

XD-S40 Technical Specification

Wuhan X-Dynamics Co., Ltd.

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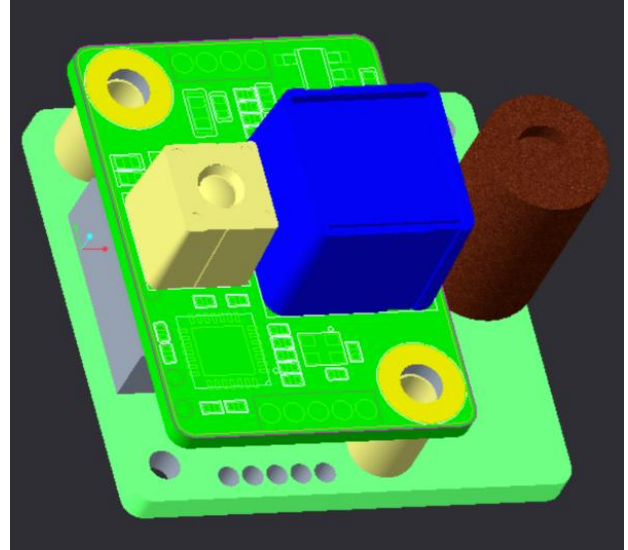
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XD-S40 Technical Specification

1. Product Overview

XD-S40 is a fully integrated single-channel dToF rangefinder compact module, integrated with self-developed highly sensitive infrared-enhanced SPAD sensor with 40m maximum range. It has 30m@100KLux ambient light resistance and reflectivity correction.

XD-S40 integrated power module with 5V single power supply and built-in temperature compensation. Supporting UART interface, it is easy to integrate and use, with small size and light weight making it an excellent choice for small ToF applications.



Product XD-S40 Features:

- Small size and light weight with red light indication;
- Ultra-small construction size of only 23.2mm x 22mm x 17mm;
- Accuracy $\pm 3\text{cm}@ (0.15\text{m}\sim 5\text{m})$, 1% (5m-30m), maximum range 40m;
- Integrated histogram statistical algorithm outputs bimodal positions for easy calibration;
- Integrated time-dependent photon thresholding anti-ambient light algorithm with 30m@100KLux anti-ambient light capability;
- TDC time window is configurable to adapt to the needs of different application scenarios;
- Data is stabilized for output on a configured cycle with a frame rate of 100fps;
- With reflectivity correction function, small error in black and white object.

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)	0.1~40m	

	Accurate	$\pm 3\text{cm}@ (0.1\text{m}\sim 5\text{m}), 1\%D>5\text{m}$	
	Frame rate	100fps	
	FOV	$<2^\circ$	
	Temperature compensation	Yes	
	Reflectance correction	Yes	
	Wavelength	905nm	
	Laser indication type	650nm wavelength, single spot, cross spot selectable	
System parameter	Working environment	Indoor & Outdoor	
	Operating Temperature	$-20^\circ\text{C} \sim 50^\circ\text{C}$	
	Storage Temperature	$-40^\circ\text{C} \sim 85^\circ\text{C}$	
	Structural Dimensions	$\leq 23.2\text{mm} \times 22\text{mm} \times 17\text{mm}$	
	Weights	$<10\text{g}$	
Electronic	Communications interface	UART	
	Supply voltage	5V	
	Peak power consumption	$\leq 400\text{mW}$	
	Baud	921600bps	

2.2. Structural Drawings

The structure of the product XD-S40 is shown below:

