Laser Displacement Operating Manual

V2.0

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Laser Displacement Operating Manual V2.0

Revision History

Version	Revision	Date
V1.0	The first version was published.	2018/09/03
V2.0	Add the function description and the register address of the “Response speed setting” and “Median filter setting” items.	2019/08/15

Chapter 1

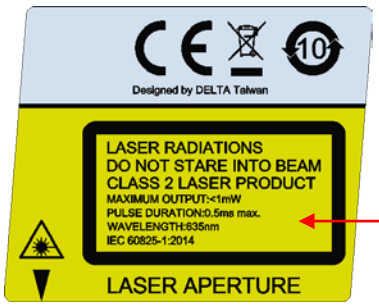
Product Profile

1.1 Packaging

The following is included:

1) Laser displacement
2) Cable (optional)
3) Laser label

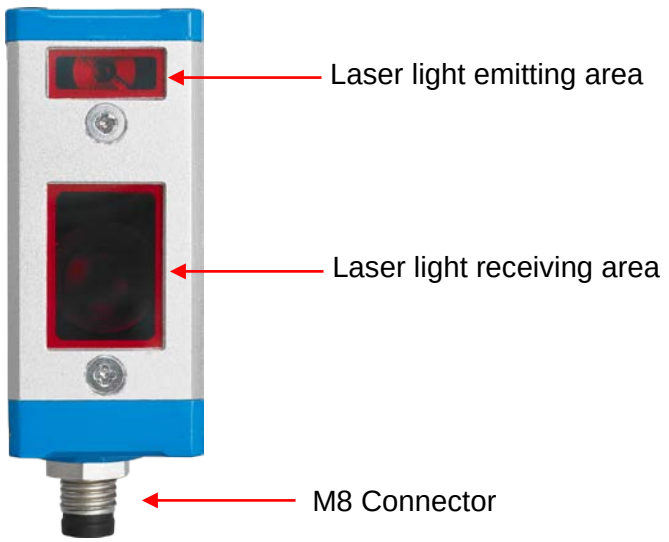
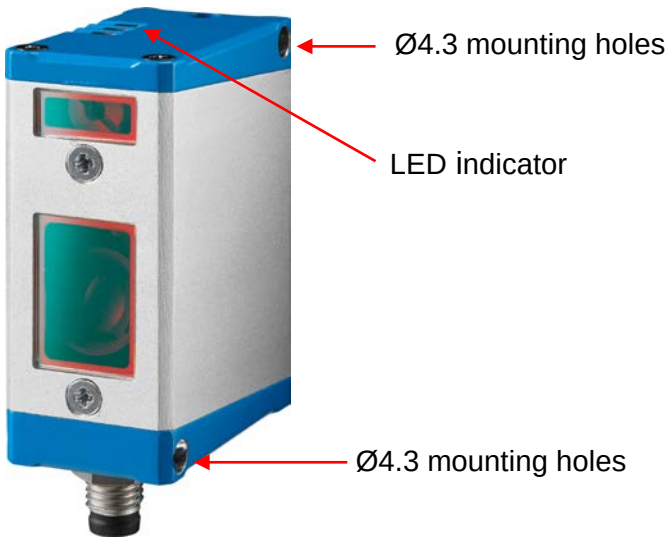
➢ Laser Label Description



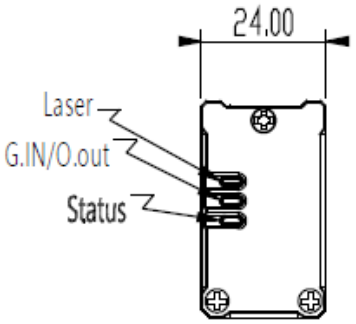
Laser Radiations: Class 2 Product
Maximum Output: <1mW
Pulse Duration: 0.5ms max.
Wave Length: 635nm, IEC 60825-1:2014

1.2 Part Names and Functions

◎ **Exterior**

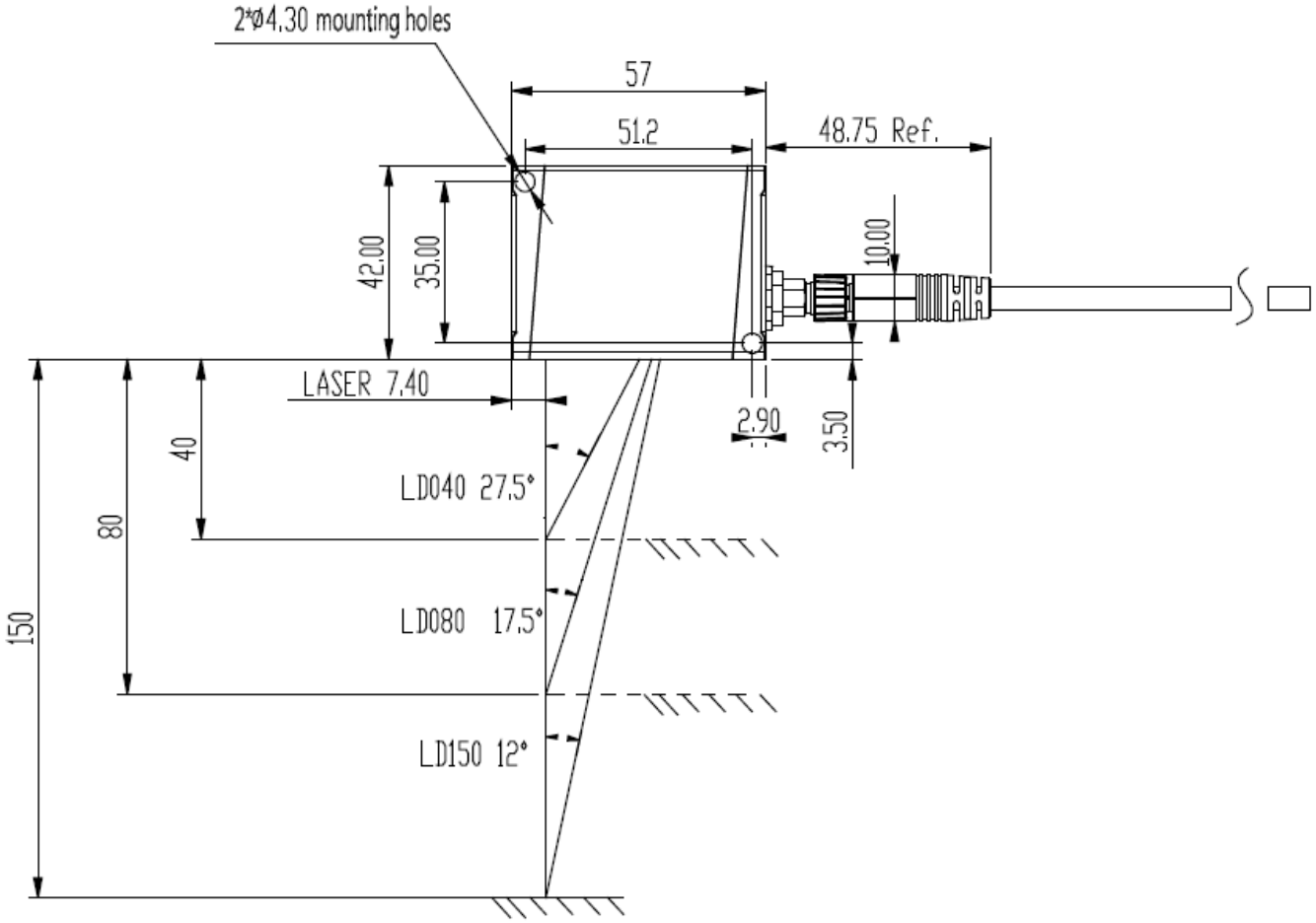
Front	Side
	

◎ **Laser Indicator**

Indicator	Color	Description	Schematically
Laser Indicator	Blue light	Start (laser on)	
Measurement Range	Green light	Within measurement range	
	Orange light	Out of measurement range	
DI/DO	Red light	DO	
	Green light	DI	

