# XD-S20 Technical Specification

**Wuhan X-Dynamics Co., Ltd.**

**Jan.,2024**

# Revision Record

| Version | Revision Date | Revised Chapter | Revision History |
|---|---|---|---|
| V1.1.1 | 2024/01/15 | All chapters | First edition |
| V1.1.2 | 2024/3/18 | All chapters | Local parameter update |
| V1.1.3 | 2024/04/08 | Chapter 5 | Updating some parameters |
| V1.1.4 | 2024/6/14 | Chapters 2 and 3 | Updating of the structural dimensions section |

## Copyright Notes



## Declaration of Secrecy

Information from this document ( all attachments included) is confidential.

The recipient understand that the document is confidential，should neither use it for any other purpose beyond that allowed nor disclose it to any third part.

# Contents

# XD-S20 Technical Specification

## 1. Product Overview

XD-S20 laser distance measurement module has a small structural volume and high distance measurement accuracy, even in harsh environments, it still maintains high measurement accuracy.

Product XD-S20 Features:

- Self-developed high-precision calibration and alignment algorithms;
- Small size and light weight, high precision;

## 2. Specification

### 2.1. Product Specification

Product-related specifications and parameters are as follows:

**Table 1 . Product specification table**

| Name | Performance indicators | Indicator parameters | note |
|---|---|---|---|
| Key indicators | Range (of scales or measuring equipment) | 0.03~20m | |
| | Accurate | ±(1.5mm + D*5 parts per million) | |
| | Measuring time | 0.1~4s | |
| | Wavelength | 620~690nm | |
| System parameter | Working environment | Indoor & Semi-Outdoor | |
| | Operating temperature | -20°C ~ 50°C | |
| | Storage temperature | -25°C ~ 70°C | |
| | Security level | Class II | |
| | Structural dimensions | ≤42mm x 17.2mm x 7.1 mm | |

| | | | |
|---|---|---|---|
| | Weights | ≤5g | |
| Electronic | Communications interface | UART | |
| | Power connector | DC5521 | |
| | Supply Voltage | DC2.5V~3.3V | |
| | Peak power consumption | 3.3V/300mA | |
| | Baud | 19200bps | |

**Attention:**

(1) Under adverse measurement conditions (e.g. high ambient light, large or small diffuse reflection coefficient of the measured point), the measurement accuracy will have a large error: ±3mm +40PPM.

(2) Use a spotter's plate in strong daylight or when the target is poorly reflected.

(3) Accuracy varies slightly at different frame rates

# 3. Structure Description and Interface Definition

## 3.1. Structural Drawings

The structure of the product XD-S20 is shown below:

