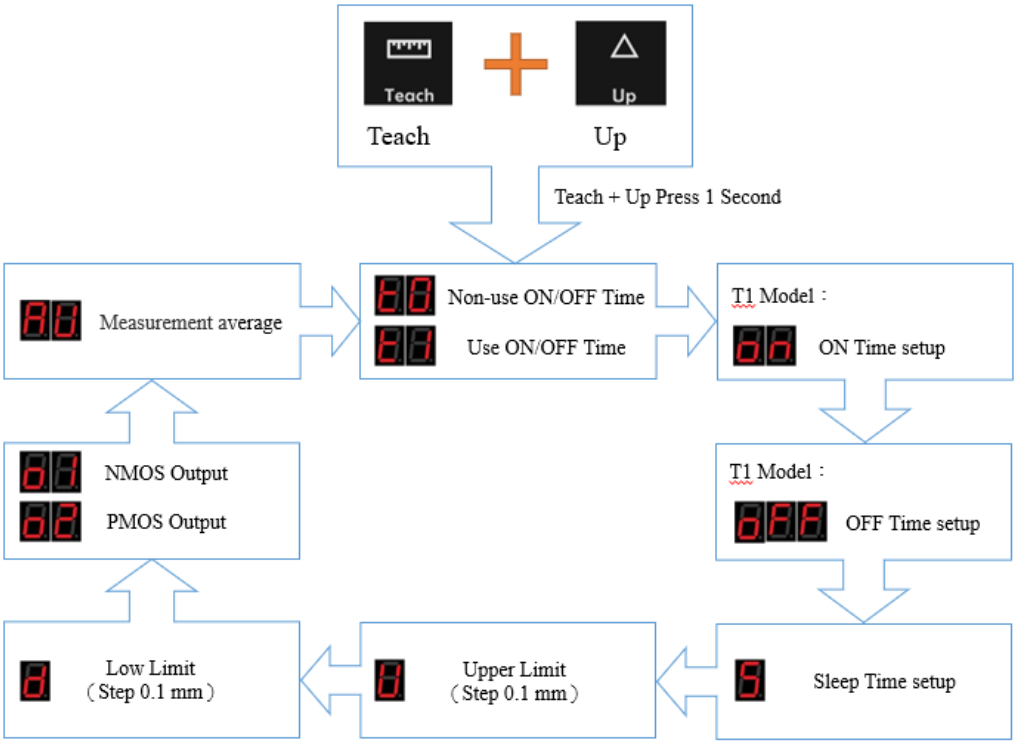


Figure 11. Mode overview map

Press the Teach key and Up key simultaneously for 1 second to switch to the setting mode; click the Up key and Down key to switch the mode menu; after 5 seconds of no action, the system will save the setting and exit the setting mode.

2.1.2 Description of each setting mode

The figure below shows how to enter a certain setting mode. Take T0/T1 mode as an example. The preset display panel is T0, Teach key and Down key are pressed for 1 second to enter T0/T1 mode switching. Use Up key or Down key to switch between

T0 and T1 modes.

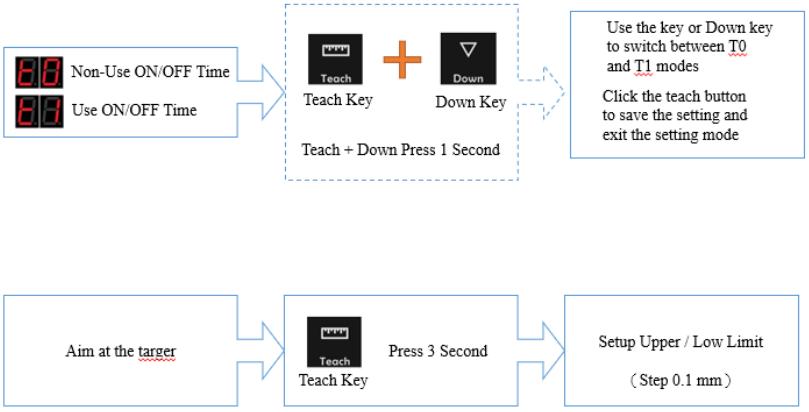


Figure 12. Each setting mode enters the setting

2.1.2.1 T0/T1 mode switching

The system defaults to T0 mode. When switching to T1 mode, the setting parameters of ON/OFF Time and average measurement value will be used. (For details of ON/OFF Time, please refer to 1.2.2 in Appendix 1)

2.1.2.2 ON Time setting

When entering the ON Time setting, use the Up key to increase the set value and the Down key to decrement the set value. The set value cycles from 5 to 100 in milliseconds (ms).

2.1.2.3 OFF Time setting

When entering the OFF Time setting, use the Up key to increase the set value, and the Down key to decrement the set value. The set value cycles from 5 to 100 in milliseconds (ms).

2.1.2.4 Sleep Time Setting

When entering the Sleep Time setting, use the Up key to increase the set value, and the Down key to decrease the set value. The setting value cycles from 5, 10, 15, 20, 25, 30, 60, and the unit is Minute.

2.1.2.5 Upper limit of measuring thickness

When entering the upper limit setting of measuring thickness, use the Up key to increase the set value, and the Down key to decrease the set value. The set value ranges from 1 to 100 cycles, and the unit is 0.1 mm.

2.1.2.6 Lower limit of measuring thickness

When entering the setting of the lower limit of measurement thickness, use the Up key to increase the set value, and the Down key to decrease the set value. The set value ranges from 1 to 100 cycles, and the unit is 0.1 mm.

2.1.2.7 NMOS/PMOS output

When entering the NMOS/PMOS output setting, use the Up and Down keys to switch between NMOS output or PMOS output.

2.1.2.8 Average measurement value

When entering the average measurement value setting, use the Up key to increase the set value, and the Down key to decrease the set value, the set value is 1, 2, 4, 8, …, 2048, 4096 cycles.
(Please refer to 1.2.1 description in Appendix 1).

2.2 Instructions for teaching

2.2.1 Instructions for teaching

After the sensor is fixed, the laser is aimed at the target and starts to measure. Press and hold the Teach button for 3 seconds to set the currently measured distance value as the teaching value, and then set the upper/lower thickness limit.

Figure 13. Set teaching value

2.2.2 Set the upper/lower limit of measuring thickness

In previous chapters 2.1.2.5 and 2.1.2.6 it is explained how to set the upper and lower limits of the measured thickness. The following figure is a schematic diagram of detecting the thickness of the object; if you want to detect the flatness of the background surface or whether there is an object, set the distance from the laser to the background surface as the teaching value.

