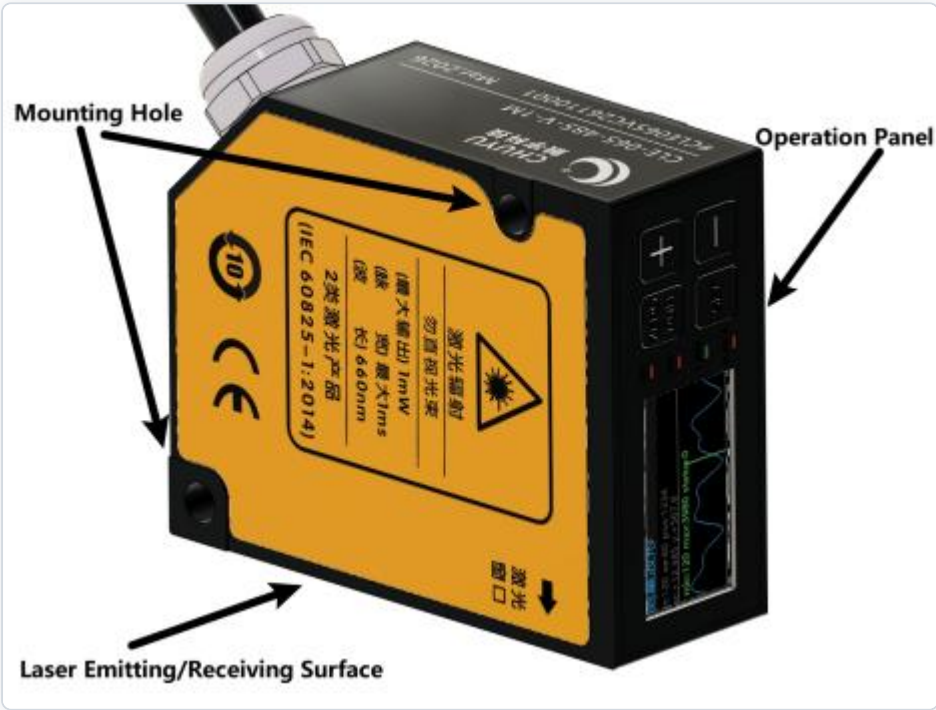


COMPACT LASER DISPLACEMENT SENSOR

LLE Series

Operating manual for installation, on-panel configuration, teaching, and RS-485 / Modbus RTU communication.



INTERFACE	LASER	PROTECTION	MODELS
RS-485 · Modbus RTU	Class 2 · 660 nm	IP67	030 / 050 / 100 / 195

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A Register Map

BEFORE YOU BEGIN

- Confirm that this product meets the requirements of your application.
- Read the safety precautions in Chapter 1 and operate the product only after understanding them.

01 Safety Guidelines

Using this product without adhering to the specified operating instructions may result in personal injury or property damage. Read this chapter before installation and operation.

WARNING

- This product uses a visible semiconductor laser. Do not allow the beam — directly or reflected from a shiny surface — to enter the eyes; exposure may cause blindness.
- This product has no explosion-proof design. Do not use it in environments containing flammable or explosive gases or liquids.
- Do not disassemble or modify the product. It does not automatically switch off laser emission when opened.
- Do not use this device as personal safety protection equipment.
- Unauthorized disassembly or modification may cause personal injury, fire, or electric shock.

CAUTION

- Never connect or disconnect interfaces while powered. Always turn off power before any wiring operation.
- Avoid installation in locations with dust or steam, corrosive gases, direct water or oil splash, or severe vibration or impact. Not suitable for outdoor use or use in water.
- Allow roughly 5 minutes of warm-up after power-on before relying on measurements.
- Do not route alongside high-voltage or power lines, which may induce faults or damage. If a switching-power-supply regulator is used, connect its ground terminal to earth.
- Keep the emitting and receiving windows clean, and avoid direct impact from foreign objects. Operate within the rated range.

1.1 Laser Class & Labelling

This product is classified as a **Class 2 (II)** laser product under IEC 60825-1:2014. If the laser label on the device is obscured during installation, apply the included laser warning label in a clearly visible location.