1.3 Installation

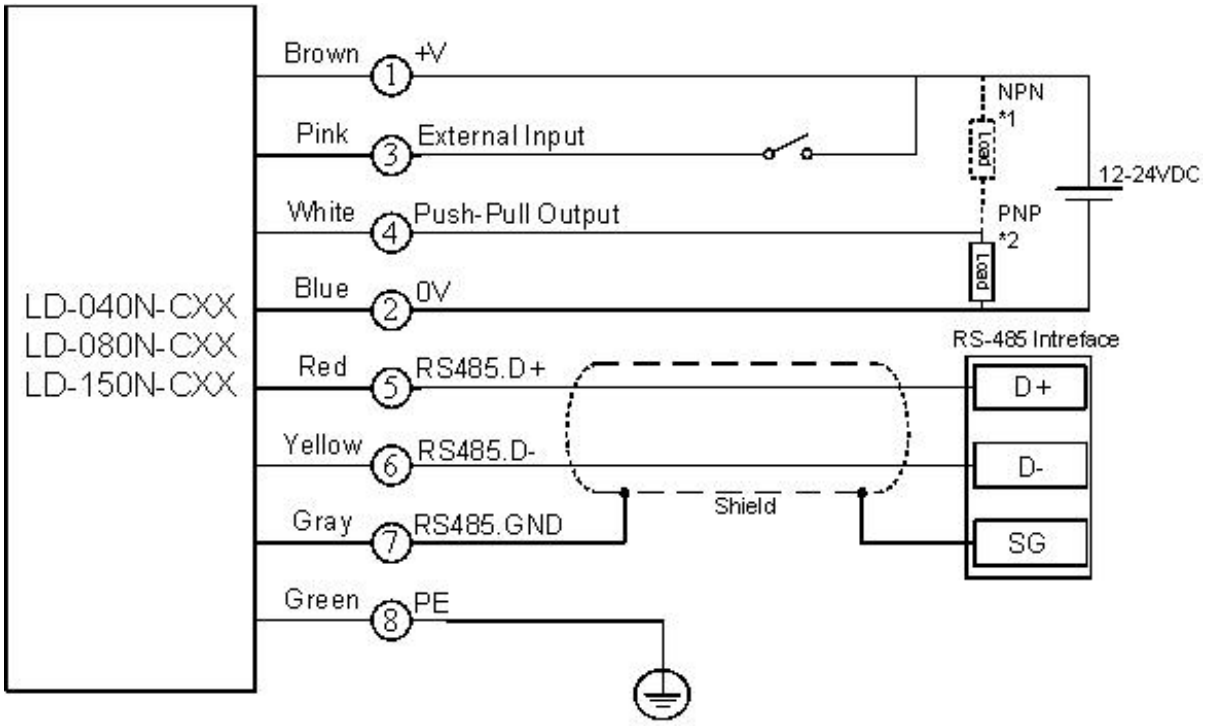
◎ **Dimension (unit: mm)**



◎ M8 Connector

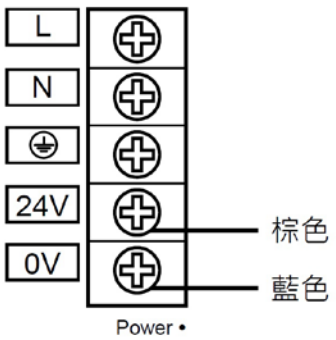
Wiring Material	Item	Serial Number
PUR Cable + M8 Connector	1.5m PUR cable	UC-S015088
	3m PUR cable	UC-S030088
	5m PUR cable	UC-S050088

◎ Wiring Instructions



*1. In case of NPN connection, please connect the load between Pin 4 and Pin 1.
*2. In case of PNP connection, please connect the load between Pin 4 and Pin 2.

◎ Wiring Diagram

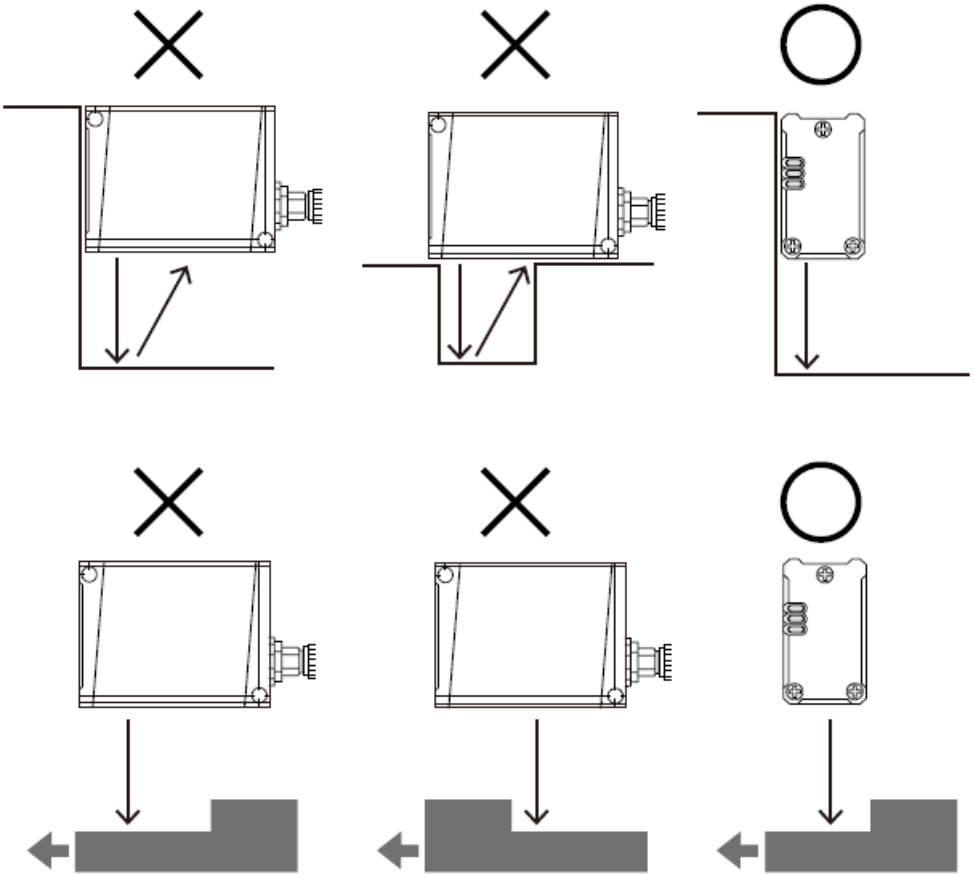


◎ **Caution on Mounting Direction**

For best product performance, please note the following instructions when installing products.

