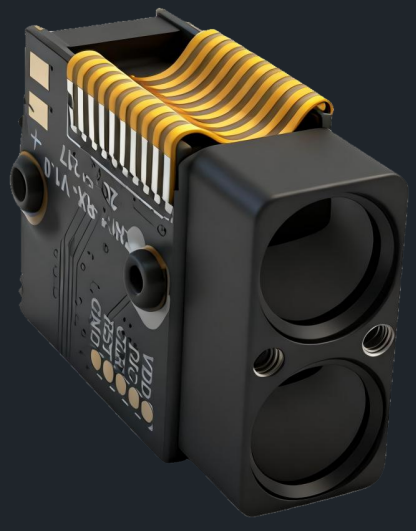
# SPD1200ZG

## USER MANUAL



**ERDI TECH LTD**

**905 ± 5 nm**
WAVELENGTH

**IEC Class 1**
LASER SAFETY CLASS
IEC classification

**0.1–1200 m**
MEASUREMENT RANGE

**±0.5 m**
RANGING ACCURACY
At ≤100 m; see notes

**7.2 × 14.7 × 22.3 mm**
BODY DIMENSIONS
Rectangular

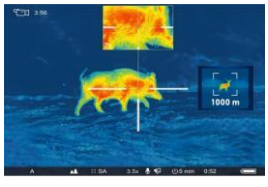
**UART-TTL**
COMMUNICATION
Customizable

For 100 m < d < 1200 m: ±(0.5 m + 0.0007d), with d in meters. Range conditions: see Section 2.
Body dimensions exclude the wider mounting features; see Section 4.2 for the complete drawing.

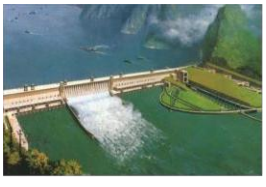
# 1 Product Overview

The SPD1200ZG series is a compact, high-accuracy laser rangefinder module with an integrated six-axis inertial sensor and a center wavelength of 905 nm. Its measurement range is 0.1–1200 m, and its measurement update rate is 2–10 Hz. Custom configurations are available to meet customer requirements. The module combines distance and attitude measurements to determine target-point coordinates and calculate the straight-line distance between two points in three-dimensional space. It uses a UART-TTL communication interface and is supplied with test software and interface protocol documentation for system integration. It features a compact, lightweight design, high ranging accuracy, and a high measurement update rate.

The module can provide ranging functions for handheld equipment such as night vision devices, thermal imagers, telescopes, and laser illuminators. Other applications include perimeter security monitoring, aviation, communications, railways, law enforcement, power infrastructure inspection, smart water management, and outdoor recreation.