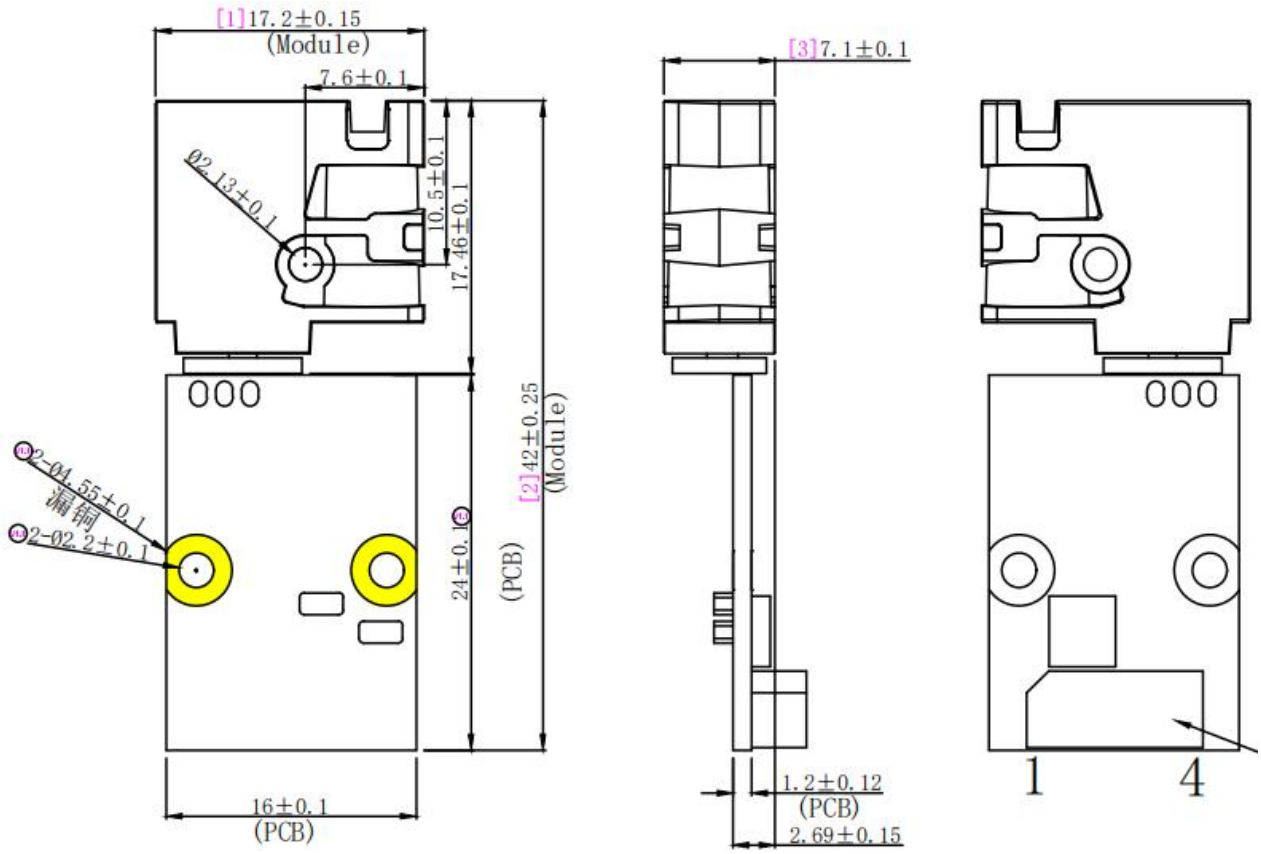


**Figure 1 . XD-S20 mechanical dimension drawing**

## 3.2. Hardware Interface Definitions

The control module requires the following pins to be connected:

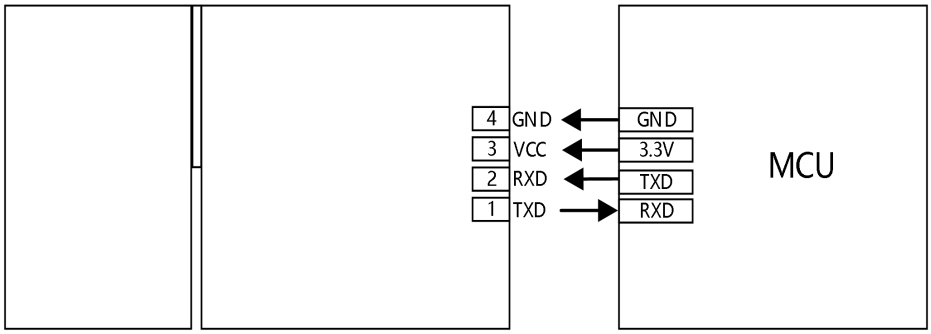


**Figure 2 . Schematic diagram of the pins**

The pinouts are as follows.

**Table 2 . Pad Pin Description Table**

| Pinout | Name | Functionality | Default | D=escriptive |
|---|---|---|---|---|
| 1 | TXD | Communications output | High level | Module USART output pin, open drain |
| 2 | RXD | Communications input | High level | Module USART receive pin, open drain |

| | | | | |
|---|---|---|---|---|
| 3 | VCC | power supply | Power Input | Module power supply positive, DC3.3V, 300mA+ |
| 4 | GND | power supply | POWER GROUND | module power ground |

# 4. Electrical Characteristics

## 4.1. Power Supply and Power Consumption

Product XD-S20 power supply and power consumption related parameters are shown in the table below:

**Table 3 . Power Supply Parameters and Specifications Table**

| | |
|---|---|
| Supply Voltage | DC2.5V~3.3V |
| Peak power consumption | 3.3V/300mA |