02

Package Contents & Wiring

2.1 Package Contents

Confirm that the packaging includes the following items:

- LLE-XXX-485-XX sensor unit
 - Installation screws: M4 × 30, 2 pcs
 - Certificate of conformity
- Product manual (this operating manual)
 - Laser warning label
 - Warranty card

2.2 Cable Pin Assignment

The cable conductor colours correspond to the following functions:

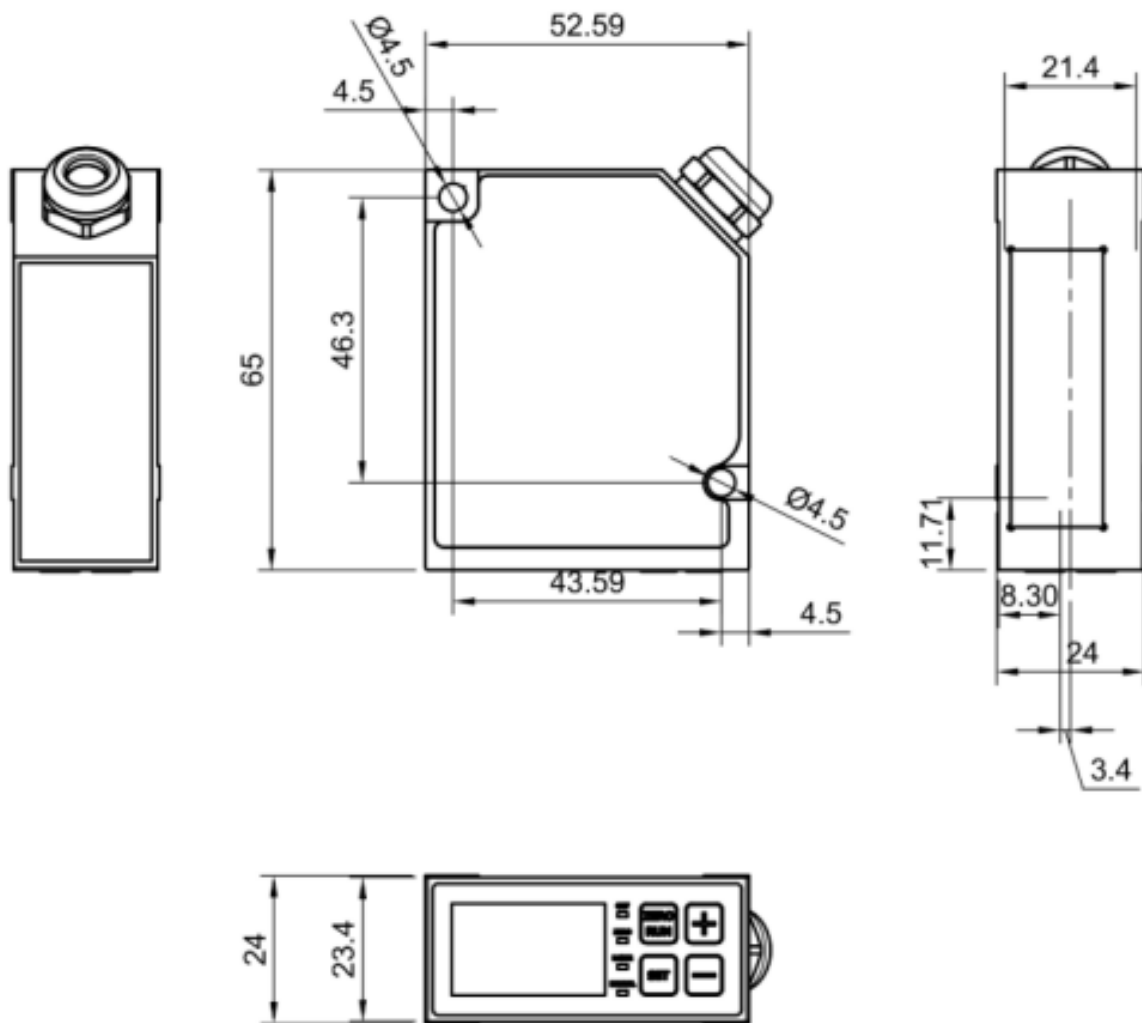
CONDUCTOR COLOUR	FUNCTION
Brown	DC 12–24 V
Red	Sync A
Green	Sync B
Blue	GND
White	RS-485 Data (B)
Black	RS-485 Data (A)
Pink	External input (multi-function)
Grey	Discrete (switching) output
Purple	Analog output
Shield layer	Analog output GND
Yellow-green	PE

CAUTION

Connecting or disconnecting the cable while powered is extremely dangerous. Turn off the power before wiring.

03 Dimensions

All dimensions in millimetres (mm). Mounting holes accept M4 screws ($2 \times \varnothing 4.5$ through-holes).



Outline dimensional drawing — LLE series (65 × 52.59 × 24 mm).