Infrared Night Vision



Smart Water Management



Outdoor Recreation



Electro-Optical Gimbal



UAV Altitude Hold and Obstacle Avoidance



Thermal Imaging



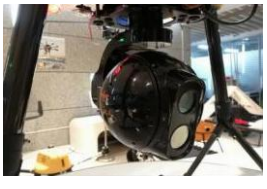
Perimeter Surveillance



Weapon-Sight Applications



UAV and Counter-UAV Applications



UAV Electro-Optical Payload

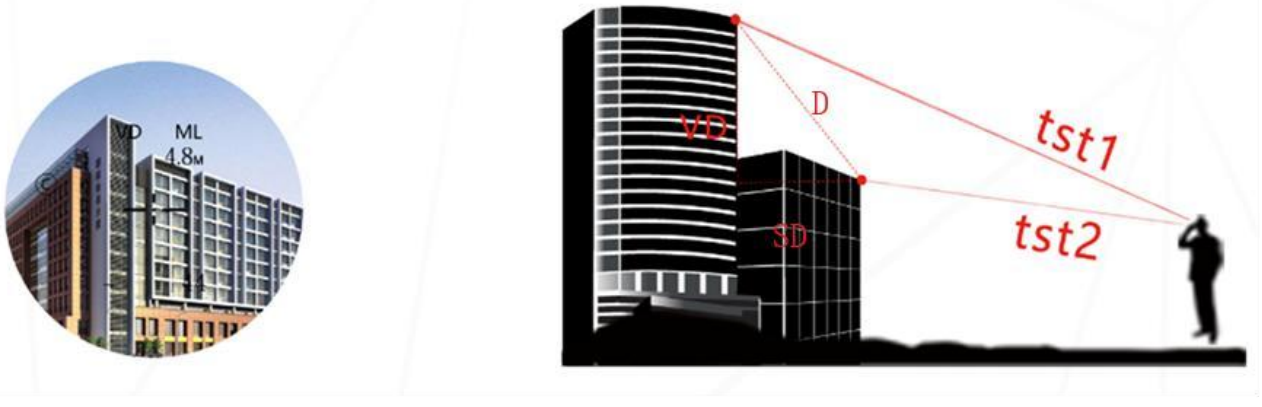



Figure 1 Point-to-Point Measurement Illustration

# 2 Technical Specifications

| No. | Parameter | Specification |
|---|---|---|
| 1 | Laser wavelength | 905 ± 5 nm |
| 2 | Beam divergence | <6 mrad; small beam spot |
| 3 | Optical element type | Aspheric lens |
| 4 | Receiver aperture | Ø6.5 mm |
| 5 | Measurement range | 0.1–1200 m<br>Visibility ≥10 km; humidity ≤60%; building target |
| 6 | Ranging accuracy | ±0.5 m at d ≤100 m<br>±(0.5 m + 0.0007d) for 100 m < d <1200 m |
| 7 | Measurement update rate | 2–10 Hz |
| 8 | Measurement success rate | ≥98% |
| 9 | False alarm rate | ≤1% |
| 10 | Communication interface | UART-TTL; customizable |
| 11 | Baud rate | 115200 bps default |
| 12 | Supply voltage | 3.3–5 V |
| 13 | Startup time | ≤200 ms |
| 14 | Peak startup current | ≤200 mA |
| 15 | Standby power consumption | ≤0.3 W |
| 16 | Average power consumption | ≤0.7 W |
| 17 | Operating temperature | −20 to +60 °C |
| 18 | Storage temperature | −30 to +70 °C |
| 19 | Ingress protection | Lens cavity: IP67 |
| 20 | Laser safety class | IEC Class 1 |
| 21 | Dimensions and housing material | 7.2 × 14.7 × 22.3 mm (rectangular)<br>6061 aluminum alloy |
| 22 | Weight | ≤5 g |

In the error expressions, d is a distance in meters. The specified body dimensions do not include the full width across mounting features.

## Six-Axis Inertial Sensor Specifications

| No. | Parameter | Specification |
|---|---|---|
| 23 | Euler angle range | Roll (X): ±180°<br>Pitch (Y): ±90°<br>Yaw (Z): ±180° [1] |
| 24 | Tilt accuracy (X and Y axes) | 0.3° |
| 25 | Heading accuracy (Z axis) | ≤0.75° within a 10 s dynamic measurement interval [2] |
| 26 | Radial error in 3D point-to-point distance | ±1 m at d ≤500 m<br>±(1 m + 0.001d) for 500 m < d <1200 m |

| No. | Parameter | Specification |
|---|---|---|
| 27 | 3D point-to-point distance error (static) | Absolute error ≤1 m at distances <100 m<br>Absolute error ≤3 m at 100–500 m<br>Absolute error ≤5 m at 500–1000 m |
| 28 | 3D point-to-point distance error (dynamic) | Absolute error ≤1 m at distances <50 m<br>Absolute error ≤3 m at 50–100 m<br>Absolute error ≤6 m at 100–500 m<br>Absolute error ≤10 m at 500–1000 m |

1. The X, Y, and Z axes are shown in the coordinate diagram. The Y axis points in the lens direction.

2. The heading specification applies during a 10 s dynamic measurement interval. Integration error accumulates during motion.

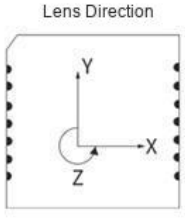



Figure 2 Coordinate Axes

# 3 Functions

The module supports single and continuous measurements.

## 3.1 Single Measurement

A single-measurement command initiates a target distance measurement. For targets with low reflectivity, the module automatically repeats the measurement until it obtains a stable distance reading, then reports the result through the serial port in the standard data format.

## 3.2 Continuous Measurement

In continuous measurement mode, the module repeatedly measures the distance to the target at an update rate of 2–10 Hz.

## 3.3 Angle Measurement

Angle measurement can be customized as required. The module measures pitch, roll, and heading. The angle range is −180° to +180° for the X and Z axes and −90° to +90° for the Y axis.