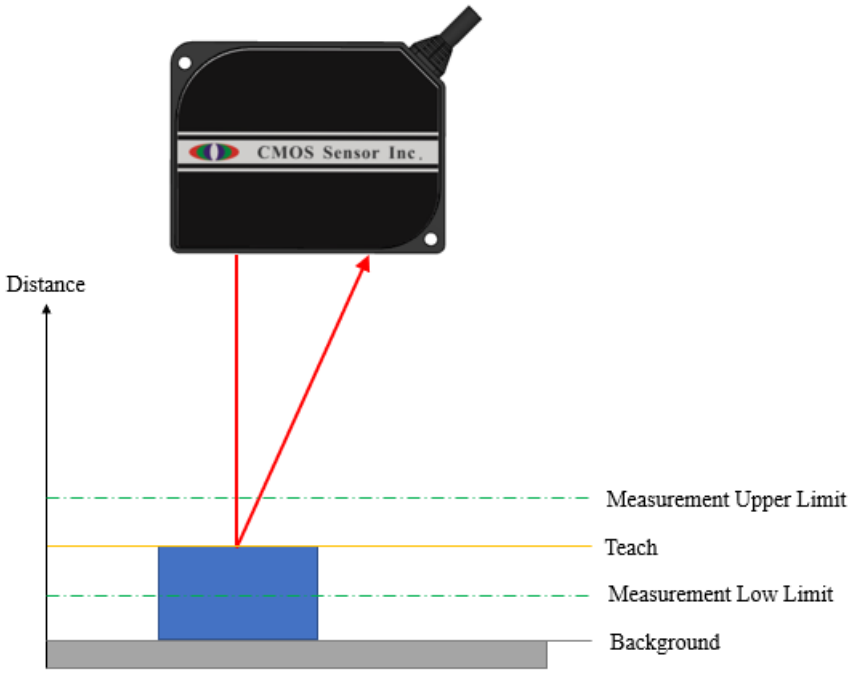


Figure 14. Diagram of setting the upper/lower limit of measuring thickness

2.2.3 Judge the Pass/Fail of the teaching value

2.2.3.1 Judging from the display panel

It is mentioned in chapter 1.3 that there is a distance output indicator on the display panel. The distance measurement value will light up when the upper and lower thickness limits are met; if the conditions are not met, the indicator will turn off.

Figure 15. Diagram of judging from the display panel

2.2.3.2 Judging from NMOS/PMOS

The previous chapter 1.2.2 describes how to use the NMOS/PMOS output circuit. When the distance measurement value meets the upper and lower thickness limits, there will be a voltage output.

2.2.3.3 Judging from DAC output

This product provides DAC output, which will output the voltage proportionally (5 V / 4096 steps) according to the measured distance value, and then judge whether the conditions are met from the output voltage.

Distance (mm)	Vout (mv)
100	80
110	500
120	1000
130	1500
140	2000
150	2500
160	3000
170	3500
180	4000
190	4500
200	5000

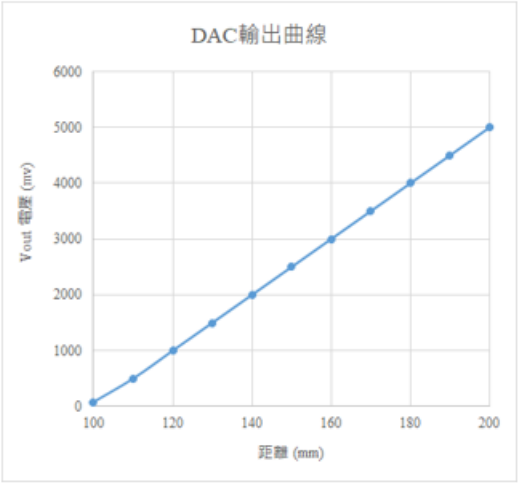


Figure 16. DAC output curve

*Note 1:

When the measurement distance is exceeded (refer to Section 4.1 Performance Parameters), the DAC output is 0 V (MOS OFF).

2.3 Error display

When the display light is  , it means that the currently measured distance value exceeds the measurement range, or the sensor cannot see the laser spot and cannot interpret the distance.

3 USB 2.0 connection to the computer to use the UI interface

3.2 Introduction to the test program

3.2.1 Test program C# software

File Name：CLDM-150mm.exe

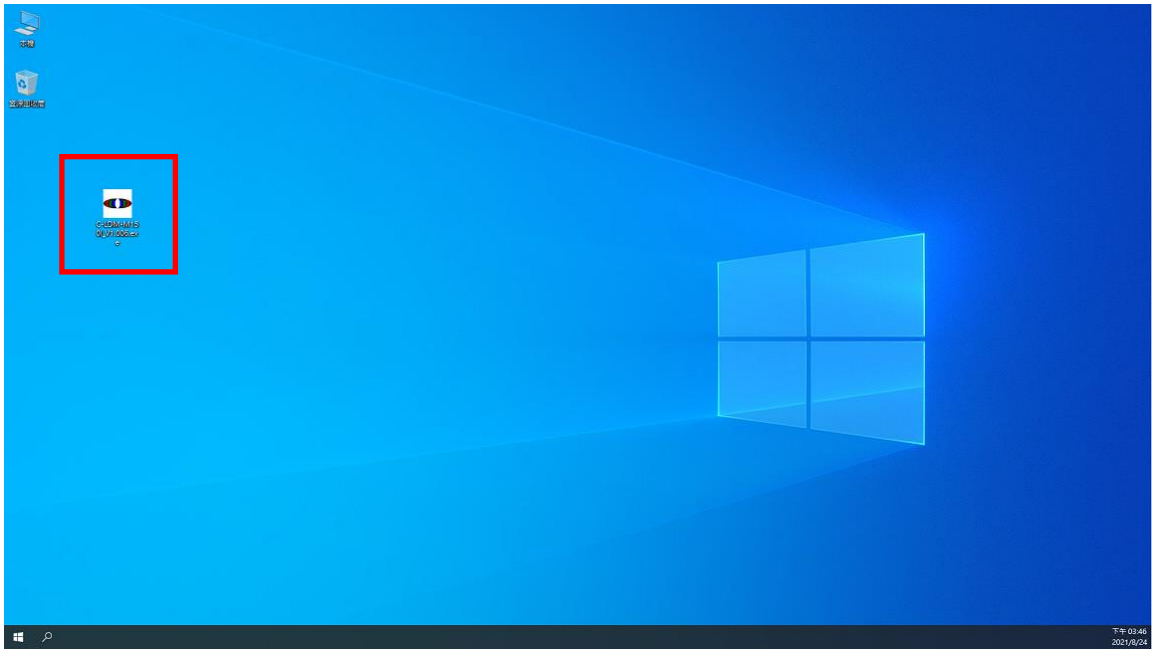


Figure 17. Test program on PC desktop

3.2.2 Operating system environment.

OS: Windows 7 or Windows 10 (32 or 64 bit)
Development Environment: Visual Studio 2017 (15.8.9)
Visual C# project development firmware information:
CLDM-150mm Micro Laser Distance Scanner Copyright (c) 2021 CMOS Sensor, Inc. All Rights Reserved Runtime V3.21.07.001
(The version number will change with the version)

*Note 2:

The version number of the software and firmware will change with the new version. This document only provides the initial version number at the time of development.