1) When products cling to devices, install the products in parallel with the devices to assure product performance.

2) When the shape of an inspection object is extrusive, ensure the product's lighting route is vertical to the inspection object's path to assure product performance.



Chapter 2

Settings and Measurements

1) After brown (+24V) and blue wires (0V) are connected to DC power and the signal cable (RS485) is connected to the master controller (PC, HMI or PLC), the laser displacement can be powered on and start reading value.
2) When the signal cable (RS485) is connected to the master controller (PC, HMI or PLC), the laser displacement will send a piece of data to master controller every 1ms.
3) It is recommended to use Delta's UI on the PC for initial judgment.

Chapter 3

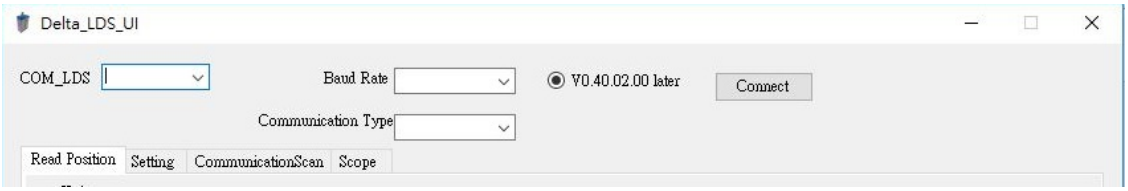
Software Operation

3.1 Communication Setting

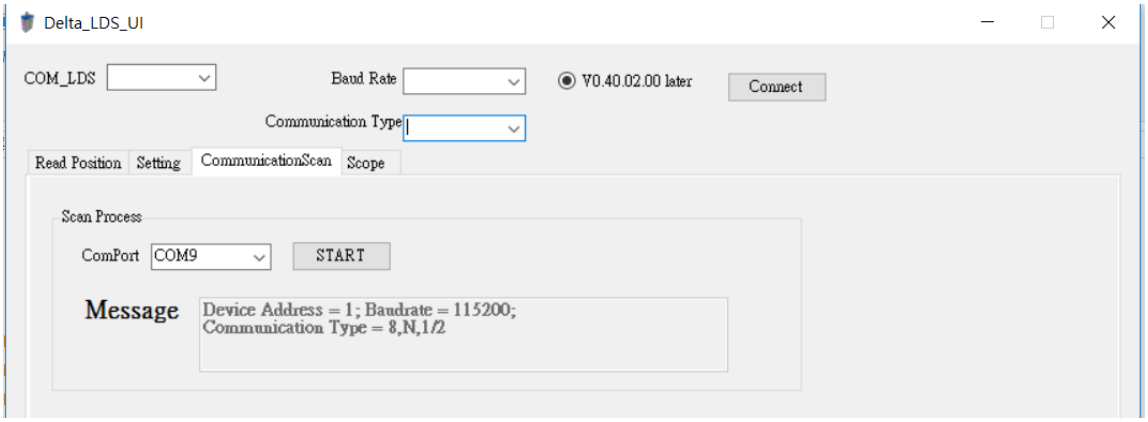
◎ **Open file Delta_LDS_UI.exe**

◎ **Communication format Setting (communication port, baud rate, communication format)**

➢ Take COM9, 115200(Default), 8,N,1/2 as an example



➢ If you can't determine the product baud rate, you can click the **Communication Scan** and select **COM_LDS**, then you can get the device address, baud rate and communication format.

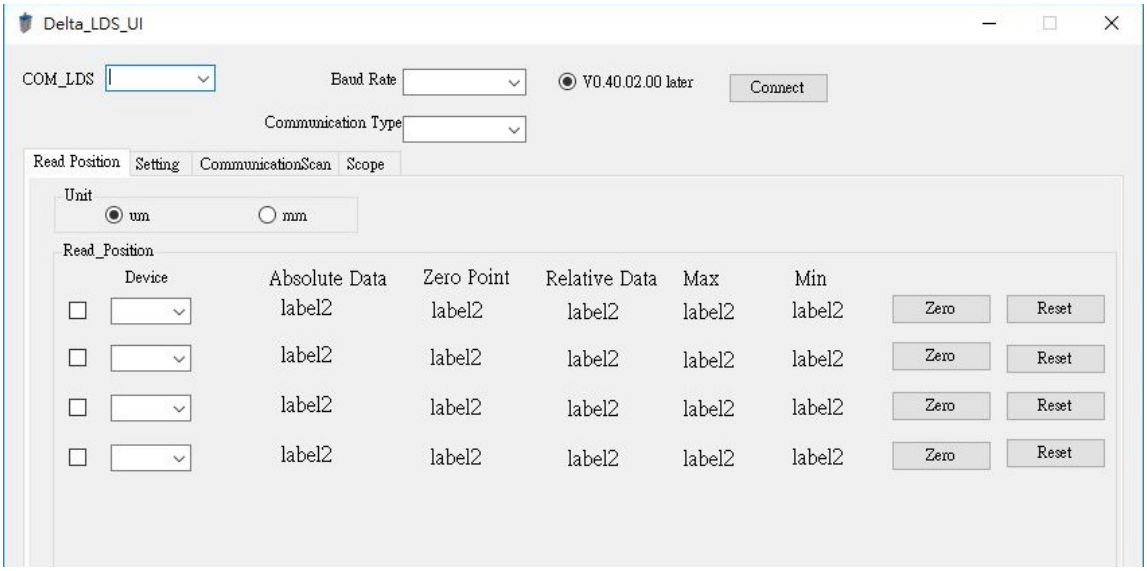


Remark User interface is RS485 and it must be executed on the PC or laptop and confirmed to be powered on.

3.2 Position Reading and Set the Zero Value

◎ **Position Reading**

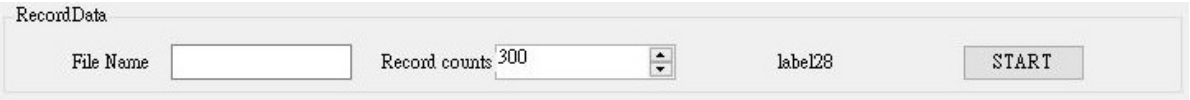
Providing users to read absolute position, zero position, relative position, max value, min value. In addition, you can also set the zero value and reset value here.