# 4 Hardware Installation

## 4.1 Electrical Interface

| Pin | Signal | Description |
|---|---|---|
| 1 | GND | Power supply ground |
| 2 | VCC | Positive supply input |
| 3 | IO (reserved) | Reserved for expansion |
| 4 | TXD | Signal output: module → host |
| 5 | RXD | Signal input: host → module |
| 6 | SW-SHOT | Function enable, active-high; high-level input range: 3.3–5 V |

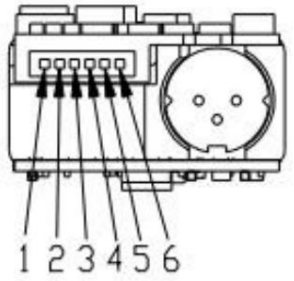


Figure 3 Electrical Interface Pinout

### 4.2 Mechanical Drawing

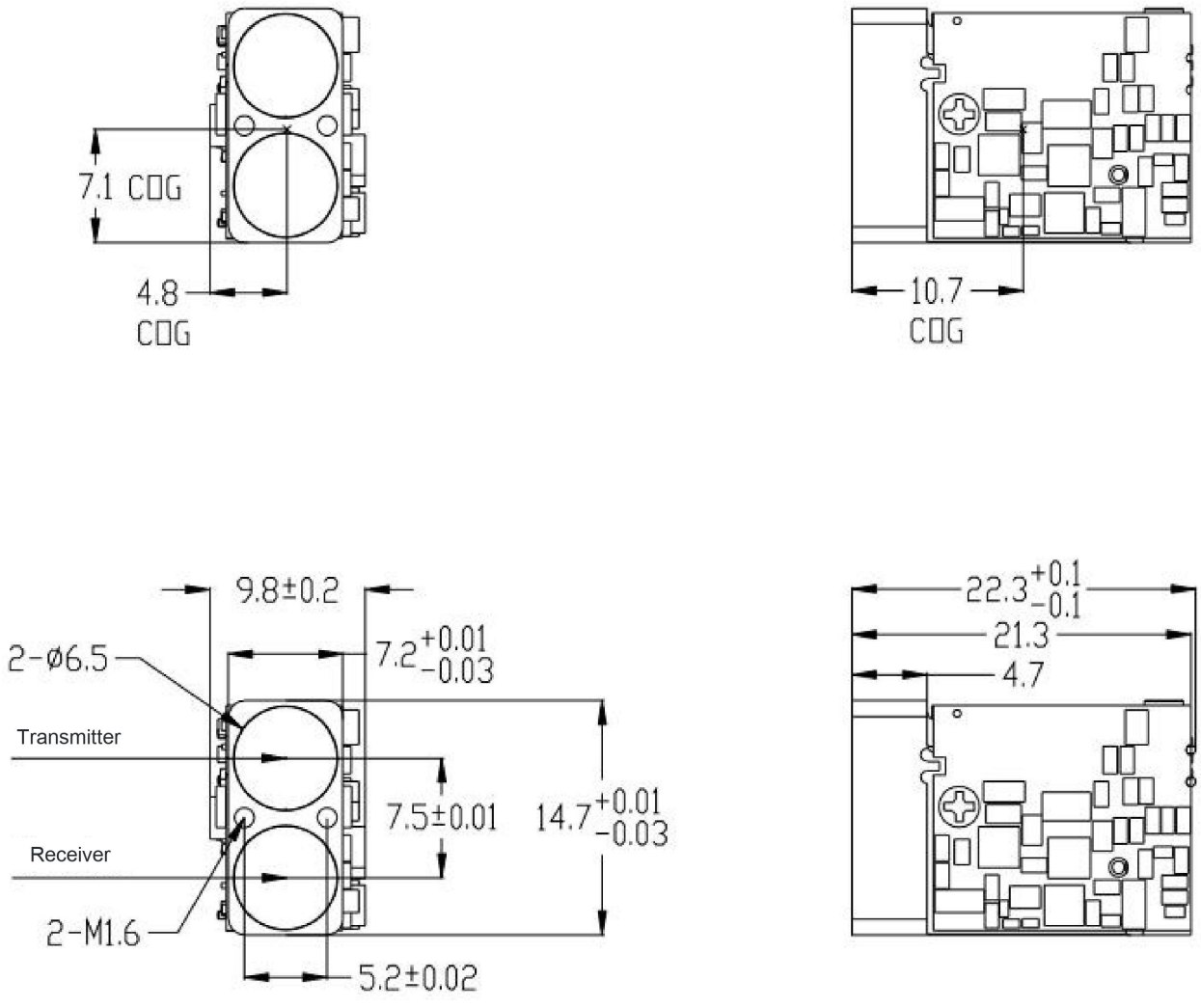



Figure 4 Mechanical Drawing

Dimensions are in millimeters. COG means center of gravity. The 9.8 ±0.2 mm dimension includes the wider mounting features.