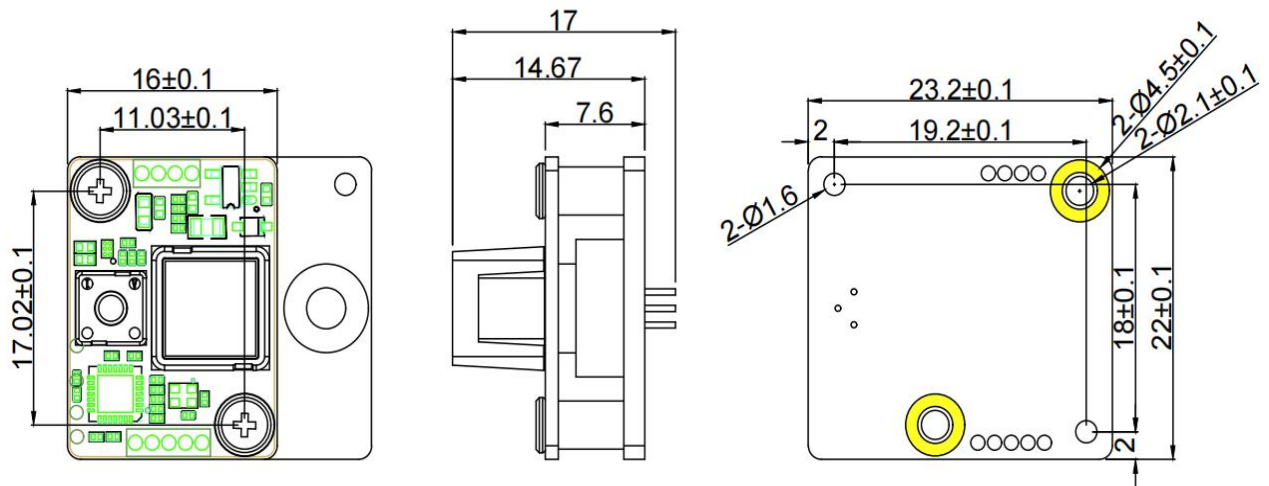


Figure 1 . XD-S40 structure diagram

2.3. Hardware Interface Definitions

The product hardware interface structure is shown below:

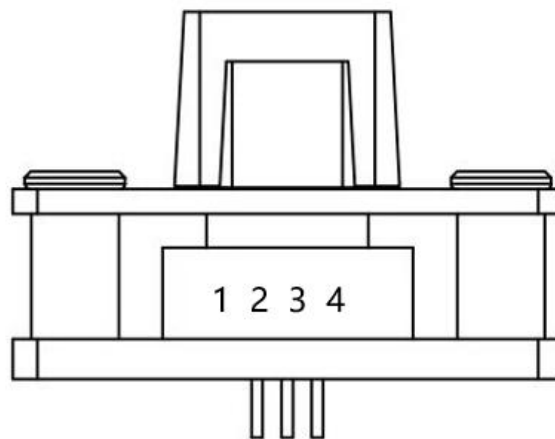


Figure 2 . Schematic diagram of the pins

The function of each pin is described below:

Table 2 . Connector Model List

No.	Port Name	Functional Description
1	5V	Module power supply
2	TX	UART interface sends data signals (module side)
3	RX	UART interface accepts data signals (module side)
4	GND	grounding

3. Electrical Characteristics

3.1. Power Supply and Power Consumption

Product XD-S40 power supply and power consumption related parameters are shown in the table below:

Table 3 . Power Supply Parameters and Specifications Table

Supply Voltage	5V
Peak power consumption	$\leq 400\text{mW}$

3.2. Reliability Standards

Product XD-S40 reliability standard parameters are shown in the table below:

Table 4 . Reliability criteria table

Operating temperature		-20°C~50°C
Storage temperature		-40°C~85°C
Antistatic class 3	Human Body Model Antistatic Rating (HBM)	2000V
	Machine model antistatic grade (MM)	200V
	Charging Device Model Antistatic Rating (CDM)	500V

Reference Standard: HBM: JESD22-A114; CDM: JESD22-C101; MM: JESD22-A115

4. UART Protocol

4.1. UART Protocol Contents

This protocol adopts the master-slave communication mode, which stipulates that the PC is the upper computer and the microcontroller is the lower computer. The upper computer transmits data to the lower computer as send and the lower computer transmits data to the upper computer as answer.

The communication rate of this protocol is: 921600bps;

The hardware communication format used in this paper: 1 start bit, 8 data bits and 1 stop bit, and nothing else.

In this paper, CRC16 data calculation is performed for each frame of data which contains all data

except checksum.

All the data in this file's protocol uses the big-end mode and MSB first.

4.2. Summary Table of Protocols

Table 5. Summary table of protocols

No.	Command name	Command code
1	start flowing	0x01
2	closing stream	0x02
3	version number	0x0a
4	Getting Calibration Values	0x06

4.3. Protocol Frame Format

There are two forms of communication throughout the protocol content:

- The commands 0x01, 0x02, 0x0a are used to ask the PC - the lower computer to answer (i.e., one question and one answer).

(1) , the send frame format (i.e., upper → lower) is:

Table 6. Transmit Frame Format Table

Packet header	Device number	Equipment type	CMD	Reserved bit	Lengths	Data	CRC16
1 byte	1 byte	1 byte	1 byte	1 byte	2 byte	N byte	2 byte

(2) , the answer frame format (lower unit → upper unit) is:

Table 7. Answer frame format table

Packet header	Device number	Equipment type	CMD	Reserved bit	Lengths	Data	CRC16
1 byte	1 byte	1 byte	1 byte	1 byte	2 byte	N byte	2 byte

Among them:

- 1) Packet header: is 1 byte, i.e. 0xA5.
- 2) Device number: is 1 byte, i.e. 0x04.