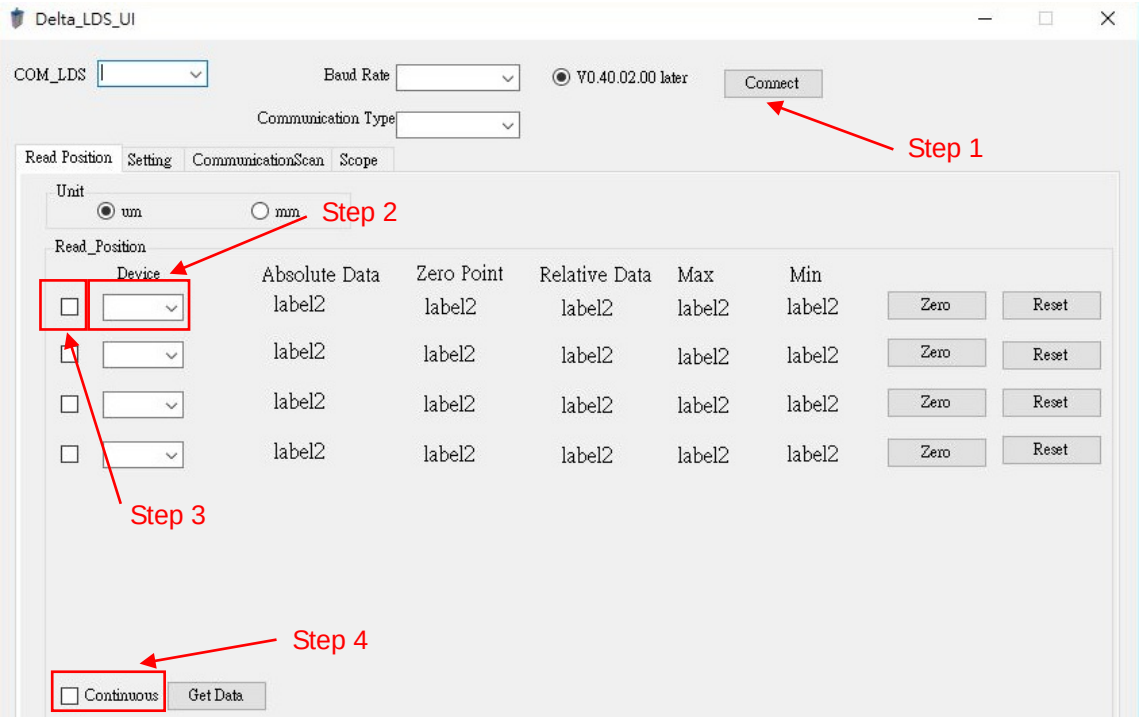
- Absolute Position: the distance between sensors and measured objects
- Homing Position: the distance between sensors and the homing point.
- Relative position: the distance between absolute position and relative position.
- Max: maximum relative position
- Min: minimum relative position
- Homing: Set the current measured distance as the default, and the value is displayed as 0
- Reset value: reset the homing position to the initial value (initial values may differ based on different models) (LD-040 → 40000um; LD-080 → 80000um; LD-150 → 150000um)

◎ **Data Record**

You can set your own file name and data quality. Click **Start**, UI software generates a record file (.TXT) in the same folder.



1) Steps
2) Check if the software is correctly connected to the laser displacement
3) Select the corresponding device address
4) Select the laser displacement which needs to be read
5) Select **Continuous**



◎ **Setup**

Provide all internal settings of the laser displacement, the following shows the setting options according to the application.

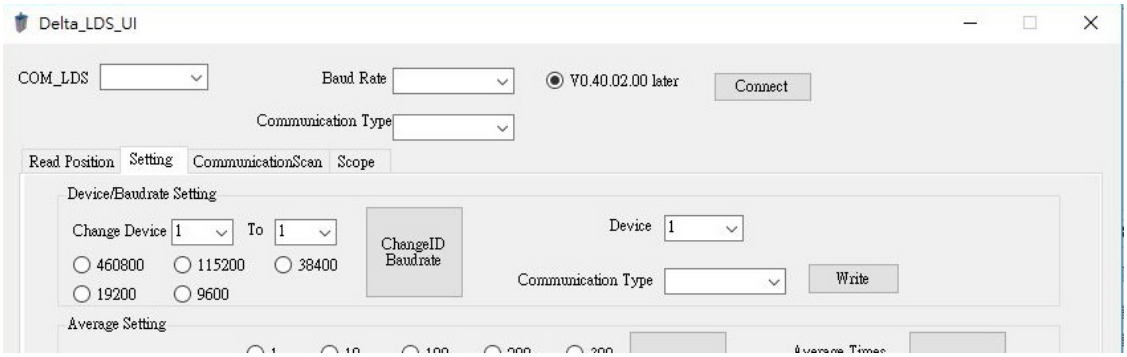
➢ Device Address, Baud Rate, Communication Format

Device address and baud rate needs to be setup at the same time, press the button of address change and the button of baud rate after setting is completed.

For example: device 1 is changed to device 2 and the baud rate changed from 115200 to 38400.

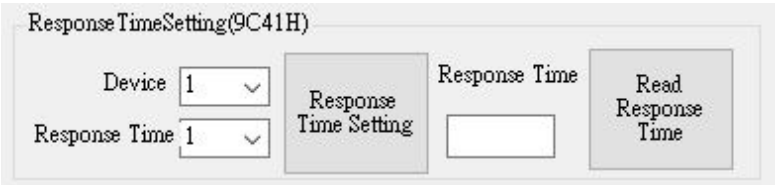
➢ Communication Format

For example: select the current device address and the desired communication format, then press “write”.



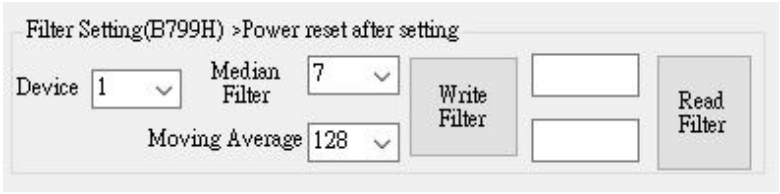
◎ **Response Time Setting**

After selecting the current device address, you can read or set the response speed.



◎ **Filter Setting & Power reset after setting**

After selecting the station number, you can set the size of the median filter and the average number of times. After writing, please resend the power and the parameters will be written into the firmware.



◎ Average Setting

First, select current device address. Then, click **Average Times** that needs to be changed and click **Average Setting**.

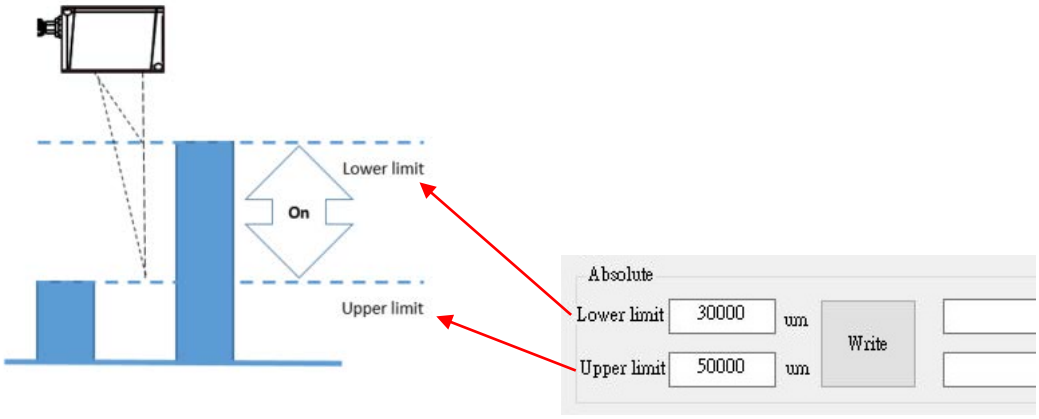
◎ Do Setting

➢ Comparator

The comparator provides absolute position setting and relative position setting. Whenever there is a homing action, comparator output will automatically switch to relative position setting. If you need to switch to absolute position, you need to reset the zero point or resend power.