# 5 Optical Window Selection

The following recommendations apply when integrating the module behind a protective optical window. Window selection and mounting require validation in the completed assembly; they are not additional module performance specifications.

### 5.1 Material and Coating

Choose an optical substrate with high transmission across 900–910 nm, corresponding to the module wavelength of 905 ± 5 nm. Optical glass or fused silica can be evaluated as candidates. Select the substrate for its transmission, surface quality, mechanical strength, and thermal behavior. Use an antireflection coating on the optical surfaces that is designed for the operating wavelength and the actual angle of incidence. A coating optimized for a different spectral band may reduce transmission.

Optical reference: Edmund Optics — Understanding Optical Windows

Coating reference: Thorlabs — Antireflection Performance, p. 2

### 5.2 Clear Aperture and Mounting

Keep the transmit and receive optical paths unobstructed. Size the clear aperture for both lens openings, assembly tolerances, and the intended viewing geometry. Do not use the body width as the clear-aperture diameter. Choose window thickness, spacing, and retention to suit the enclosure, and avoid clamping stress that can distort the optical surfaces. Keep the window and mounting hardware clear of the lenses and exposed electronics.

### 5.3 Assembly Validation

As an integration check, compare ranging results before and after installing the window at short and long distances under the intended lighting conditions. Check for reduced return signal, stray reflections, and unstable readings. Inspect the window for contamination, scratches, and condensation. Clean it only with materials and methods approved for its substrate and coating. The final enclosure needs its own environmental assessment; the module's IP67 rating applies only to the lens cavity.

# 6 Communication Protocol

The interface uses UART-TTL at 115200 bps by default. Command and response bytes are listed in transmission order. Hexadecimal letter case is standardized in this manual; byte values are unchanged.

### Protocol Compatibility

The 8-byte distance responses in Sections 6.5 and 6.6 contain a two-byte result scaled by 10. Use the protocol supplied for the optional combined distance and angle output configuration; do not interpret these two-byte fields as 32-bit floating-point values. Confirm the field scale and signed-number encoding for the 12-byte responses, and the checksum overflow convention for both packet formats, before implementation.

### 6.1 Baud Rate Configuration

| Direction | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Command | 55 | AA | 01 | FF | FF | FF | Type | SUM[3:7] |
| Response | 55 | AA | 01 | STA | FF | FF | Type | SUM[1:7] |

| Type | Baud Rate |
|---|---|
| 01 | 9600 bps |
| 02 | 14400 bps |
| 03 | 19200 bps |
| 04 | 38400 bps |
| 05 | 56000 bps |
| 06 | 115200 bps (default) |
| 07 | 128000 bps |
| 08 | 230400 bps |

STA = 0x00: configuration failed; STA = 0x01: configuration successful.

## 6.2 Angle Zeroing

Command

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 55 | AA | 90 | 04 | FF | FF | FF | 91 |

Response

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0x55 | 0xAA | 0x97 | 0xFF | 0xFF | Roll_h | Roll_l | Yaw_h | Yaw_l | Pitch_h | Pitch_l | Checksum |

Roll_h: high byte of roll; Roll_l: low byte of roll.

Yaw_h: high byte of yaw; Yaw_l: low byte of yaw.

Pitch_h: high byte of pitch; Pitch_l: low byte of pitch.

Checksum: sum of bytes 1–11.

## 6.3 Point-to-Point Measurement

Command

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 55 | AA | 90 | 07 | FF | FF | FF | 94 |

First click — Returns the distance and angle packet for point A.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0x55 | 0xAA | 0x97 | 0xFF | 0xFF | D_h | D_l | Yaw_h | Yaw_l | Pitch_h | Pitch_l | Checksum |

D_h: high byte of distance; D_l: low byte of distance.

Yaw_h: high byte of yaw; Yaw_l: low byte of yaw.

Pitch_h: high byte of pitch; Pitch_l: low byte of pitch.

Checksum: sum of bytes 1–11.

Second click — Returns the distance and angle packet for point B.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0x55 | 0xAA | 0x96 | D1_h | D1_l | D0_h | D0_l | Yaw_h | Yaw_l | Pitch_h | Pitch_l | Checksum |

D1_h: high byte of the 3D point-to-point distance; D1_l: low byte of the 3D point-to-point distance.