04 Specifications

MODEL · LLE-XXX-485-V	030	050	100	195
Measurement distance (centre)	30 mm	50 mm	100 mm	195 mm
Measuring range	±4 mm	±10 mm	±20 mm	±90 mm
ILLUMINANT				
Light source · wavelength	Red semiconductor laser · 660 nm			
Spot size	665 μm @ C.D.			
Maximum output	1 mW			
Laser class (GB / IEC)	Class 2			
PERFORMANCE				
Linearity	±0.1% F.S.			
Repeatability	2 μm	5 μm	10 μm	50 μm
Sampling period	333 / 500 / 1000 / 2000 / 3333 μs			
Temperature drift (ref.)	±0.05% F.S. / °C			
INTERFACE & OUTPUT				
Communication	RS-485 half-duplex (Modbus RTU)			
External input	Laser shutdown, remote teaching, sample hold, single-pulse trigger, zeroing			
Analog output · voltage	0–10 V, output impedance 100 Ω			
Switching output	Open-collector (NPN / PNP selectable): max 100 mA @ DC 30 V; residual voltage 1.8 V			
POWER				
Supply voltage	DC 12–24 V ±10%			
Current consumption	< 70 mA @ DC 24 V · < 125 mA @ DC 12 V			
Protection circuit	Over-current protection, reverse-connection protection			
ENVIRONMENT & PHYSICAL				
Protection level	IP67			
Operating temp. / humidity	–10 to +50 °C / 35–85% RH (no condensation or icing)			
Ambient light	Incandescent lamp: below 7000 lx			
Vibration resistance	10–55 Hz, 1.5 mm double amplitude, 2 h per X / Y / Z axis			
Shock resistance	500 m/s² (≈50 G), 3× in each of X / Y / Z			
Housing material	Die-cast aluminium			

MODEL · LLE-XXX-485-V	030	050	100	195
Weight	≈ 200 g			

Test conditions: operating temperature 15 °C (room temperature); supply voltage DC 24 V; sampling period 1000 μs; averaging 64×.



LLE series control panel — display, indicator LEDs, and four keys.

5.1 Indicator LEDs

LED	LIT WHEN
OUT	The switching output is ON.
ZERO	The zero-setting function is active.
LASER	The laser source is emitting.
MANUAL	The unit is in Basic or Detailed setting mode.

5.2 Keys

KEY	FUNCTION
[+] [-]	Select menu items and adjust values.
[SET]	Confirm / enter the selected item.
[ZERO/RUN]	Return to the previous level; in detection mode, execute zeroing (see Chapter 10).

06 Operating Modes

The LLE series operates in four modes. The **MANUAL** LED is lit whenever the unit is in Basic or Detailed setting mode.

MODE	PURPOSE
Detection (RUN)	Normal measurement and output; the default mode after power-on.
Teaching (Demonstration)	Set thresholds and calibrations from physical target positions (§7).
Basic Setting	Everyday parameters: baud rate, thresholds, sampling, output (§8).
Detailed Setting	Advanced parameters: hysteresis, waveform, sensitivity, reporting (§9).

6.1 Switching Between Modes

- Press [SET] to enter teaching mode and select the desired item.
- From the default display, use [+] / [-] to reach **Basic Settings**, then press [SET] . Press [SET] again on **Detailed Settings** to enter that mode.
- Press [ZERO/RUN] to return to detection mode at any time.

NOTE • SETTING VALUES

In any setting menu, [+] / [-] choose the option or adjust the value, [SET] confirms, and [ZERO/RUN] returns one level.

6.2 Detection Display

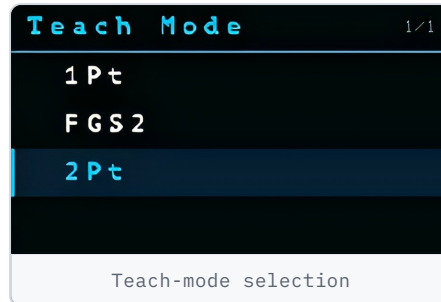
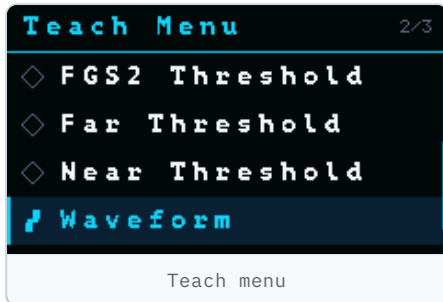


In detection (RUN) mode the display shows the live measurement value in large digits, the status icons along the top (LOCK / ZERO / OUT), and a bar indicating the position of the target within the taught range.