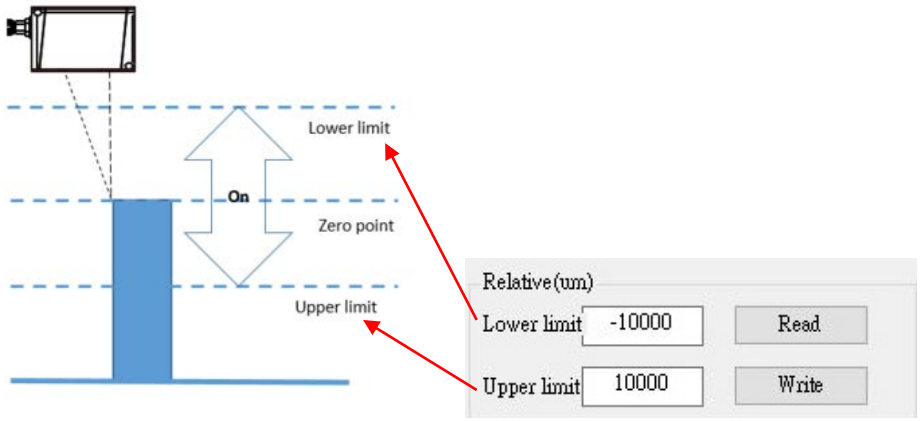
1) Absolute Position Comparator

Set the upper and lower limits of the absolute position. When the object to be tested is in this range, the signal will be output.



2) Relative Position Comparator

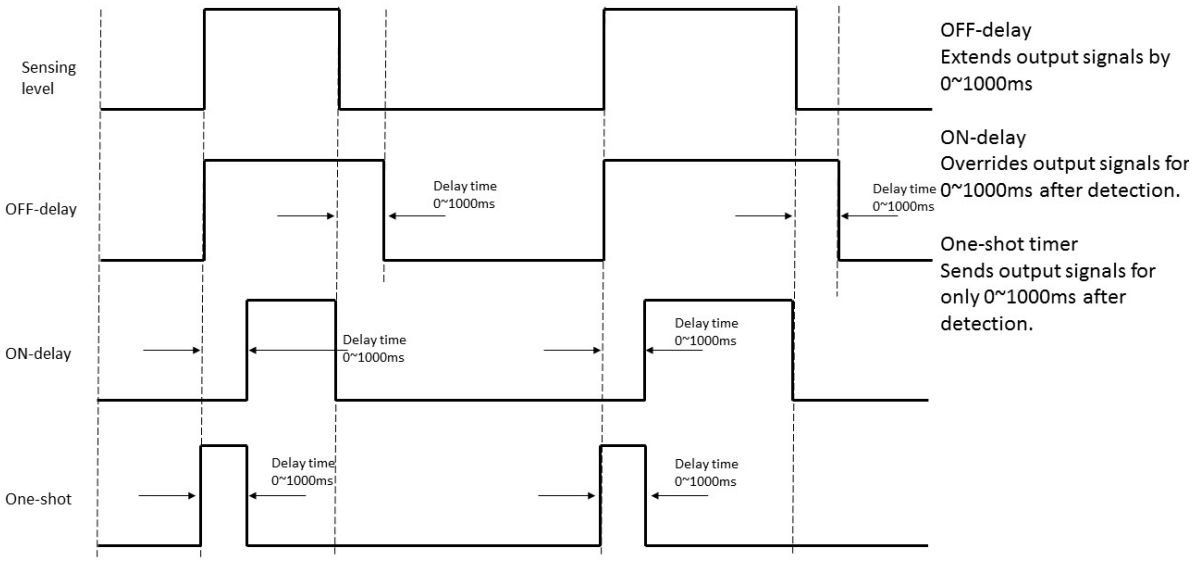
As mentioned above, relative position comparator must be zeroed before it is executed. Also, when the object to be tested is in this range, the signal will be output.



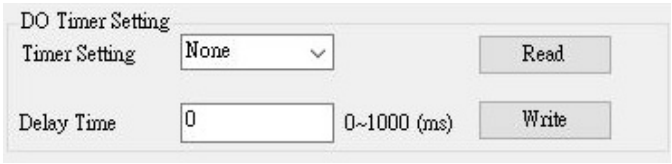
➢ DO Timer Setting

Delay time can be configured according to your use conditions. The setting range of delay time is 0~1000ms.

Timing diagram is shown as follow

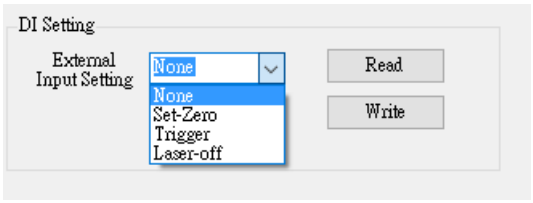


The setting page shown in the following picture.



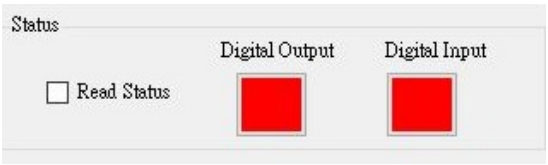
➢ Digital Input

1) None: No function
2) Set-Zero: Zeroing
3) Trigger: Start reading the position
4) Laser-off: Turn off the laser



➢ Digital I/O Status Displaying

Check **Read Status** in the LDS_UI software to monitor I/O status in real-time. The green light represents start.

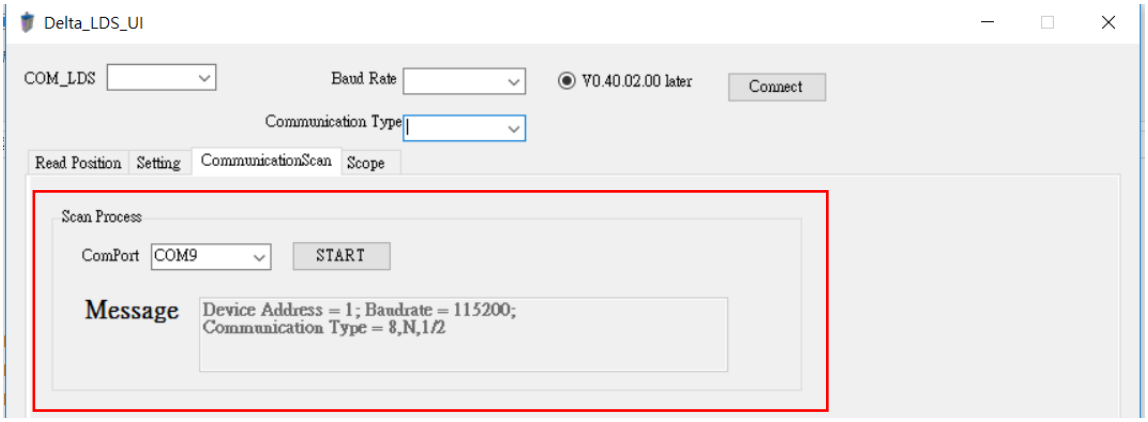


➢ Read Version

Firmeware version

◎ **Scan Process**

If you can't determine the product baud rate, you can click the **Communication Scan** page and select **ComPort**, then you can get the device address, baud rate and communication format.