- 3) Device Type: is 1 byte, depending on the type of the lower evaluation board, 0x20.
- 4) CMD: is 1 byte, command function code, is the function that the upper computer wants the lower computer to perform.
- 5) Reserved Bit: 1 byte for subsequent use.
- 6) Length: 2 bytes, it is the length of data in data area.
- 7) Data: is N bytes and is the relevant data area.
- 8) CRC16: 2 bytes, the result of the CRC16 validation of all data, with the high bit first and the low bit second.

The functions corresponding to the command codes are shown in the table below, where the command codes are expressed in hexadecimal. The "command" in the answer frame is the same as the command in the send frame, i.e., the same command is answered for what command is sent.

4.4. Commands and Parsing

The send command and the corresponding answer command match each other, and the data in the table and the data with 0x are in hexadecimal.

4.4.1. Start Measurement Command 0x01

The command format is shown in the following table.

Table 8 . Command table for lower computer frame rate setting

Orientations	Packet header	Device number	Equipment type	CMD	Reserved bit	Lengths	Data	CRC16
Dispatch	A5	0x04	0x20	0x01	1 byte	0x0 0x3	0x00 0x08 0x00	Based on actual calculations
Reception	A5	0x04	0x20	0x01	1 byte	0x0 0x4	0x33 0x00 0x0F 0x04	

PC Sending:

- Command code area: 0x01, this command is a frame rate overlay command.
- Data area: 0x00 0x08 0x00 Indicates the data sent to the lower computer for setting the mode.

Example of lower computer response: A5 04 20 01 00 00 04 33 00 0F 04 45 F6

- 01: Open stream for command. (After sending once, the lower computer periodically answers automatically);
- 00: Reserved byte;
- 00 04: Length of the data area;
- 33 00 0f 04: data area has two results data, each data two bytes, and is LSB format, that is, the two data are distance integer part of "00 33", decimal part of "04 0f", of which the decimal part of the need to parse, the valid part is the low 4 bits of the high byte, that is, "4", the precision of the decimal place is 1/16, that is, at this time, the decimal place is 0.25. part is the lower 4 bits of the high byte, that is, "4", the precision of the decimal place is 1/16, that is, at this time the decimal place is 0.25;
- 45 f6:16-bit crc checksum.

4.4.2.End Measurement Task 0x02

The command format is shown in the following table.

Table 9 . Command table for lower unit frame rate overlay configuration

Direction	Packet header	Device number	Equipment type	CMD	Reserved bit	Lengths	Data	CRC16
Dispatch	A5	0x04	0x20	x02	1 byte	00 00	None	Based on actual calculations
Reception	A5	0x04	0x20	0x02	1 byte	00 01	1 byte	

PC Sending:

- Command code area: 0x02, this command is a frame rate overlay command.
- Data area: no data.

The lower unit answers:

- Command code area: 0x02, this command is the end measurement command.
- Data area: returns a one-byte unsigned char variable. A return of 0 indicates a successful setup, a return of 1 indicates a failed setup.

4.4.3.Query Version Number 0x0a

The command format is shown in the following table.

Table 10 . Command table for lower unit frame rate overlay configuration

Direction	Packet header	Device number	Equipment type	CMD	Reserved bit	Lengths	Data	CRC16
Dispatch	A5	0x04	0x20	0x0a	1 byte	00 00	None	Based on actual calculations
Reception	A5	0x04	0x20	0x0a	1 byte	00 01	1 byte	

PC Sending:

- Command code area: 0x0a, this command is a frame rate overlay command.
- Data area: no data.

The lower unit answers:

- Data area: return the version number.

4.4.4. Get Calibration Parameter 0x06

The command format is shown in the following table.

Table 11 . Command table for lower unit frame rate overlay configuration

Direction	Packet header	Device number	Equipment type	CMD	Reserved bit	Lengths	Data	CRC16
Dispatch	A5	0x04	0x20	0x06	1 byte	00 00	not have	Based on actual calculations
Reception	A5	0x04	0x20	0x06	1 byte	00 0x13	19 bytes	

PC Sending:

- Command code area: 0x02, this command is a frame rate overlay command.
- Data area: no data.

Lower unit responds.

- a5 04 20 06 00 00 13 64 37 65 2d 31 32 00 00 72 00 00 9c 33 a2 3c 84 0d 33 c0 b0 a5
- Data area: 64 37 65 2D 31 32 00 00 72 00 00 9C 33 A2 3C 84 0D 33 C0

The high 11 bytes are the sn code, and the last 8 bytes are the calibration parameters K and B, which are of float type, and the actual data is calculated as: $(X-B)/k$, where X is the original data

obtained by the 0x1 command mentioned above.

5. Appendix

5.1. System Integration Guide

Before users choose XD-S40 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-S40 technical specifications;
- Purchase and get a sample XD-S40 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;

5.2. 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.