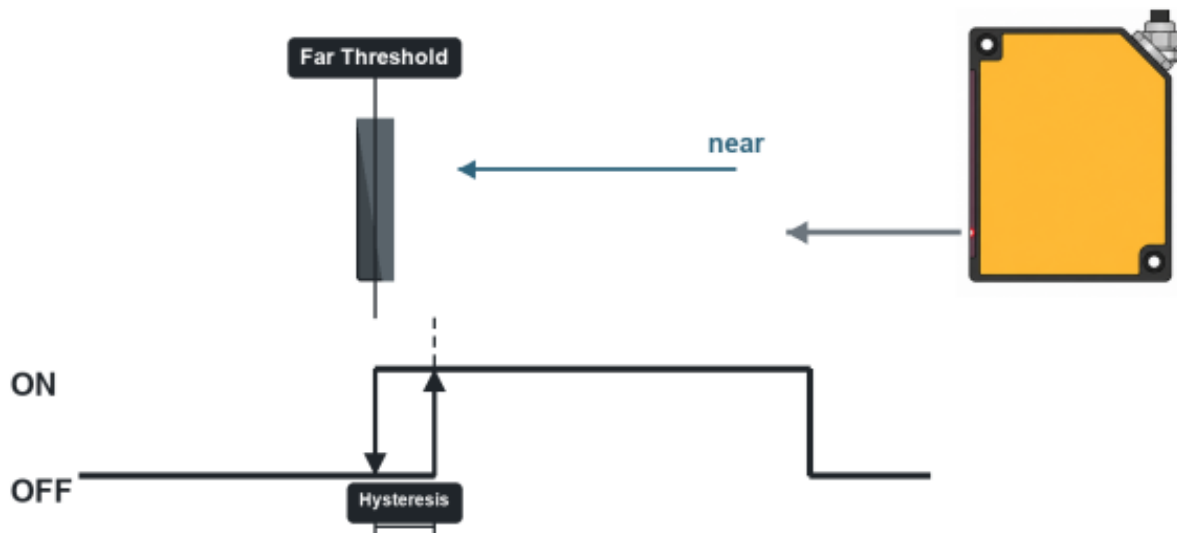
07 Teaching & Output

Teaching lets the sensor "remember" physical positions instead of entering threshold values by hand. The LLE series offers three teaching modes. The behaviour below assumes **output polarity = Normally Open**; setting Normally Closed inverts the output.