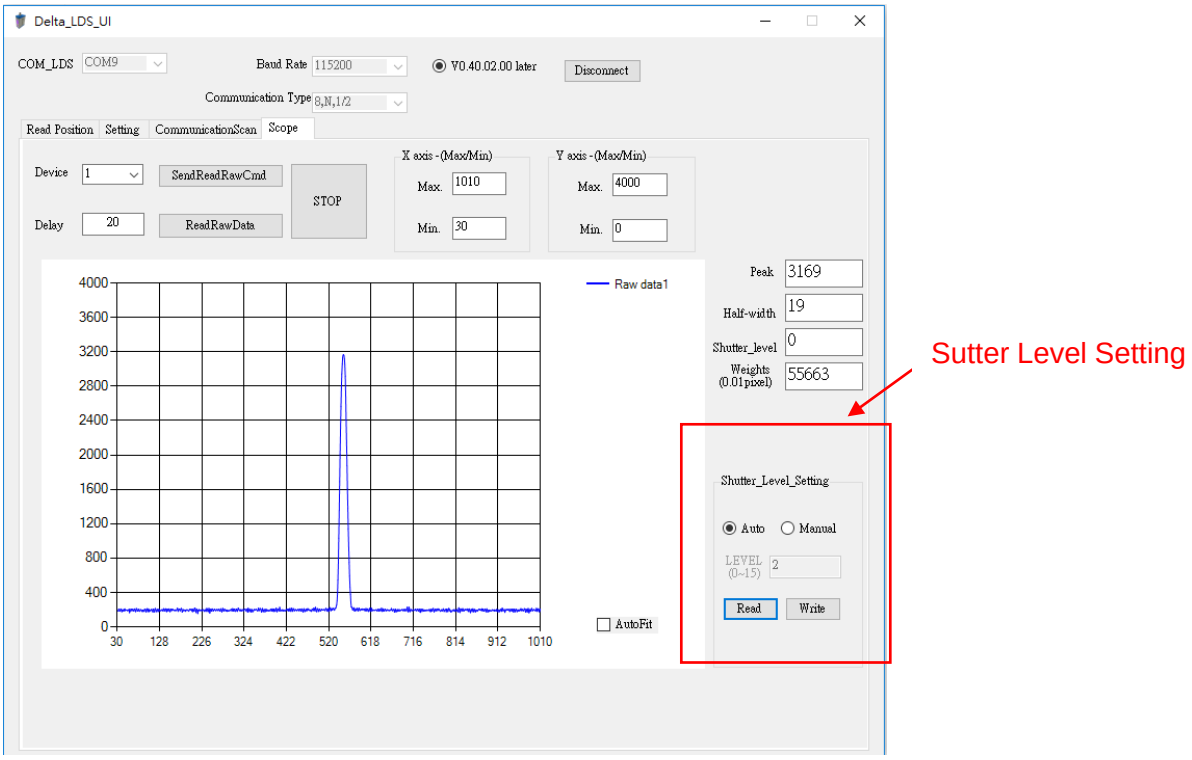
◎ **Oscilloscope**

The oscilloscope can be used to observe the situation where the light source hits the object and is imaged on the CCD sensor.

- Weight
- Peak
- Shutter Level

The shutter level setting can be set up as automatic or manual based on user requirements.

If every surface color and matrial of the objects are certain, in order to increase the scanning efficiency ,we suggest that we can setting the shutter level value into definite value.



Chapter 4

Communication Setting

4.1 Communication Address

◎ **RS485 Communication Mode**

- Baud Rate Supported: 9600, 19200, 38400, 115200, 460800bps
- Communication Mode Supported: 8,N,1、8,N,2、8,O,1、8,O,2、8,E,1、8,E,2
- Communications Protocol: Modbus(RTU)
- Communication Address Supported: 1~127
- Function Code

  03H: Read Command

  06H: Single Entry Write Command

  10H: Multiple Entry Write Command

Position	Function code supported	Name	Description
0H~1H (R)	(03H)	Firmware version	Firmware version
7531H~7532H(R)	(03H)	Absolute position	The data represents the current absolute position LD-040: 30~50mm LD-080: 55~105mm LD-150: 90~210mm
80E9H~80EAH(R)	(03H)	Relative value output	The distance relative to the zero point
9C41H (R/W)	(03H,06H)	Response Time Setting	Response Time: 1(0x0001) : 1 ms; 3(0x0003) : 3 ms; 5(0x0005) : 5 ms; 10(0x000A) : 10ms
9C41H (R/W)	(03H,06H)	Average setting/response time setting	Average time /response time: 1(0x0001) : 1 time /close to 1ms; 10(0x000A): 1 times /close to 10ms; 100(0x0064): 100 times /close to 100ms; 200(0x00c8): 200 times /close to 200ms; 300(0x012c): 300 times /close to 300ms; 400(0x0190): 400 times /close to 400ms;

			500(0x01F4): 500 times /close to 500ms; 1000(0x03E8) : 1000 times /close to 1000ms
B799H(R/W)	(03H,06H)	Median filters & Moving average setting	High byte: (0x00 : Filter length:1) (0x01 : Filter length: 3) (0x02 : Filter length: 5) (0x03 : Filter length: 7) (0x04 : Filter length: 9) (0x05 : Filter length: 11) (0x06 : Filter length: 13) (0x07 : Filter length: 15) Low byte: (0x01 : Moving average: 1) (0x02 : Moving average: 4) (0x03 : Moving average: 8) (0x04 : Moving average: 16) (0x05 : Moving average: 32) (0x06 : Moving average: 64) (0x07 : Moving average: 128) (0x08 : Moving average: 256)
753BH~753CH (R)	(03H)	Peak of PD	Peak of PD
7595H~7610(R)	(03H)	Continuous value	62 consecutive positions (two characters represent a single value) 7595H(High) & 7596H(Low) is the 1st value 7597H(High) & 7598H(Low) is the 2nd value ……. 760FH(High) & 7610H(Low) is the 62th value
7919H~ 7995H (R)	(03H)	Amplitude of 30 to 154 pixels on the PD	7919H is the 1st value (pixel 30). 7995H is the 125th value (pixel 154)
79E1H~ 7A5DH (R)	(03H)	Amplitude of 155 to 279 pixels on the PD	79E1H is the 1st value (pixel 155). 7A5DH is the 125th value (pixel 279)
7AA9H~ 7B25H (R)	(03H)	Amplitude of 280 to 404 pixels on the PD	7AA9H is the 1st value (pixel 280). 7B25H is the 125th value (pixel 404)
7B71H~ 7BEDH (R)	(03H)	Amplitude of 405 to 529 pixels on	7B71H is the 1st value (pixel 405). 7BEDH is the 125th value (pixels 529)