3.2.3 The initial state when the test program is started.

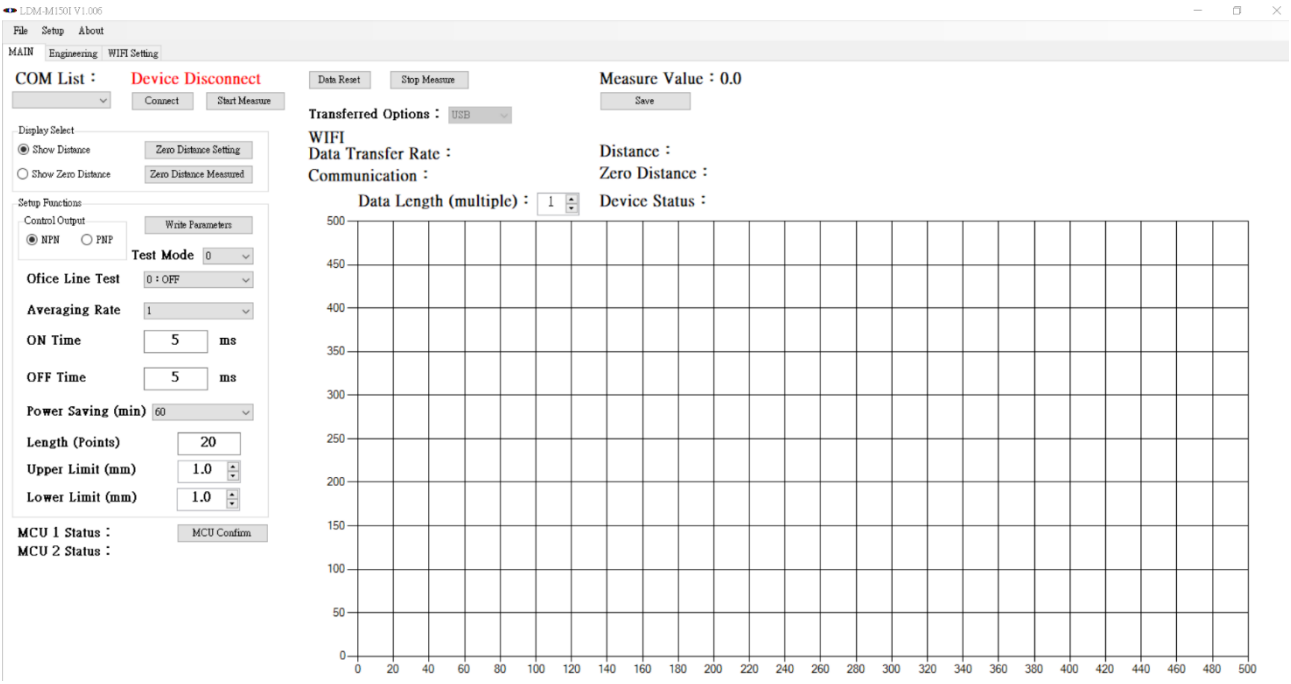


Figure 18. test program

3.3 Instructions for use

3.3.1 General user interface.

The following figure shows the UI interface, the operation instructions are as follows

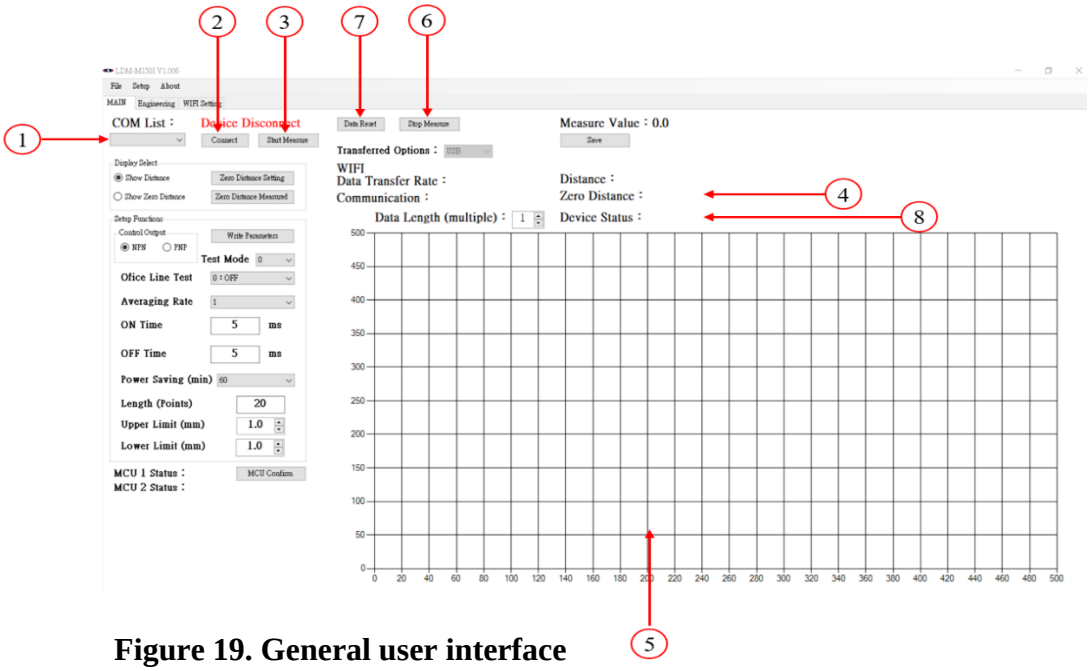


Figure 19. General user interface

① Select Com Port (different computers will have different COM Numbers)
② Establish a connection
③ Send Command through UI to let Module measure distance
④ Display the current distance value
⑤ Continuous distance values are plotted on the chart
⑥ Data output stops
⑦ To stop data output by issuing Reset Command
⑧ Module status, which are running, stopped, reset, hibernate