7.1 Teaching Modes

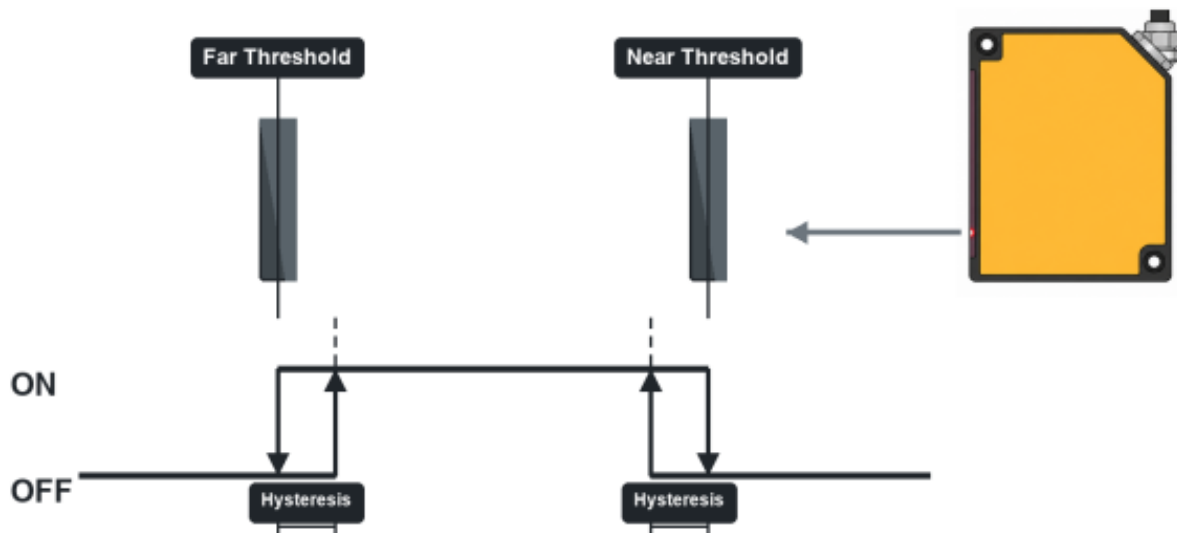


1-POINT TEACHING



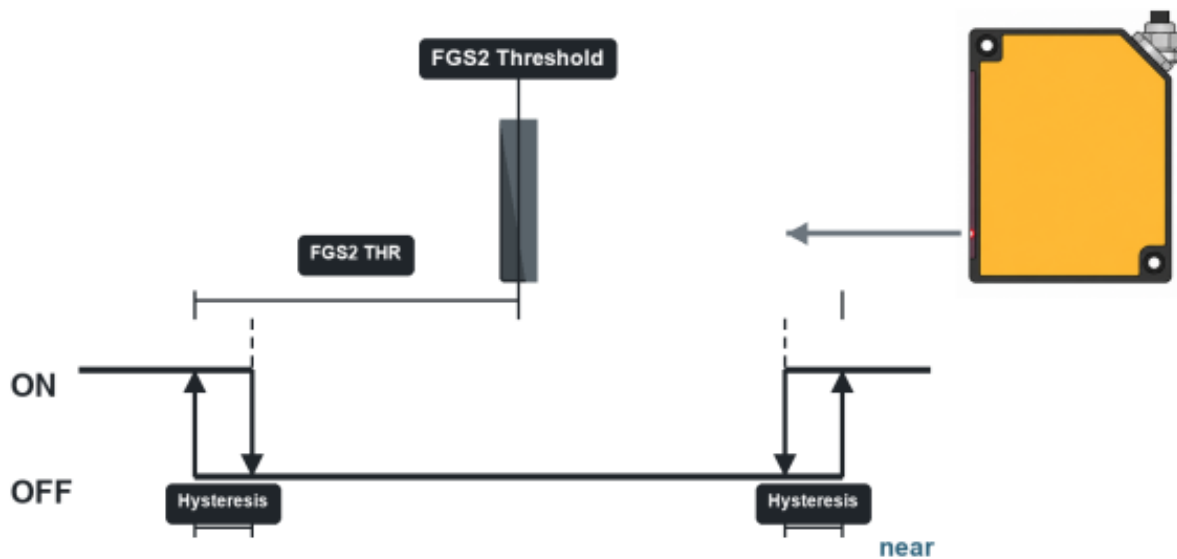
After teaching at the specified location, the output is ON from that point to the proximal end of the detection area.

2-POINT TEACHING



After teaching two locations, the output is ON within the range between the two points.

FGS2 TEACHING



After teaching a reference location, the output turns ON when the distance exceeds the allowable tolerance. Use FGS2 for workpieces on a reference plane such as a conveyor belt.

7.2 External-Input Teaching (timing)

With **External input = Teach**, hold the external input line for the following durations to perform each function:

INPUT DURATION (S)	FUNCTION
0 - 0.5	Not executed
0.5 - 1.5	Proximal teaching
1.5 - 2.5	Distal teaching

INPUT DURATION (S)	FUNCTION
2.5 – 3.5	Proximal threshold (1st point of 2-point teaching)
3.5 – 4.5	Distal threshold (2nd point / 1-point teaching)
≥ 4.5	FGS2 threshold

With **External input = Zero**:

INPUT DURATION (SAMPLES)	FUNCTION
0 – 1800	Set zero
> 2200	Cancel / clear zero

7.3 Analog Output

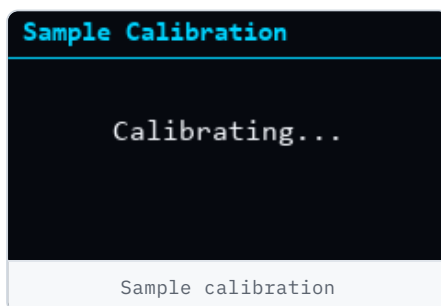
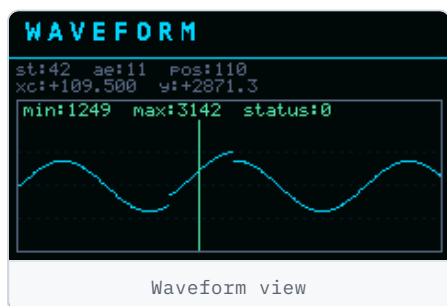
Analog-output models convert the measurement result into an analog signal spanning the measuring range (0–10 V).

ATTENTION

- When an alarm is triggered, the analog voltage output is 11 V.
- When using analog voltage output, the supply voltage must be at least 12 V.

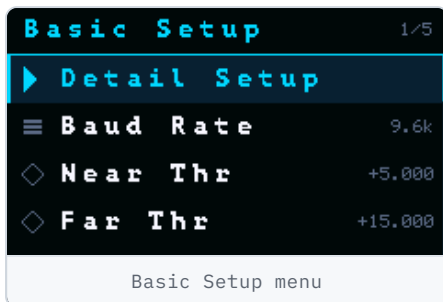
7.4 Waveform & Sample Calibration

The Teach menu includes a live **Waveform** view showing the light-signal intensity from the target surface, and a one-touch **Sample Calibration** that, with the target within range, automatically adjusts sensitivity and laser brightness to an optimal level. If the waveform amplitude is too high or too low, adjust brightness and sensitivity (Chapter 9) into the normal range.