		the PD	
7C39H~ 7CB5H (R)	(03H)	Amplitude of 530 to 649 pixels on the PD	7C39H is the 1st value (pixel 530). 7CB5H is the 125th value (pixels 649)
7D01H~ 7D7DH (R)	(03H)	Amplitude of 650 to 774 pixels on the PD	7D01H is the 1st value (pixel 650). 7D7DH is the 125th value (pixels 774)
7DC9H~ 7E45H (R)	(03H)	Amplitude of 775 to 899 pixels on the PD	7DC9H is the 1st value (pixel 775). 7E45H is the 125th value (pixels 899)
7E91H~ 7F0DH (R)	(03H)	Amplitude of 900 to 1019 pixels on the PD	7E91H is the 1st value (pixel 900). 7F0DH is the 125th value (pixels 1019)
9C41H (R/W)	(03H,06H)	Average times and response times	Average times/ response times: 1(0x0001) : 1 time/ close to 1ms; 10(0x000A): 10 times/ close to 10ms; 100(0x0064): 100 times/ close to 100ms; 200(0x00c8): 200 times/ close to 200ms; 300(0x012c): 300 times/ close to 300ms; 400(0x0190): 400 times/ close to 400ms; 500(0x01F4): 500 times/ close to 500ms; 1000(0x03E8) : 1000 times/ close to 1000ms
A029H (R/W)	(03H,06H)	Device address and baud rate setting	High byte: device address (0x1~0x7f) Low byte: baud rate (0x0: 460800, 0x1: 115200 (initial value), 0x2: 9600, 0x3: 19200, 0x4: 38400
A411H (W)	(06H)	Start reading the amplitude on the PD	0x01: start Automatic zeroing when finished
A7F9H (R/W)	(03H,06H)	Lower limit	Lower limit: high byte (digital output) → absolute position
A85DH (R/W)	(03H,06H)		Lower limit: low byte (digital output) → absolute position
A8C1H (R/W)	(03H,06H)	Upper limit	Upper limit: high byte (digital output) → absolute position
A925H (R/W)	(03H,06H)		Upper limit: high byte (digital output) → absolute position
A989H (R/W)	(03H,06H)	DI/DO status	High byte: 0x00:DI/DO is OFF

		DI/DO NO/NC	0x01: DI is OFF、DO is ON 0x10: DI is ON、DO is OFF 0x11: DI/DO is ON Low byte: 0x00:DI/DO is NC 0x01: DI is NC、DO is NO 0x10: DI is NO、DO is NC 0x11: DI/DO is NO
AA51H (R/W)	(03H,06H)	Output delay mode setting	0x00: Normal output、0x01: Off-delay; 0x02: On-delay; 0x03: One-shot
AAB5H (R/W)	(03H,06H)	Output delay time setting	0~1000ms
AB19H~AB1AH (R/W)	(03H,10H)	Relative lower limit setting	-120000um~120000um → relative position (numbers)
AB7DH~ AB7EH (R/W)	(03H,10H)	Relative upper limit setting	-120000um~120000um → relative position (numbers)
AFC9H (R/W)	(03H,06H)	Set the zero value	0x00: Reset the zero value 0x01: set to zero
84D1H~84D2H (R/W)	(03H,10H)	Read the zero value	Read the set zero value
B3B1H (R/W)	(03H,06H)	Communication setting	0x00: 8,O,1/2 0x01: 8,N,1/2 0x03: 8,E,1/2
ABE1H (R/W)	（03H,06H）	Set external input function	0x00: None 0x01:Set-zero 0x02: Trigger 0x03: Laser-off
A9EDH (R/W)	（03H,06H）	Set shutter level	High byte: 0x00→Manual 0x01→Auto Low byte: 0x00~0x0F→ 15 levels can be adjusted, if it is in the automatic mode, it cannot be set.

4.2 Communication Protocol

◎ **Communication code can read N bytes (The maximum value of N is 125): function code is 03H**

➢ For example: When the device address of the laser displacement is 01H and the register is 0x00 (Dec), the RTU mode command to read the current position is as follows.

RTU mode

Command message

Address	0x01
Function code	0x03
Initial address (high)	0x00
Initial address (low)	0x00
Data entries In bytes (high)	0x00
Data entries In bytes (low)	0x02
CRC checksum (low)	0xC4
CRC checksum (high)	0x0B

Reply message

Address	0x01
Function code	0x03
Bits	0x04
Register 30001 (high)	0x01
Register 30001 (low)	0x00
Register 30002 (high)	0x00
Register 30002 (low)	0x04
CRC checksum (low)	0xFA
CRC checksum (high)	0x0C

➢ For example: When the device address of the laser displacement is 01H and the register is 7537H (absolute position), the RTU mode command to read the current position is as follows.

RTU mode

Command message

Address	0x01
Function code	0x03
Initial address (high)	0x75
Initial address (low)	0x31
Data entries In bytes (high)	0x00
Data entries In bytes (low)	0x02
CRC checksum (low)	0x8F
CRC checksum (high)	0xC8

Reply message

Address	0x01
Function code	0x03
Bits	0x04
Register 30001 (high)	0x96
Register 30001 (low)	0x0E
Register 30002 (high)	0x00
Register 30002 (low)	0x05
CRC checksum (low)	0x76
CRC checksum (high)	0x7B

➢ For example: When the device address of the laser displacement is 01H and the register is 753BH (PD peak position), the RTU mode command to read the current position is as follows.

RTU mode

Command message

Address	0x01
Function code	0x03
Initial address (high)	0x75
Initial address (low)	0x3B
Data entries In bytes (high)	0x00
Data entries In bytes (low)	0x02
CRC checksum (low)	0xAF
CRC checksum (high)	0xCA

Reply message

Address	0x01
Function code	0x03
Bits	0x04
Register 30001 (high)	0x32
Register 30001 (low)	0xB0
Register 30002 (high)	0x00
Register 30002 (low)	0x01
CRC checksum (low)	0x34
CRC checksum (high)	0xAC

➢ For example: When the device address of the laser displacement is 01H and the register is 7595H (62 consecutive data), after receiving the command, the laser displacement will read the previous 62 consecutive data and the RTU command is as follows.

Command message

Address	0x01
Function code	0x03
Initial address (high)	0x75
Initial address (low)	0x95
Data entries In bytes (high)	0x00
Data entries In bytes (low)	0x7C
CRC checksum (low)	0x4E
CRC checksum (high)	0x0B

Reply message

Address	0x01
Function code	0x03
Bits	0xF8
Register 30101 (high)	0x00
Register 30101 (low)	0x05
Register 30102 (high)	0x9B
Register 30102 (low)	0x09
⋮	⋮
⋮	⋮
⋮	⋮
⋮	⋮
Register 30223 (high)	0x00
Register 30223 (low)	0x05
Register 30224 (high)	0x9B
Register 30224 (low)	0x00
CRC checksum (low)	0xDB
CRC checksum (high)	0x3F

The first data:
0(0x00)*256*256*256+5(0x05)*256*256+155(0x9B)*256+9(0x09)=367369(0.1um)

The last data:
0(0x00)*256*256*256+5(0x05)*256*256+155(0x9B)*256+0(0x00)=367360(0.1um)

◎ **Communication code can be 1 byte, function code: 06H**

➢ For example: Write 0201H (device address: 0x02 & baud rate: 0x01) to A029H, the device address is 0x01 and the RTU command is as follows.