3.3.2 Chart XY axis control showing distance values

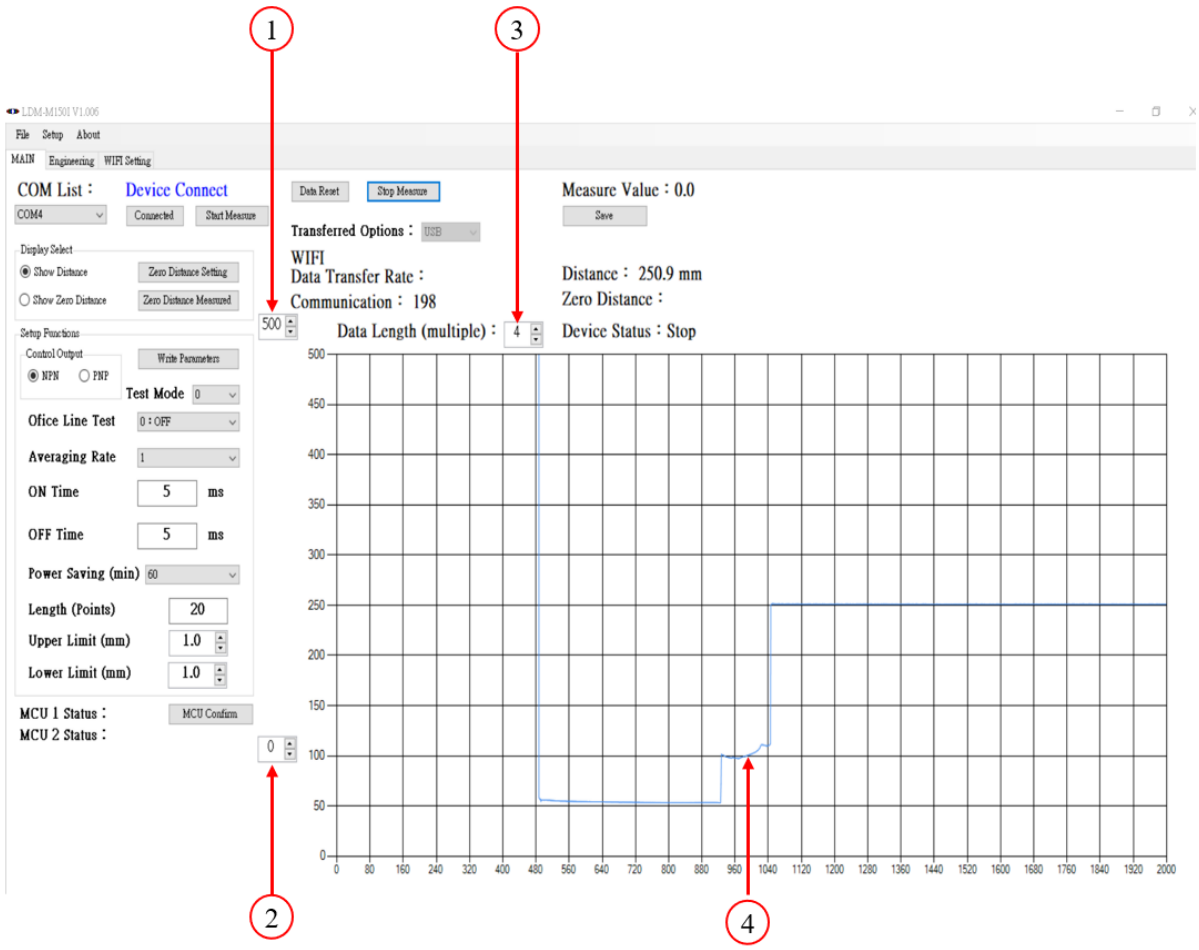


Figure 20. Chart XY axis control diagram

① X-axis upper limit → display the maximum value of the distance value

② X-axis lower limit → display the minimum value of the distance value

③ Y-axis length → display data length, 1 time is 500 points; 4 times is 2000 points

④ Change the parameter setting of XY axis to see the change of smaller distance value