## 4.2. Reliability Standards

Product XD-S20 reliability standard parameters are shown in the table below:

**Table 4 . Reliability criteria table**

| | |
|---|---|
| Operating temperature | -20℃~50℃ |
| Storage temperature | -25℃~70℃ |

# 5. Control Command

## 5.1. UART Interface

- Baud rate: Default baud rate 19200bps
- Starting bit: 1 bit
- Data bits: 8 bits
- Stop bit: 1 bit
- Check digit: None
- Flow control: none

## 5.2. Control Command Framework

All the communication commands are issued by the master control board, and the laser distance measuring module does the slave to respond to the commands from the master. The command framework can be composed of 6 parts as shown in the table below.

Table 5 . Composition of control commands

| Bytes | 0 | 1 | | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| Bit | [7:0] | [7] | [6:0] | [7:0] | [7:0] | [7:0] | [7:0] | [7:0] | [7:0] | [7:0] |
| Name | Head | R/W | Address | Register | | Payload count | | Payload | | Checksum |
| Data | 0xAA | 0 | 0x01 | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x00 | 0x22 |

The meaning of each field is as follows:

- Head: The request always starts with a fixed header byte 0xAA, which can also be 0xEE during a slave-to-host error response frame, see 5.3.16 Error Reporting;
- R/W: 0: host writes to slave; 1: host reads from slave;
- Address: the slave address is 0x01, the address is only 7 bits, so the address is 0x00~0x7F, 0x00 is the default address before the host issues the module address change command, and 0x7F is the broadcast address reserved for a single host to a multi-machine network;
- Register: the slave register is 0x0020 (REG_MEA_MODE, see Register List 6.3. 1 for details);
- Payload count: payload data count written to register 0x0020 is 0x0001, the size is (Payload byte count + 1)/2. When R/W=1, this segment may not exist, and the host reads it from the slave;
- Payload: the single data written to register 0x0020 is 0x0000, when R/W=1, this part may not exist, the host reads from the slave;
- Checksum: checksum is 0x22, checksum = address byte + register byte + payload count byte + all payload bytes, ignores byte overflow;

### 5.2.1. Control Memory

Table 6 . Table of registers

| No. | Register | Name | Function |
|---|---|---|---|
| 1 | 0x0000 | REG_ERR_CODE | System status |
| 2 | 0x0006 | REG_BAT_VOLT | Input Voltage |
| 3 | 0x0010 | REG_ADDR | Module address |
| 4 | 0x0012 | REG_OFFSET | Module measurement result offset |
| 5 | 0x0020 | REG_MEA_START | Initial measurement |
| 6 | 0x0022 | REG_MEA_RESULT | Measurement results |
| 7 | 0x01BE | REG_CTRL_LD | Laser diode control |

## 5.3. Control Commands

### 5.3.1. Read the Latest Status of the Module

(1) The following is a description of the status of the read module:

- Category: Read command;
- Slave address: 0x00;
- Register address: 0x0000;
- Function: the host reads the status of the module after executing the previous command; the

**Table 7. cmd. read module status table**

| **Bytes** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x00 | 0x80 |

(2) Rturned from the slave, byte 0xZZ is the status code returned from the slave, see Status Code Table 34 for details.

**Table 8. Feedback table for module status readout cmd.**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x00 | 0x00 | 0x01 | 0xYY | 0xZZ | Checksum |

### 5.3.2. Read the Hardware Version

(1) The following are the instructions for reading the hardware version:

- Category: Read command;
- Slave address: 0x00;
- Register address: 0x000A;
- Function: The host reads the module hardware version information.

**Table 9. cmd. read hardware version**

| **Bytes** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x0A | 0x8A |

(2) The software version number is 0xVVYY.

**Table 10. cmd hardware information return**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x0A | 0x00 | 0x01 | 0xVV | 0xYY | sum |

### 5.3.3. Read Software Version Number Information

(1) The instructions for reading the software version number information are shown below:

- Category: Read command;
- Slave address: 0x00;
- Register address: 0x000C;
- Function: The host reads the software version information of the module;

**Table 11 . cmd. read software version table**

| **Bytes** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x0C | 0x8C |

(2) , the slave returns that the hardware version number is 0xVVYY.