D0_h: high byte of slant range; D0_l: low byte of slant range.

Yaw_h: high byte of yaw; Yaw_l: low byte of yaw.

Pitch_h: high byte of pitch; Pitch_l: low byte of pitch.

Checksum: sum of bytes 1–11.

## 6.4 Read Angles

Command

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| 55 | AA | 90 | 0A | FF | FF | FF | 97 |

Response

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0x55 | 0xAA | 0x97 | 0xFF | 0xFF | Roll_h | Roll_l | Yaw_h | Yaw_l | Pitch_h | Pitch_l | Checksum |

Roll_h: high byte of roll; Roll_l: low byte of roll.

Yaw_h: high byte of yaw; Yaw_l: low byte of yaw.

Pitch_h: high byte of pitch; Pitch_l: low byte of pitch.

Checksum: sum of bytes 1–11.

### 6.5 Continuous Measurement

Use the protocol supplied for the optional angle-output configuration. The table below defines the 8-byte distance response.

| Direction | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Command | 55 | AA | 89 | FF | FF | FF | FF | SUM[3:7] |
| Response | 55 | AA | 89 | STA | FF | DATA_H | DATA_L | SUM[1:7] |

STA = 0x00: configuration failed; STA = 0x01: successful data report.

Reported quantity: distance.

Data is returned in hexadecimal format. Each reported result is the actual measured value multiplied by 10.

### 6.6 Single Measurement

Use the protocol supplied for the optional angle-output configuration. The table below defines the 8-byte distance response.

| Direction | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Command | 55 | AA | 88 | FF | FF | FF | FF | SUM[3:7] |
| Response | 55 | AA | 88 | STA | FF | DATA_H | DATA_L | SUM[1:7] |

STA = 0x00: configuration failed; STA = 0x01: configuration successful, with data reported.

Reported quantity: distance.

Data is returned in hexadecimal format. Each reported result is the actual measured value multiplied by 10.

### 6.7 Stop Measurement

| Direction | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Command | 55 | AA | 8E | FF | FF | FF | FF | SUM[3:7] |
| Response | 55 | AA | 8E | STA | FF | FF | FF | SUM[1:7] |

STA = 0x00: configuration failed; STA = 0x01: configuration successful.

### Protocol Notes

SUM[3:7] is the sum of bytes 3 through 7; SUM[1:7] is the sum of bytes 1 through 7. The 12-byte response checksum is the sum of bytes 1 through 11. The _h and _l suffixes identify high and low bytes. Keep the 8-byte and 12-byte response formats distinct.

# 7 Safety Warnings and Precautions

## 7.1 Laser Safety

The module is specified as IEC Class 1. This classification applies to normal operation of the intended configuration; it is not an approval of every host system or modified optical arrangement. As a handling precaution, do not stare into the emission aperture or deliberately view the beam through magnifying optics. Do not disassemble the optical assembly or bypass protective features. Service and optical modifications should be performed only by qualified personnel. Assess the completed host product after integration or changes to its optics.

Safety reference: OSHA — Laser Classifications

## 7.2 Electrical and Environmental Precautions

Disconnect power before wiring or handling the module. Verify pin orientation and supply polarity before energizing it. Apply 3.3–5 V to VCC and use a supply that can accommodate the specified startup current. Protect the exposed electronics from electrostatic discharge, short circuits, conductive debris, and moisture. The 3.3–5 V active-high range specified for SW-SHOT must not be assumed to define every UART signal level.

Operate the module from −20 to +60 °C and store it from −30 to +70 °C. IP67 applies only to the lens cavity, not to the circuit boards, connector, or completed enclosure. Keep the optical surfaces clean and avoid mechanical loads on the lenses and flexible circuit connections.

## 7.3 Measurement and Attitude Precautions

The 0.1–1200 m range is specified for a building target at visibility ≥10 km and humidity ≤60%. Validate the intended target and environment rather than assuming the same range in every application. Reject unsuccessful responses instead of treating them as valid distance values.

The heading accuracy of ≤0.75° applies within a 10 s dynamic interval. Integration error accumulates during motion; the heading value is not a guarantee of long-term absolute bearing. Keep static and dynamic point-to-point error limits separate and use the configured angle output format. Independently validate measurements used for decisions that could affect people or equipment.