3.3.3 Display the distance value to zero

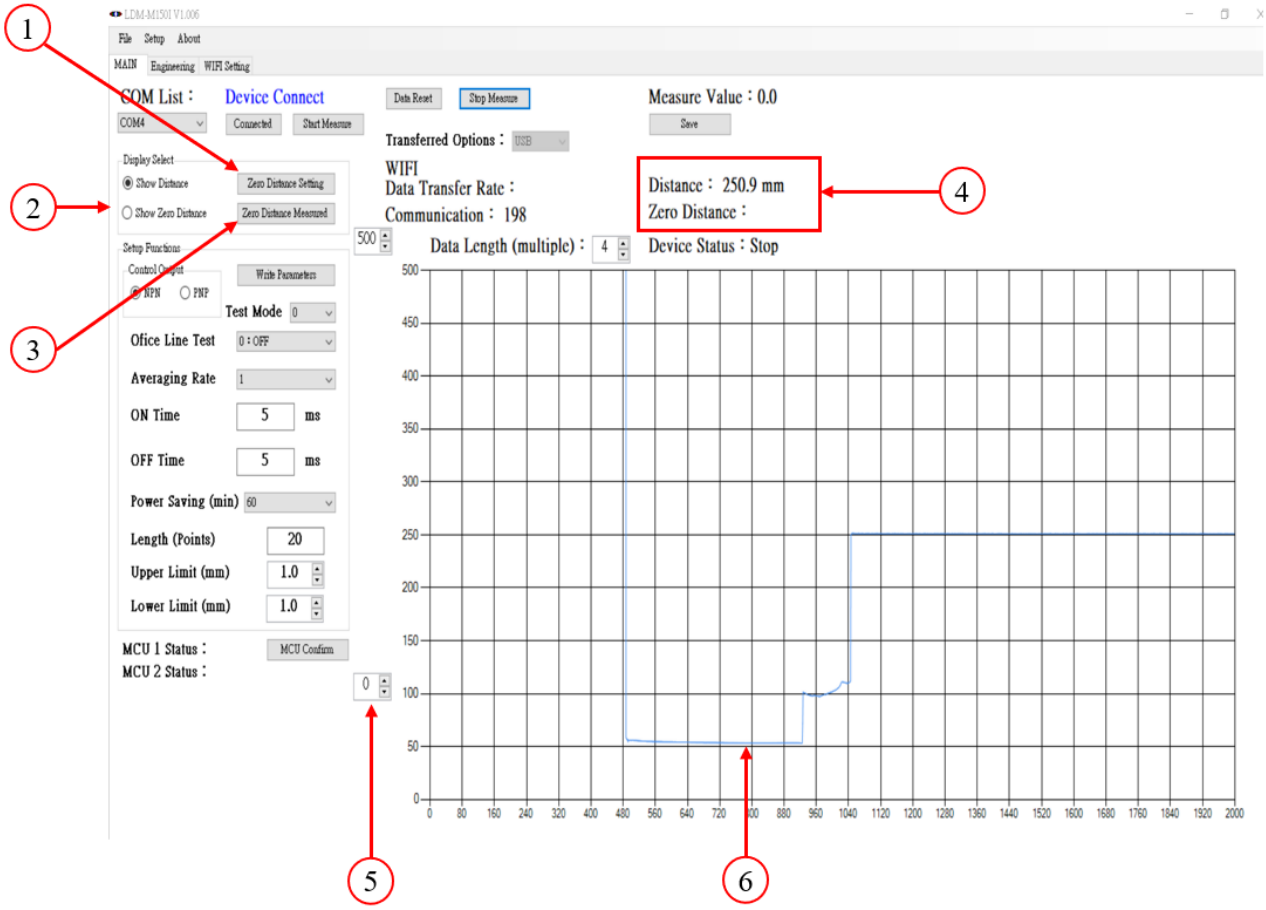


Figure 21. Diagram of distance value zeroing

① Set the current distance value to zero
② After selecting the zeroing mode, press "Distance Query" again to update the zero-point distance value
③ Read the distance value of zeroing (no storage to Flash, the default value 123.4 will be restored after power off)
④ In zeroing mode, the actual distance value is zero; when zeroing, the distance value is the set parameter
⑤ The range of the X-axis on the chart is the ± value with the zero point as the center
⑥ Change the parameter setting of XY axis to see the change of smaller distance value

3.3.4 Parameter setting

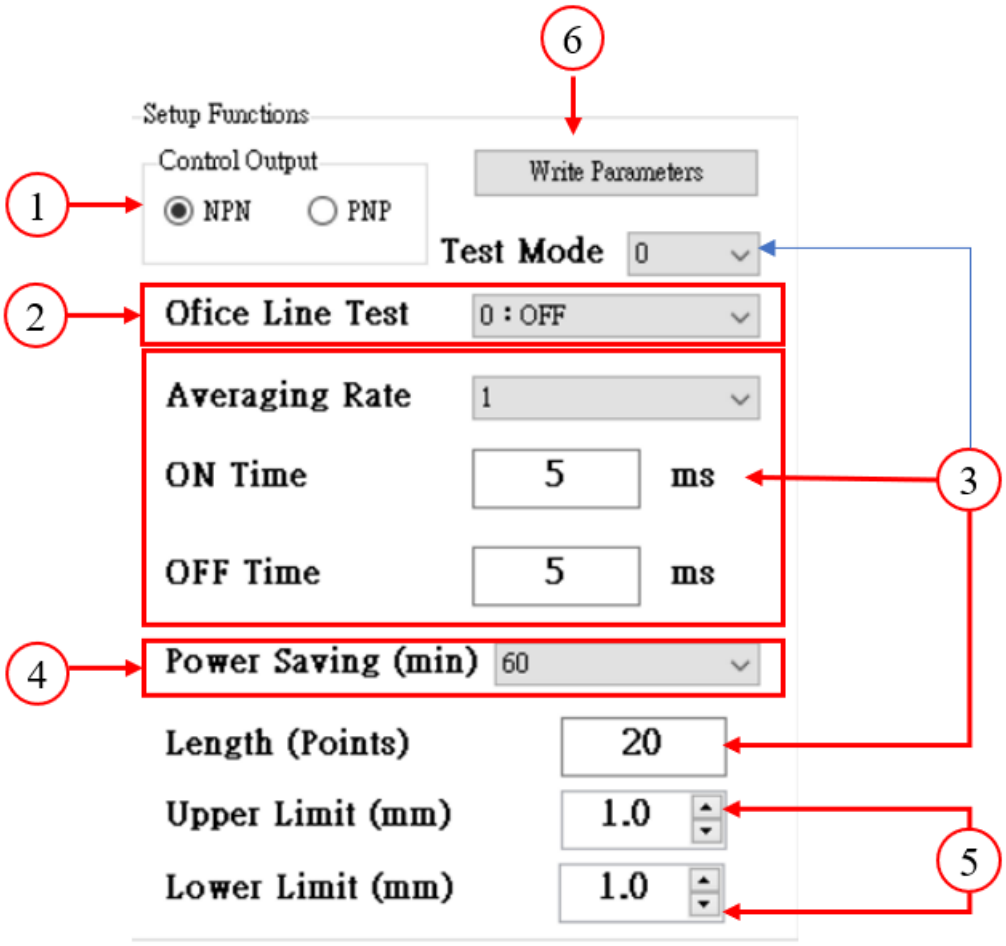


Figure 22. Parameter setting

① Control output setting, refer to appendix 1 for details.
② Automatic distance measurement mode, set to "1: On" to measure the distance after power on
③ Only when it is set to 1, it is effective, refer to Annex 2 for details.
④ Sleep time setting, the laser will be automatically turned off during sleep
⑤ The upper and lower limits of the thickness of the measured object, within the range is Pass
⑥ Press this button to write the parameters to the MCU. After power off and power on again, the set value of the parameters will still be saved

4 Specifications

4.2 Performance parameters

Item	Spec.	Unit	Remarks
Detection method	Diffuse reflection		
Measurement center distance	150	mm	
Measuring range	± 50	mm	
Repeat accuracy	0.1	mm	
Smallest measured object	1	mm	
Minimum measuring thickness	1	mm	
Sampling frequency	1000 ~ 1500	Hz	
Sampling period	1 ~ 0.66	ms	
Reaction time	2	ms	(Average 1 time)
Linearity	± 0.8%	F.S.	

4.3 Electrical/mechanical parameters

Item	Minimum	Typical	Maximum	Unit	Remarks
USB Operating Voltage	4.75	5.0	5.25	VDC	± 5% (USB)
USB Working current	-	-	200	mA	
External input Voltage	10		30	VDC	± 5%
Power (no load)	1	-	2	W	
Dimension	W65 x H50 x D27			mm	
Product weight	94			g	Estimate
Shell protection grade	IP65				
Connection method*1	Cable Ø5 x 1M / 28AWG PCB BLACK / USB + 6 Wires (VDC+, VDC-, NPN, PNP, Analog out+, Analog out -)				
Material	Core : Engineering plastics Body shell: Engineering plastic Optical Window : Optical acrylic Button panel : EBA250				

4.4 Laser parameters

Item	Minimum	Typical	Maximum	Unit	Remarks
Laser wavelength	-	650	-	nm	Red semiconductor laser (visible light)
Laser power	-	-	1	mW	Peak power
Laser safety level	-	IEC-60825 Class 2	-	-	
Light spot diameter		1		mm	

*Note 1: The laser power is the continuous luminous power, the actual average power will be much lower than this value.