**Table 12 . Feedback information table for cmd.software**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x0C | 0x00 | 0x01 | 0xVV | 0xYY | sum |

### 5.3.4. Read Module Serial Number

(1) The instructions for reading the module serial number are as follows:

- Category: Read command;
- Slave address: 0x00;
- Register address: 0x000E;
- Function: The host reads the module serial number.

**Table 13 . cmd read module serial number**

| **Bytes** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x0E | 0x8E |

(2) Returned by the slave, the hardware version number is 0xSSNN.

**Table 14 . cmd.read module serial number returns**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x0E | 0x00 | 0x01 | 0xSS | 0xNN | sum |

### 5.3.5. Read the Input Voltage

(1) The following are the instructions for reading the input voltage:

- Category: Read command;
- Slave address: 0x00;
- Register address: 0x0006;
- Function: The main module reads the input voltage (mV) of the module in BCD code.

**Table 17 . Input voltage read by cmd**

| **Bytes** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x06 | 0x86 |

(2) , slave return, input voltage = 3219mV.

**Table 18 . cmd.read input voltage return**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x06 | 0x00 | 0x01 | 0x32 | 0x19 | sum |

### 5.3.6. Reading Measurement Results

(1) The results of the readings are described below:

- Slave address: 0x00;
- Register address: 0x0022;
- Function: The host computer reads the measurement results;

**Table 15 . Measurement results from cmd reads**

| **Bytes** | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Checksum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x22 | 0xA2 |

(2) The slave returns:

**Table 16 . cmd.measurement results return values**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6:9 | 10:11 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/ Address | Register | | Payload count | | Payload Distance | Payload SQ | Check sum |
| **Data** | 0xAA | 0x80 | 0x00 | 0x22 | 0x00 | 0x03 | 0xAABBCCDD | 0x0101 | Check sum |

### 5.3.7. Setting the Module Address

(1) The address of the read module is described below:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0010;
- Function: The master sets the slave address, which will not disappear after the module is powered off;

**a meter (measuring sth) 19 . cmd set module address**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x10 | 0x00 | 0x01 | 0x00 | 0xYY | sum |

(2) The slave returns and the slave address is set to 0xYY (**!!!!**). (**Note**: the address takes only bits [6:0], other bits will be ignored).

**!!! NOTE:** Do not set the slave address to broadcast address 0x7F, which is reserved for a host to multiple slave networks, it requires all slaves to measure the distance at the same time and does not do so until the host asks a slave to do so.

**a meter (measuring sth) 20 . cmd.module address return values**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x10 | 0x00 | 0x01 | 0x00 | 0xYY | sum |

### 5.3.8. Setting the Module Measurement Offset

(1) The reading module measurement offset is described below:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0012;
- Function: The master sets the measurement offset of the slave. For example, if the offset is 0xZZYY= 0x7B (+123), it means that the final output of the measurement result will be increased by 123 millimeters, and if the offset is 0xZZYY= 0xFF85 (- 123), it means that the final output of the measurement result will be decreased by 123 millimeters.

**Table 21 . cmd. setting module measurement offset**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x12 | 0x00 | 0x01 | 0xZZ | 0xYY | sum |

(2) The slave returns:

**Table 22 . cmd. set measurement offset return value**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x12 | 0x00 | 0x01 | 0xZZ | 0xYY | sum |

### 5.3.9. Laser Switching On and Off

(1) The instructions for turning the reading laser on and off are as follows:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x01BE;
- Function: Turns the laser on or off, 0xZZ = 0x01 laser on, 0xZZ = 0x00 laser off;

**Table 23 . cmd. laser on and off**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x01 | 0xBE | 0x00 | 0x01 | 0x00 | 0xZZ | Checksum |

(2) The slave returns to the

**Table 24 . Laser On and Off Return Values**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0xBE | 0x00 | 0x01 | 0x00 | 0xZZ | Checksum |

### 5.3.10. Turning on Auto Mode Distance Measurement Once

(1) The following is a description of the automatic mode distance measurement:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0020;
- Function: Starts the slave to perform a single measurement in automatic mode, for measurement modes please refer to chapter 6;