Command message

Address	0x01
Function code	0x06
Initial address (high)	0xA0
Initial address (low)	0x29
Data content (high)	0x02
Data content (low)	0x01
CRC checksum (low)	0xBA
CRC checksum (high)	0xA2

Reply message

Address	0x01
Function code	0x06
Initial address (high)	0xA0
Initial address (low)	0x29
Data content (high)	0x02
Data content (low)	0x01
CRC checksum (low)	0xBA
CRC checksum (high)	0xA2

➢ For example: Write the lower limit of digital I/O output to the laser displacement meter of device address 0x01 which need to set high byte of lower limit(A7F9H) and low byte of lower limit(A85DH). The RTU command is as follows
Lower limit = 35000 um (high byte is 0x0000, low byte is 0x88b8)

Command message
High byte setting

Address	0x01
Function code	0x06
Initial address (high)	0xA7
Initial address (low)	0xF9
Data content (high)	0x00
Data content (low)	0x00
CRC checksum (low)	0x7A
CRC checksum (high)	0x8F

Reply message

Address	0x01
Function code	0x06
Initial address (high)	0xA7
Initial address (low)	0xF9
Data content (high)	0x00
Data content (low)	0x00
CRC checksum (low)	0x78
CRC checksum (high)	0xEF

Low byte setting

Address	0x01
Function code	0x06
Initial address (high)	0xA8
Initial address (low)	0x5D
Data content (high)	0x88
Data content (low)	0xB8
CRC checksum (low)	0x5E
CRC checksum (high)	0x0A

Address	0x01
Function code	0x06
Initial address (high)	0xA8
Initial address (low)	0x5D
Data content (high)	0x88
Data content (low)	0xB8
CRC checksum (low)	0x5E
CRC checksum (high)	0x0A

- For example: Write the lower limit of digital I/O output to the laser displacement meter of device address 0x01 which need to set high byte of upper limit(A8C1H) and low byte of lower limit(A925H). The RTU command is as follows
  Lower limit = 40000 um (high byte is 0x0000, low byte is 0x9C40)

Command message

High byte setting

Address	0x01
Function code	0x06
Initial address (high)	0xA8
Initial address (low)	0xC1
Data content (high)	0x00
Data content (low)	0x00
CRC checksum (low)	0xF8
CRC checksum (high)	0x56

Reply message

Address	0x01
Function code	0x06
Initial address (high)	0xA8
Initial address (low)	0xC1
Data content (high)	0x00
Data content (low)	0x00
CRC checksum (low)	0xF8
CRC checksum (high)	0x56

Low byte setting

Address	0x01
Function code	0x06
Initial address (high)	0xA9
Initial address (low)	0x25
Data content (high)	0x9C
Data content (low)	0x40
CRC checksum (low)	0xD1
CRC checksum (high)	0x6D

Address	0x01
Function code	0x06
Initial address (high)	0xA9
Initial address (low)	0x25
Data content (high)	0x9C
Data content (low)	0x40
CRC checksum (low)	0xD1
CRC checksum (high)	0x6D

◎ **Communication code can be 2 byte, function code: 10H**

➢ For example: Write digital I/O lower limit for relative setting and write lower limit -5000um to AB19H~AB1AH. The RTU command is as follows

Command message			Reply message	
Address	0x01		Address	0x01
Function code	0x10		Function code	0x10
Initial address (high)	0xAB		Initial address (high)	0xAB
Initial address (low)	0x19		Initial address (low)	0x19
Number of registers (high)	0x00		Number of registers (high)	0x00
Number of registers (low)	0x02		Number of registers (low)	0x02
Byte	0x04		CRC checksum (low)	0xB0
Register address 0xAB19 (high)	0xEC		CRC checksum (high)	0x2B
Register address 0xAB19 (low)	0x78			
Register address 0xAB1A (high)	0xFF			
Register address 0xAB1A (low)	0xFF			
CRC checksum (low)	0x0C			
CRC checksum (high)	0xC7			

Chapter 5

Specifications

Name	Laser Displacement		
Sensing method	Triangulation		
Model	LD-040N	LD-080N	LD-150N
Reference Distance	40mm	80mm	150mm
Measurement Range	± 10mm	± 25mm	± 60mm
Repeatability	2μm	5μm	15μm
Interface	Communication method: Digital I/O and RS485		
	Supports 9600, 19200, 38400, 115200, 460800 bps (Default value: 115200bps)		
Light Source	Laser CLASS 2		
Spot Size	50 x 15μm	90 x 25μm	168 x 40μm
Input Voltage	12~24 VDC ± 10%		
Linearity	± 0.1%		
Response Time	1ms / 3ms / 5ms / 10ms (Default value: 1ms)		
Average	1 /2 /4 /8 /16 /32 /64 /128 /256 (Default value 64)		
Sampling Rate	1ms / 10ms / 100ms / 200ms / 300ms / 400ms / 500ms / 1000ms (Default value: 100ms)		
Indicator	Laser ON: blue, Measurement range: green, Out of measurement range: orange, DO: yellow, DI: red		
Protection Circuit	Protection against reverse power connection, output overcurrent, power supply surge, output surge		
Operating Temperature	10°C ~ 50°C		
Storage Temperature	-25ºC ~ 75ºC		
Ambient Humidity	30% ~ 85 %		
Enclosure Rating	IP67		
Ambient Light Resistance	5000lus or less		
Vibration Resistance	10 ~ 55 Hz, 1.5 mm, 3 axes for 2 hours		
Insulating Resistance	20MΩ or more		
Withstand Voltage	500 VAC 50 / 60 Hz 1min		
Certifications	CE		
Materials	Optical window: Glass; Case: Aluminium		
Cables	M8 Connector (8 Pin)		
Dimensions	57mm × 42mm × 24mm		

Chapter 6

Safety Precautions

◎ **Caution of laser displacement**

- If you do not use, control, adjust, or perform operations as required, there is the possibility of exposure to radiation.
- Due to the possibility of human injury (eyes, skin, etc.), please be sure to observe the followings.
- The product doesn't have automatically stop laser emitting device after dismantling, therefore please do not disassemble it.

◎ **Caution of laser product**

- Avoid direct or indirect entrance of laser light into the eye.
- Do not deliberately irradiate the human body.
- Pay heed to the path that the laser beam passes through.
- Do not install at the same height as the beam path and human eye.

Chapter 7

Warranty

All products from Delta Electronics Inc. undergo detailed inspection before shipment. If you have any problems, please contact your local branch or distributor and detail the failure.

◎ **Warranty Term**

➢ This Limited Warranty shall last for twenty four months from shipment to purchaser.

◎ **Warranty Conditions**

➢ Our company will replace products free of charge once it becomes apparent that the company might be blamed for faults within the warranty period. However, the following conditions are not covered by the warranty:

1) Any product failure caused by improper conditions, environment, operation and operation methods not described in operation manual and user manual.
2) Any failure due to product defects, such as customer's equipment and software.
3) It is not caused by the modification or repair of products by Delta specialist.
4) It is not the damage caused by maintenance or replacement of expendable parts in accordance with operation manual and user manual.
5) Not Delta's responsibility: any natural physical disaster, such as fire, earthquake, flood or other external factor, such as abnormal voltage.

➢ Product warranty is limited to the above mentioned content. We are not responsible for any other minor loss (such as equipment damage and business) and any other damage due to product failure.