4.5 Other parameters

Item	Minimum	Typical	Maximum	Unit	Remarks
Operating temperature	-10	-	+50	°C	No condensation and freezing
Operating humidity	35		85	%RH	
Storage temperature	-20	-	+60	°C	No condensation and freezing
Storage humidity	35		85	%RH	No condensation
Optical lens	-	Size: $^{1}/_{2.5}$ inch F: 16 mm	-	-	
PC interface	USB			-	
Control output	Open collector (NPN / PNP , switchable)*1*2				
Analog voltage output	0 to 5V				
Service life	-	10000	-	Hour	
Ambient brightness	-	7500	-	Lux	Incandescent
Vibration	10 to 55 Hz, composite amplitude 1.5mm X, Y, Z axis each 2 hours				

*1: DC30V range rated NPN open collector output: 50 mA max

*2: DC30V range rated PNP open collector output: 50 mA max

Appendix 1;

1.1 Test mode is 0

1.1.1 NPN/PNP output operation instructions are as follows

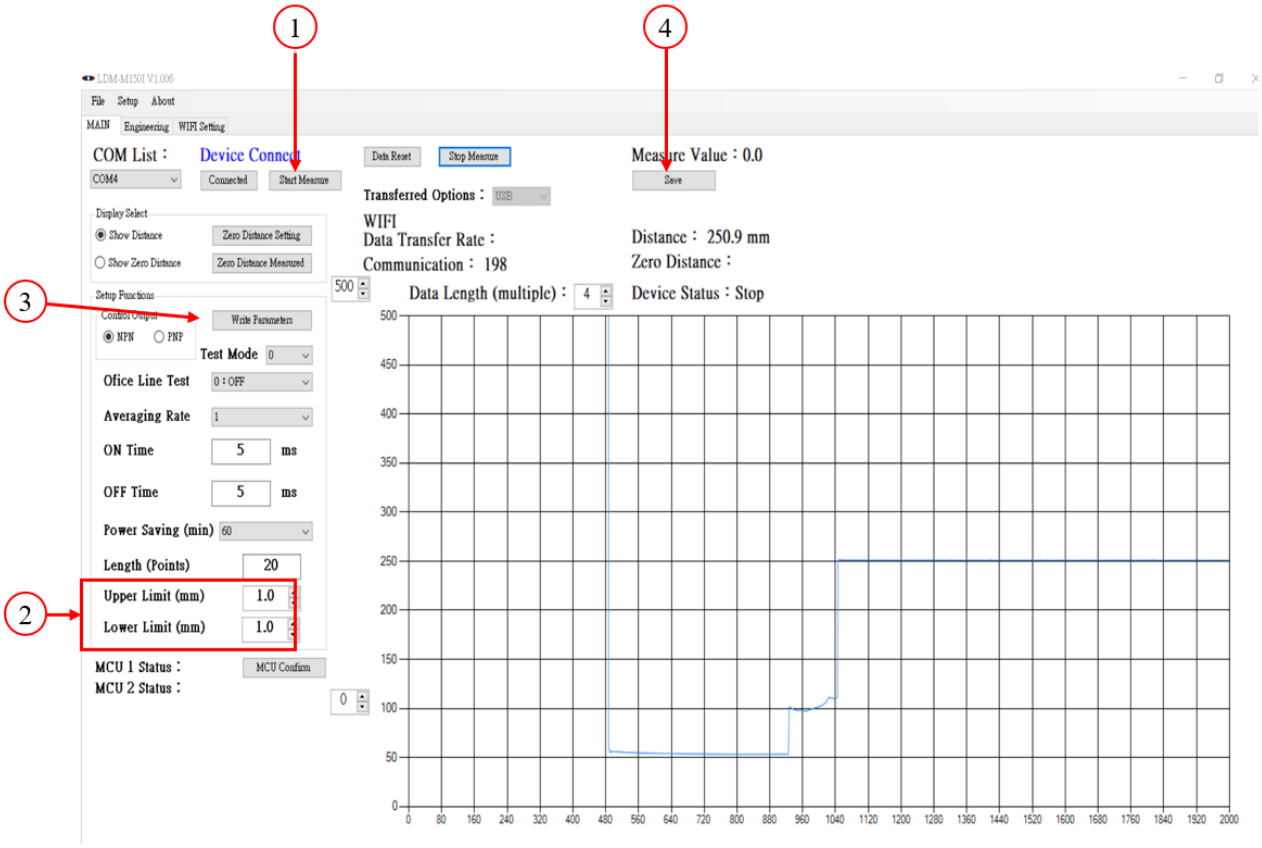


Figure 23. NPN setting

① Obtain the distance value of the current object to be measured
② Set the upper and lower limits of the thickness of the measuring object, within the range it is Pass
③ Write parameter settings to MCU
④ Store the current distance value as the criterion for judgment

1.1.2 In NPN/PNP mode, if the object to be measured passes through, it will be judged as Pass (green light), and if there is no object to be measured and the measurement distance value exceeds the upper and lower limits, it will be judged as Fail (lights off), as shown in the figure below.