**Table 25 . cmd. single automatic mode distance measurements**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x00 | 0x21 |

(2) The slave returns:

- Category: Slave Return;
- Slave address: 0x00;
- Register address: 0x0022;
- Function: Return the measurement result to the host, measurement result = 0xAABBCCDD mm (frame byte 6 = 0xAA , byte 7 = 0xBB , byte 8 = 0xCC , byte 9 = 0xDD) , signal quality = 0x101 , the smaller the signal quality number means the stronger the laser signal and the more reliable the distance result;

**Table 26 . cmd. single automatic distance measurement return**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6:9 | 10:11 | 12 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/ Address | Register | | Payload count | | Payload Distance | Payload SQ | Check sum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x22 | 0x00 | 0x03 | 0xAABBCCDD | 0x0101 | Check sum |

### 5.3.11. Switching on Slow Distance Measurement Once

(1) The instructions for reading the module serial number are as follows:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0020;
- Function: Starts the slave for one measurement in slow mode;

**Table 21. cmd. single slow distance measurements**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x01 | 0x22 |

(2) , Slave Return: Same as above for one automatic distance measurement;

### 5.3.12. Measurement Switching on Fast Distance Measurement Once

(1) The following is a description of a quick distance measurement:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0020;
- Function: Starts the slave for one distance measurement in fast mode;

**Table 27 . cmd. single fast distance measurements**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x02 | 0x23 |

(2) , Slave Return: Same as above for one automatic distance measurement;

### 5.3.13. Turning on Auto Mode Continuous Distance Measurement

(1) The instructions for continuous distance measurement with auto mode turned on are as follows:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0020;
- Function: Starts the slave for continuous measurement in automatic mode;

**Table 28 . cmd. continuous automatic distance measurement**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x04 | 0x25 |

(2) , Slave Return: Same as above for one automatic distance measurement;

### 5.3.14. Turning on Slow Mode Continuous Distance Measurement

(1) Turn on the slow mode to say continuous distance measurement instructions as follows:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0020;
- Function: Starts the slave for continuous measurement in slow mode;

**Table 29 . cmd. continuous slow distance measurements**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x00 | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x05 | 0x26 |

(2) , Slave Return: Same as above for one automatic distance measurement;

### 5.3.15. Turning on Fast Mode Continuous Measurement

(1) The instructions for continuous measurement with fast mode on are as follows:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0020;
- Function: Starts the slave for continuous measurement in fast mode;

**Table 30 . cmd. continuous fast distance measurements**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Data** | 0xAA | 0x00 | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x06 | 0x27 |

(2) Slave Return: Same as above for one automatic distance measurement;

### 5.3.16. Slave Error Reporting

If any error occurs during the measurement phase, the laser rangefinder module will return an error report:

(1) The slave error report description is as follows:

- Category: Slave Return;
- Slave address: 0x00;
- Register address: 0x0000;
- Function: Report the error status code to the host, error code = 0x000F , please refer to section 5.5 Meaning of Error Codes;

**Table 31 . Error Reporting**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xEE | 0x00 | 0x00 | 0x00 | 0x00 | 0x01 | 0x00 | 0x0F | 0x10 |

### 5.3.17. Exiting Continuous Measurement

The host computer transmits five consecutive bytes 0x58 (uppercase character 'X' ) immediately stopping the continuous measurement mode.

### 5.3.18. Turning on Multi-slave Measurements

The master sends a single measurement command to slave address 0x7F, which causes all online slaves to measure the distance at the same time, but none of them will return their measurements to the master until the master asks each slave to return a measurement. Before the master issues the Read Measurement Result command, the master should read the slave's status code to ensure that no errors occur during the slave's measurement.

(1) , turn on multiple slave measurements as follows:

- Category: Write command;
- Slave address: 0x00;
- Register address: 0x0020;
- Function: Report the error status code to the host, error code = 0x000F , please refer to section 5.5 Meaning of Error Codes;
- Slave return: no return;

After sending this command, the master polls the status of each slave address and if the slave returns 0x0000, there is no error and then sends the Read Measurement Result command to start the distance measurement. The measurement result of each slave will not be overwritten until the next successful measurement command and new distance result.