08 Basic Setting Mode

From the default display, press **[+]/[-]** to reach **Basic Settings**, then **[SET]** to enter. An asterisk (*) marks the factory default.



#	SETTING	OPTIONS & DEFAULT
1	Port (baud) rate	9.6k · 19.2k · 38.4k · 57.6k · 115.2k* · 230.4k · 312.5k · 460.8k · 500k · 625k · 833.3k · 937.5k · 1.25M bps
2	Proximal threshold	1st point of 2-point teaching. Default +5.00 mm
3	Distal threshold	2nd point of 2-point / 1-point teaching. Default +15.00 mm
4	FGS2 threshold	FGS mode threshold. Default +10.00 mm
5	Teaching model	1Pt · FGS2 · 2Pt*
6	FGS2 parallax distance	Enter directly. Default +0.5 mm
7	Sampling cycle	333 (3 kHz) · 500 (2 kHz) · 1000 (1 kHz)* · 2000 (500 Hz) · 3333 μs (300 Hz)
8	Output polarity	Normally open* (ON beyond threshold) · Normally closed (ON below threshold)
9	Averaging	1× · 8× · 64x* · 512×
10	Abnormal pattern	Max output value (999.999)* · Hold last measurement value
11	Abnormal hold count	000–999. Retains the last value for N samples, then outputs 999.999. At 000, holds the last value continuously.
12	Initialize	Select and press [SET] to restore factory defaults.
13	Display screen	Open* (show value) · Close (hide value when locked)
14	Output method	NPN* · PNP open-collector. Unchanged by Initialize.
15	External input	Off* · Laser off · Teach · Sample hold · Single-pulse · Zero · Continuous output
16	Protocol / station	Modbus RTU, station 1*–128. Unchanged by Initialize.

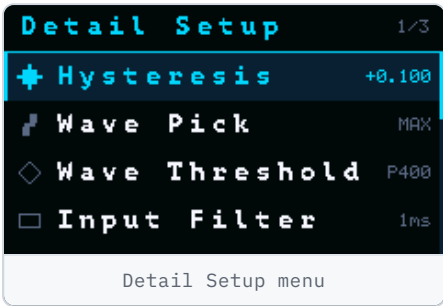
Custom protocol and Modbus RTU cannot be used simultaneously.

09 Detailed Setting Mode

CAUTION

Improper parameters in Detailed Setting mode may cause detection or communication failure. Keep the factory defaults unless a specific need applies.

From **Basic Settings**, press **[SET]** , select **Detailed Settings**, then press **[SET]** again. An asterisk (*) marks the factory default.



#	SETTING	OPTIONS & DEFAULT
1	Hysteresis (lag)	Enter directly. Default 0.100 mm
2	Light-waveform peak	Max peak* · 1st · 2nd · 3rd · 4th · 5th peak. Selects which peak to measure when several are present.
3	Waveform threshold	High · Middle · Low. Signals below the threshold are ignored.
4	Input filtering	1–256 samples. External input shorter than this is ignored.
5	Zero display value	Value shown after a zero-reset.
6	Sensitivity	Level 1 (min) – 6 (max). Default Level 5
7	Brightness	Level 1 (min) – 9 (max). Default Level 6
8	Active send	Set the baud rate first, then enable. Actively transmits measurement and decision values.
9	ON interval frames	Transmit interval (in frames) while output is ON.
10	OFF interval frames	Transmit interval (in frames) while output is OFF.
11	Model	Displays the software and hardware versions.
12	Language	Switch between Chinese and English.

10 Other Features

10.1 Zero Function

- **Set zero:** in detection mode (RUN), press and hold `[ZERO/RUN]` for more than 2 s. The current value becomes 0.000 and the **ZERO** LED lights.
- **Clear zero:** in RUN mode, press and hold `[ZERO/RUN]` for more than 4 s to cancel the zero offset.

10.2 Key Lock

- **Lock:** in RUN mode, hold `[+]` for more than 2 s. All actions except unlock become invalid.
- **Unlock:** in RUN mode, hold `[+] [-]` together for more than 2 s.

11 Communication — Modbus RTU

11.1 Communication Format

Communication mode	RS-485 (half-duplex)
Transmission code	Binary
Data length	8 bit
Stop bit	1 bit
Parity	None
Baud rate	9.6k / 19.2k / 38.4k / 57.6k / 115.2k / 230.4k / 312k / 460.8k / 500k / 625k / 833.3k / 937.5k / 1.25M bps

- **Half-duplex bus:** only the host or one device drives the bus at a time. A device replies only after receiving a complete, CRC-valid request frame addressed to it (or the broadcast address).
- **Protocol:** Modbus RTU · address range 1–128.
- **Byte order:** registers and multi-byte values are big-endian (high byte first).
- **Checksum:** CRC-16 / Modbus, polynomial 0xA001 (reflected), initial value 0xFFFF; computed from the station byte to the byte before the CRC. In the frame the CRC is sent low byte first (CRC_LO) then high byte (CRC_HI).