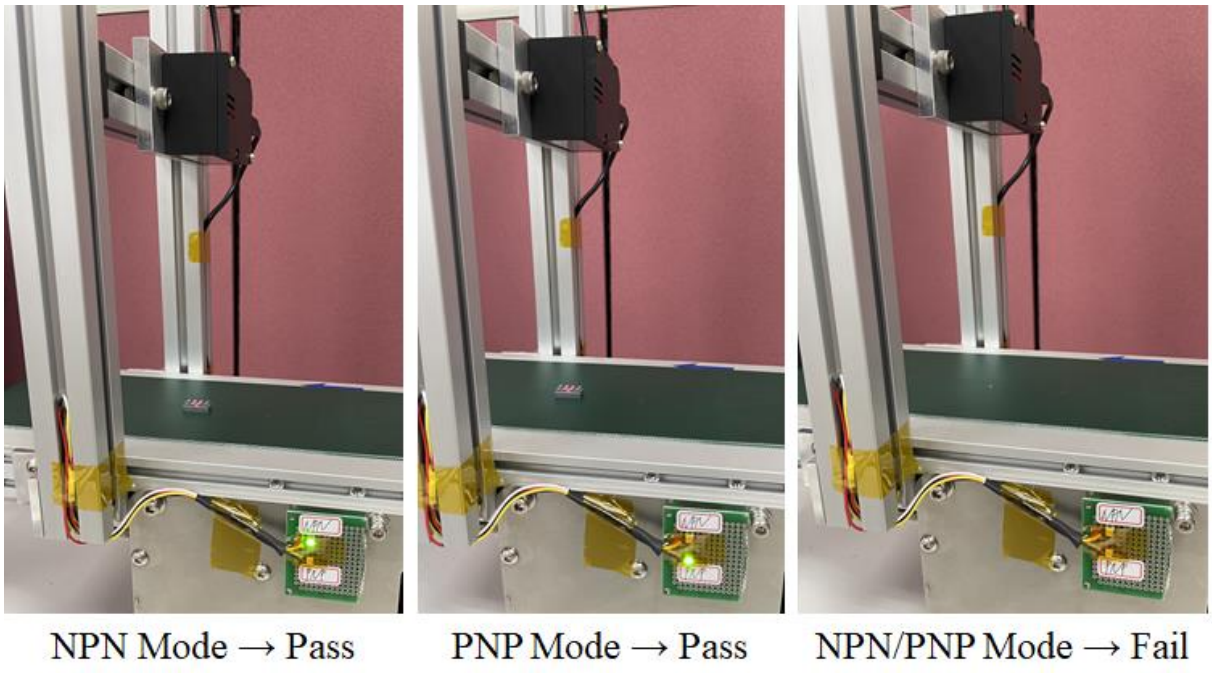


Figure 24. Test result

1.2 Test mode is 1

1.2.1 The average number of tests: the average of multiple samples, the more times the samples are, the more stable the value will be, which will affect the response time.

(ms)

Sampling period	Average times						
	1	2	4	8	16	32	64
1 ms	2	4	8	16	32	64	128

(ms)

Sampling period	Average times					
	128	256	512	1024	2048	4096
1 ms	256	512	1024	2048	4096	8192

Figure 25. Average times and response time

1.2.2 The description of ON Time/OFF Time is as follows

Time required to change the GO judgment output operation from ON to OFF is delayed for specified time set on the timer. Also, time required to change the HIGH judgment output and LOW judgment output operations from OFF to ON is delayed.

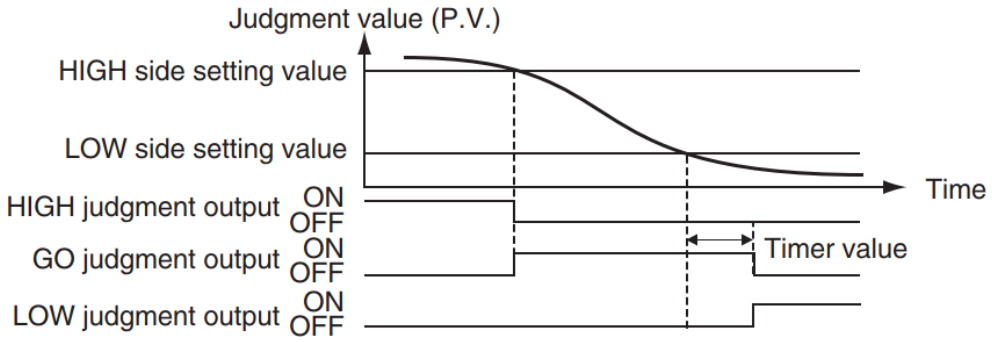


Figure 26. ON Time

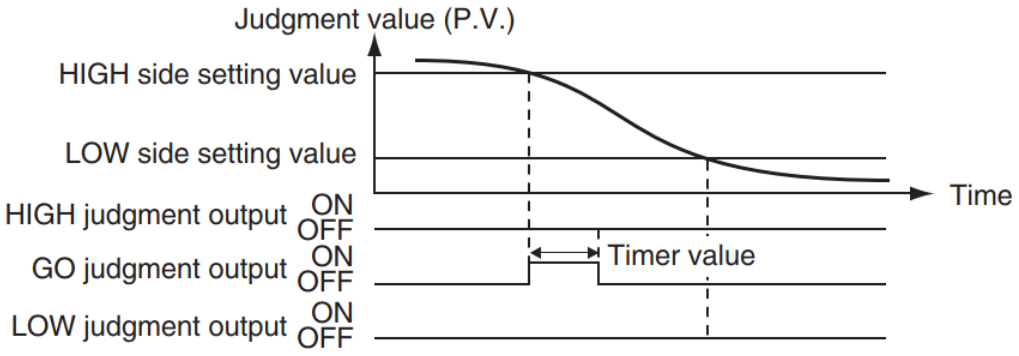


Figure 27. OFF Time

1.2.3 Data length (Points) setting:

a. When the object to be tested passes by, press "Data Stop" immediately to stop the chart from updating the distance value

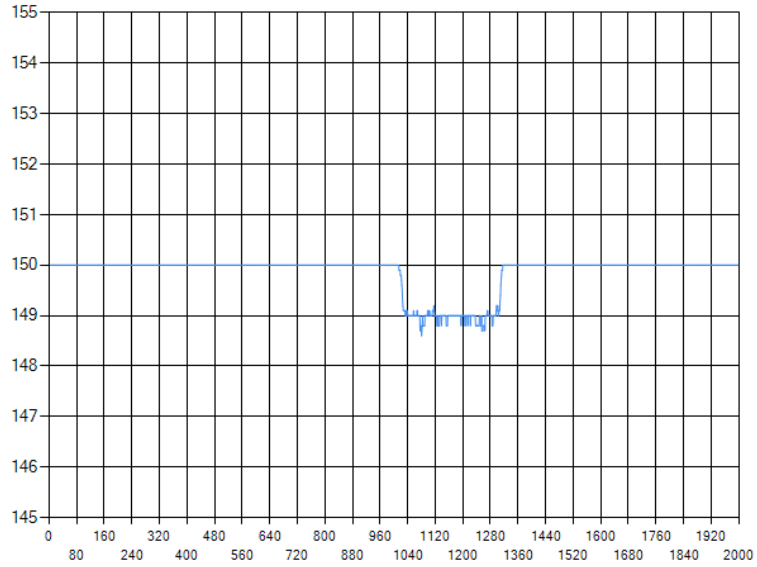


Figure 28. Stop update the chart

b. Use the mouse to select the range you want to judge on the chart.