**Table 32 . Multi-slave measurements**

| **Bytes** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Name** | Head | RW/Address | Register | | Payload count | | Payload | | Checksum |
| **Data** | 0xAA | 0x7F | 0x00 | 0x20 | 0x00 | 0x01 | 0x00 | 0x00 | 0xA0 |

## 5.4. Measurement Modes

There are two measurement modes: single measurement and continuous measurement.

- A single measurement commands one result per measurement.
- If the host does not interrupt the continuous measurement, to interrupt the continuous measurement, the host needs to send 1 byte of 0x58 (uppercase character 'X' in ASCII) during the measurement.
- Each measurement mode has three operating modes.
- In automatic mode, the module returns the measurement result and the signal quality (SQ), where a smaller SQ value represents a more reliable distance result and where the module adjusts the reading speed according to the laser reflection level.
- Slow mode, higher accuracy.
- Fast mode, higher frequency, low accuracy;

**Table 33 . Measurement operating modes**

| Progress / Mode | Automation | Slow speed | Speedy |
|---|---|---|---|
| One-off | Single-issue automatic | Single Slow | Single Rapid |
| Progression | Automatic continuous measurement | Slow continuous measurement | Fast and continuous measurement |
| Measurement speed | Automation | Slow speed | Speedy |
| Measurement accuracy | Automation | High | Low |

## 5.5. Status Codes

**Table 34 . Code Status**

| States Code | Description |
|---|---|

| | |
|---|---|
| 0x0000 | Error-free |
| 0x0001 | Input voltage is too low, input voltage should be greater than or equal to 3.0V |
| 0x0002 | Internal error, can be ignored. |
| 0x0003 | Module temperature too low (< -20°C) |
| 0x0004 | High module temperature (> +50°C) |
| 0x0005 | Measurement target out of range |
| 0x0006 | Invalid measurement results |
| 0x0007 | Too much light in the background. |
| 0x0008 | Reflected signal too weak |
| 0x0009 | Reflected signals are too strong |
| 0x000A | Hardware error 1 |
| 0x000B | Hardware error 2 |
| 0x000C | Hardware error 3 |
| 0x000D | Hardware error 4 |
| 0x000E | Hardware error 5 |
| 0x000F | Reflected signal instability |
| 0x0010 | Hardware error 6 |
| 0x0011 | Hardware error 7 |
| 0x0081 | Invalid structure |

## 5.6. Attention for the Use

(1) Please do not touch the module directly with your hands and pay attention to static electricity protection during the whole testing process. Can be operated with electrostatic gloves or electrostatic hand ring to avoid damage to the module laser diode or other electronic components.

(2) Please make sure that the power cord is not reversed and that the voltage does not exceed the maximum range.

(3) The module is designed to prevent dust from entering the interior of the lens and affecting the performance of the module.

(4) The module should be used to avoid stress, the optical part, and the electronic components on top of the PCB should not be subjected to stress.

# 6. Appendix

## 6.1. System Integration Guide

Before users choose XD-S20 camera for development, please contact Wuhan Extreme Motion Intelligent Technology Co., Ltd. personnel to obtain technical specifications and other information. You can determine whether it meets the mass production requirements through preliminary evaluation, debugging and verification steps.

Suggested Process:

- Read the XD-S20 technical specifications;
- Purchase and get the XD-S20 prototype through official channels;
- Before development, please contact with the personnel of Wuhan Extreme Motion Intelligent Technology Co;
- Depending on the need, you can choose the right development platform;
- According to the function of the product development, in the development of just encountered any problem, please contact with the staff of the intelligent pole action in a timely manner;
- Determine the mass production program for the final end product;

## 6.2. Recommendations for Use

Factors that affect ranging capability, accuracy include:

- Target reflectivity: Usually the higher the target reflectivity, the better the ranging capability and the faster the response.
- Measuring Angle: The better the ranging capability, the faster the response when the laser angle is measured vertically to the target, and vice versa. Extreme use does not ensure that the range capabilities and range response speeds specified in this manual will be achieved.
- Measurement environment: Factors affecting the response speed of ranging capability also include the intensity of sunlight, the concentration of water vapor and suspended particulate matter in the air, and the angle of deviation from sunlight exposure.