11.2 Supported Function Codes

CODE	USE	STANDARD MODBUS?
0x03	Read parameters	Yes
0x06	Write single parameter	Yes
0x10	Write multiple parameters	Yes
0x42	Command family (read measurement / decision / version; action commands)	No (private)

11.3 Frame Structure

Values in [] are one byte; Hi/Lo denote the high/low byte of a 16-bit value.

TYPE	HOST SENDS	DEVICE RETURNS
Read (03)	[Stn] [03] [AddrHi] [AddrLo] [QtyHi] [QtyLo] [CRCL] [CRCH]	[Stn] [03] [ByteCount] [Data...] [CRCL] [CRCH]
Write single (06)	[Stn] [06] [AddrHi] [AddrLo] [DataHi] [DataLo] [CRCL] [CRCH]	Echoes the request frame
Write multi (10)	[Stn] [10] [AddrHi] [AddrLo] [QtyHi] [QtyLo] [ByteCount] [Data...] [CRCL] [CRCH]	[Stn] [10] [AddrHi] [AddrLo] [QtyHi] [QtyLo] [CRCL] [CRCH]
Command (42)	[Stn] [42] [SubHi] [SubLo] [LenHi] [LenLo] [CRCL] [CRCH]	Read: [Stn][42][Len][Data][CRCL][CRCH]; action: echoes request
Exception	—	[Stn] [FC 0x80] [ErrCode] [CRCL] [CRCH]

TYPE	HOST SENDS	DEVICE RETURNS
Active report	—	[Stn] [04] [04] [Measurement 4B] [CRCL] [CRCH]

The "length" field in a 0x42 command corresponds to Modbus's register quantity and varies by sub-command. Under the broadcast address (station 0x00) the device returns no response, including exception frames.

11.4 Exception Codes

CODE	NAME	MEANING
0x01	ILLEGAL_FUNCTION	Unsupported function code / illegal in current state
0x02	ILLEGAL_DATA_ADDRESS	Register address out of range or sub-command does not exist
0x03	ILLEGAL_DATA_VALUE	Invalid value / length mismatch / out of range
0x21	STREAM_BAUD_NOT_ENOUGH	Baud rate insufficient for the requested active-reporting configuration

11.5 Saving Set Values (important)

READ	Before writing, first read the target register (0x03) for the item you intend to change.
WRITE	Values written by 0x06 / 0x10 enter a temporary area and take effect immediately, but are not yet in Flash.
SAVE	Send Save Settings (0xA000) to persist to Flash. Otherwise changes are lost at power-off. To discard, send Cancel (0xA001) .

11.6 The 0x42 Command Family

Basic request frame (8 bytes): [Stn] [0x42] [SubHi] [SubLo] [LenHi] [LenLo] [CRCL] [CRCH]. The "length" field corresponds to Modbus's register quantity.

READ COMMANDS

SUB-CMD	LENGTH	FUNCTION & RETURN
B001	0x0002	Read measurement value — 4-byte Int32, unit mm × 1000
B002	0x0001	Read decision value — 2-byte uInt16 (bit definition below)
B003	0x0002	Read device + version — 4 bytes: model (2B) + version (2B), e.g. V1.4 → 0x0104

Decision value (B002 / register 0x0020) bit definition:

Bit0	Output status (ON = 1)
Bit4	Test valid (valid = 1)
Bit5–Bit7	Error code (0 = normal, 1 = no signal, 2 = out of range, 3 = internal error)
Remaining	Reserved 0

ACTION COMMANDS (QTY = 0, LENGTH FIELD 0x0000; DEVICE ECHOES REQUEST)

A000	Save settings to Flash
A001	Cancel / discard pending settings
A003 / A002	Laser on / laser off
A100 / A101	Set zero / clear zero
A104 / A105	Lock keys / unlock keys
1105 / 1106 / 1107	Set current value as proximal / distal / FGS2 threshold
4000	Initialize (restore defaults, clears temporary area; follow with A000 to persist)

11.7 Active Reporting (Continuous Output)

When enabled, the device sends a measurement frame every measurement cycle without host polling.