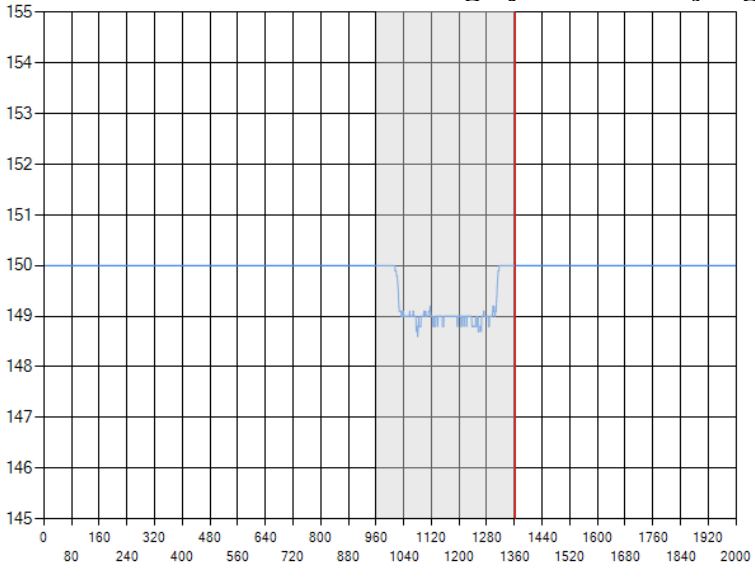


Figure 29. Selecting the range

c. After the selection is made, the chart will enlarge the selected range. If you need to further enlarge the selection area, repeat step b.

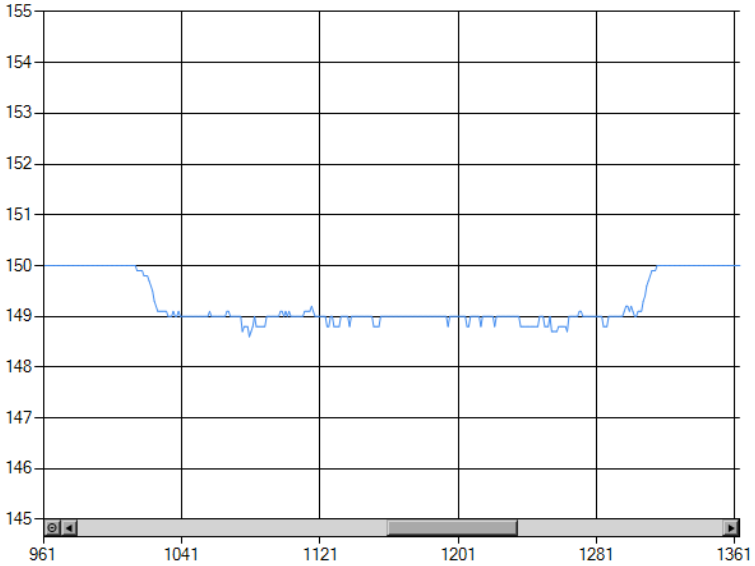


Figure 30. Selected the range

d. Finally, click Save in the upper right corner to calculate the average value of the selected range, and then pass/fail will be judged based on the selection data.

e.

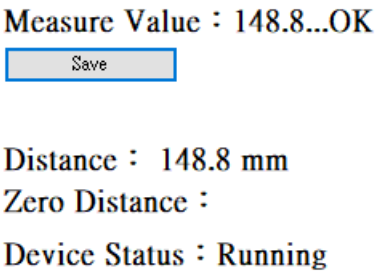


Figure 31. Push save button and setting OK

Appendix 2:

2.1 Instruction set

MCU1 instruction	MCU2 instruction	Description
showv		Show MCU1's Firmware version
	MCU2Ver?	Show MCU's 的 Firmware version
showh		Help
getf		Update MCU's Firmware
rs		Reset MCU1
setv		setv d1 1000\r setv d3 1500\r setv d2 2500\r E.g.：1000, 1500, and 2500 are calibrated at 100 mm, 150 mm and 250 mm respectively (the 2nd method added by the micro-ranging CLDM-150mm must be used with the command runcal b16 mark 1800\r)
getv		getv d\r：Get the parameter value after Calibration
savev		savev yyyyMMdd\r：Store Calibration's Pixel Count yyyyMMdd：year month day
runcal		runcal b16 1800\r（16bit return data, no markers） runcal b16 mark 1800\r（16bit return data, with markers） b16：16bit Vout resolution
runldm		runldm real xxxx\r（4 bytes data；First 2 bytes is distance data，unit is 0.1mm；The other two bytes is a fixed number = 2000, just for Sync） xxxx：1800、1500、1000 are Sample Rate
s0013		s0013 xxxx\r：Sensor Exposure xxxx：100 ~ 4000，default is 1300
s0017		s0017 xxxx\r：Laser PWM xxxx：5000~ 8000，default is 6300；0 is OFF
s0023		s0023 xxxx\r：Laser EN xxxx：100 ~ 4000，default is 1300

	Live?	Check if the MCU is still working
	Range	Range = N 或 P, Test Mod, Auto, Average, On Time, Off Time, Sleep, Length Range, Up Range, Down Range, END\r This is the parameter setting, defined as follows: N = NPN ; P = PNP Test Mod : test mode Auto : automatic ranging 0 = OFF; 1 = ON Average : test average number 1 ~ 4096 On Time Off Time Sleep : sleep time 5 ~ 60 min Length Range: data length Up Range ; upper limit of thickness Down Range: lower limit of thickness
	IniValSet	Distance setting when zeroing niValSet=xxx\r xxx : the current distance value
	IniVal	Inquiry about the distance when zeroing
	Shape	The distance value of the selection range on the chart is used as the criterion for judgment. Shape=Index, Length, Distance1, Distance2, …, END\r When the data length of the selected range exceeds 40 points, it will be split into 40 points/segment and transmitted to MCU2 for storage. Index : index value for each segment of data Length : the length of the data, and each segment is up to 40 points. Distance1 ~ 40 : the distance value within the selected range END : the end position of the last point of the selected range of data
	Set	Trend line formula corrects distance value Setdm=xxx\r Setdm=xxx\r Xxx : trend line parameters
	Get	Read trend line parameters from Flash of MCU2 Getdm\r Getdb\r

WARRANTY

CMOS Sensor Inc. will repair or replace, at our option any product found to be defective in materials or workmanship within one year from shipment date.

CMOS Sensor, Inc. reserves the right to make changes to its products or to discontinue any semiconductor product without notice, and advises its customers to obtain the latest version of relevant information to verify, before placing orders, that the information being relied on is current.

CMOS Sensor, Inc. assumes no liability for application assistance, customer product design, or infringement of patents or services described herein. Nor does CMOS Sensor, Inc.'s warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of CMOS Sensor Inc. covering or relating to any combination, machine, or process in which such products or services might be or are used.