Enable (0xB010): [Stn] [0x42] [0xB0] [0x10] [Flag] [ON_skip] [OFF_skip] [CRCL] [CRCH]

Flag	Lower 2 bits: Bit0 = 1 include frame number; Bit1 = 1 include timestamp. Other bits must be 0 (else exception 0x03).
ON_skip	0–255. Interval while output ON: 0 = every frame; N = send one, skip N.
OFF_skip	0–255. Same meaning while output OFF.

FORCED SHUTDOWN

Because RS-485 is half-duplex, send two consecutive bytes 0xAA 0xAA (no station number or CRC) to stop reporting immediately. The device returns no reply. Re-enable with 0xB010.

Reporting frame: [Stn][0x42] ([FrameNo 2B]) ([Timestamp 2B]) [Measurement 3B] [Decision 1B] [CRCL][CRCH] — frame number present when Flag bit0 = 1, timestamp when bit1 = 1. Shortest frame is 8 bytes. Measurement is the low 24 bits (signed) of mm × 1000.

Minimum baud rate (≈20% margin included; enabling with an insufficient rate returns 0x21):

SAMPLING PERIOD	MODE 0 (8 B)	MODE 1/2 (10 B)	MODE 3 (12 B)
333 μs (3 kHz)	≥ 312.5k	≥ 460.8k	≥ 460.8k
500 μs (2 kHz)	≥ 230.4k	≥ 312.5k	≥ 312.5k
1000 μs (1 kHz)	≥ 115.2k	≥ 230.4k	≥ 230.4k
2000 μs (500 Hz)	≥ 57.6k	≥ 115.2k	≥ 115.2k
3333 μs (300 Hz)	≥ 38.4k	≥ 38.4k	≥ 57.6k

11.8 Interaction Examples

Station 0x01; CRC shown as xx xx (low byte first).

► **Read measurement (0x03, reg 0x001E, 2 regs)**
TX: 01 03 00 1E 00 02 xx xx
RX: 01 03 04 <m_hi..m_lo> xx xx ; Int32 = mm×1000

► **Proximal threshold = 10.000 mm (0x00002710)**

TX: 01 10 00 00 00 02 04 00 00 27 10 xx xx

RX: 01 10 00 00 00 02 xx xx

Save: 01 42 A0 00 00 00 xx xx

► **Laser on / off (0x42 action)**

On: 01 42 A0 03 00 00 xx xx

Off: 01 42 A0 02 00 00 xx xx

► **Read model + version (0x42 / B003, Qty 2)**

TX: 01 42 B0 03 00 02 xx xx

RX: 01 42 04 <ModelHi><ModelLo><VerHi><VerLo> xx xx ; 0x0104 = V1.4

► **Enable reporting (frame no. + timestamp, interval 0), then force stop**

TX: 01 42 B0 10 03 00 00 xx xx

RX: 01 42 B0 10 xx xx

Rpt: 01 42 <FrameNo 2B> <TS 2B> <Meas 3B> <Dec 1B> xx xx

Stop: AA AA

A Register Map

Read the target register before writing; after changing a value, send Save Settings (0xA000) or it is lost at power-off.

ADDRESS	NAME	TYPE	RANGE / ENCODING
0x0000	Proximal threshold	Int32	mm×1000
0x0002	Distal threshold	Int32	mm×1000
0x0004	FGS2 threshold	Int32	mm×1000
0x0006	FGS2 variance	uInt32	mm×1000
0x0008	Sampling period	uInt16	0=333 · 1=500 · 2=1000 · 3=2000 · 4=3333 μs
0x0009	Averaging	uInt16	0=1× · 1=8× · 2=64× · 3=512×
0x000A	Output polarity	uInt16	0=normally open · 1=normally closed
0x000B	Abnormal pattern	uInt16	0=max output · 1=hold last
0x000C	Abnormal hold	uInt16	0...999
0x000D	Display screen	uInt16	0=off · 1=on
0x000E	External input	uInt16	0=off · 1=laser off · 2=teach · 3=sample hold · 4=single pulse · 5=zero · 6=continuous
0x000F	Teaching mode	uInt16	0=1-point · 1=FGS2 · 2=2-point
0x0010	Sensitivity	uInt16	0=auto · 1–6 = Level 1–6
0x0011	Brightness	uInt16	0=auto · 1–9 = Level 1–9
0x0012	Input filtering	uInt16	1...256
0x0013	Hysteresis (lag)	uInt16	mm×1000
0x0014	Zero display value	Int32	mm×1000
0x0016	Light-waveform peak	uInt16	0=max · 1–5 = 1st–5th peak
0x0017	Waveform threshold	uInt16	0=high · 1=medium · 2=low
Other	Reserved	—	Undefined in the current version

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LLE SERIES
OPERATING MANUAL
VERSION 1.3