product description

SDAM is a fully integrated single channel dToF ranging small module that integrates a highly sensitive infrared enhanced SPAD sensor, with a range of up to 20m under normal ambient light. The chip integrates time correlated photon counting (TCSPC) algorithm, histogram statistical algorithm, and fast TDC architecture to achieve high-precision ranging while also achieving 12m@10WLux It has the ability to resist sunlight and has reflectivity correction function.

SDAM integrated power module, powered by a 3.3V single power supply, with built-in temperature compensation function. Supporting I2C and UART interfaces, easy to integrate and use, and adopting a compact and reliable optical package, with small size and light weight, it is an excellent choice for micro sized dToF applications.

Visit the official website of Ximan Sensingwww.Siman.asia for more product information.

SDAM

Single point dToF sensor micro ranging module

Product features:

- High integration dToF ranging small module solution
- Ultra small structural dimensions, only 21x15x7.87mm;
- Ultra light weight, only 1.35 grams;
- **± 6cm@200mm ~6m; 1% @>6m accuracy;**
- Integrated histogram statistical algorithm, dual target detection;
- Time Related Single Photon Counting (TCSPC) algorithm, equipped with **12m 10W lux resistance to ambient light**
- **The TDC time window can be configured to meet the requirements of different application scenarios;**
- Equipped with reflectivity correction function.

Application areas:

- **AGV obstacle avoidance**
- Height setting and obstacle avoidance
- Proximity detection
- Whether there is perception or not

catalogue

1 Parameter Table

1.1 Basic parameters

parameter	numerical value
Package Size	21mm×15mm×7.87mm
Number of connector pins	6
interface type	UART/I2C
working voltage	Typical: 3.3V Minimum: 3.0V Maximum: 3.6V
Frame rate	Default: 100fps 50fps/250fps interface configuration
Fob	<2°
Multi target detection	Double peak detection data
temperature compensation	have
reflectivity correction	have
wavelength	905nm
Weight	1.35g

1.2 performance parameter

parameter	minimum value	Typical values	Maximum value	unit
Range (@ 10W Lux ambient light)	0.2	-	22	m
Frame rate	50	100	250	Hz
accuracy	± 6cm@0.2m ~6m; ± 1% @>6m (corresponding to target reflectivity of 18%~88%)			
Sunlight resistance 100kLux		12		m
I2C interface speed	-	-	400k	bit/s
UART interface speed	-	-	921600	baut
Standby current	-	48.7	-	mA
Working current	-	99.6	-	mA

1.3 Conditions of Use

parameter		numerical value	unit
Working temperature range		-20 ~ 50	℃
Storage Temperature Range		-40 ~ 85	℃
Anti static level 3	Human body model anti-static level (HBM)	2000	V
	Anti static level of machine model (MM)	200	V
	Anti static level (CDM) of charging device model	500	V

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

2 System Block Diagram

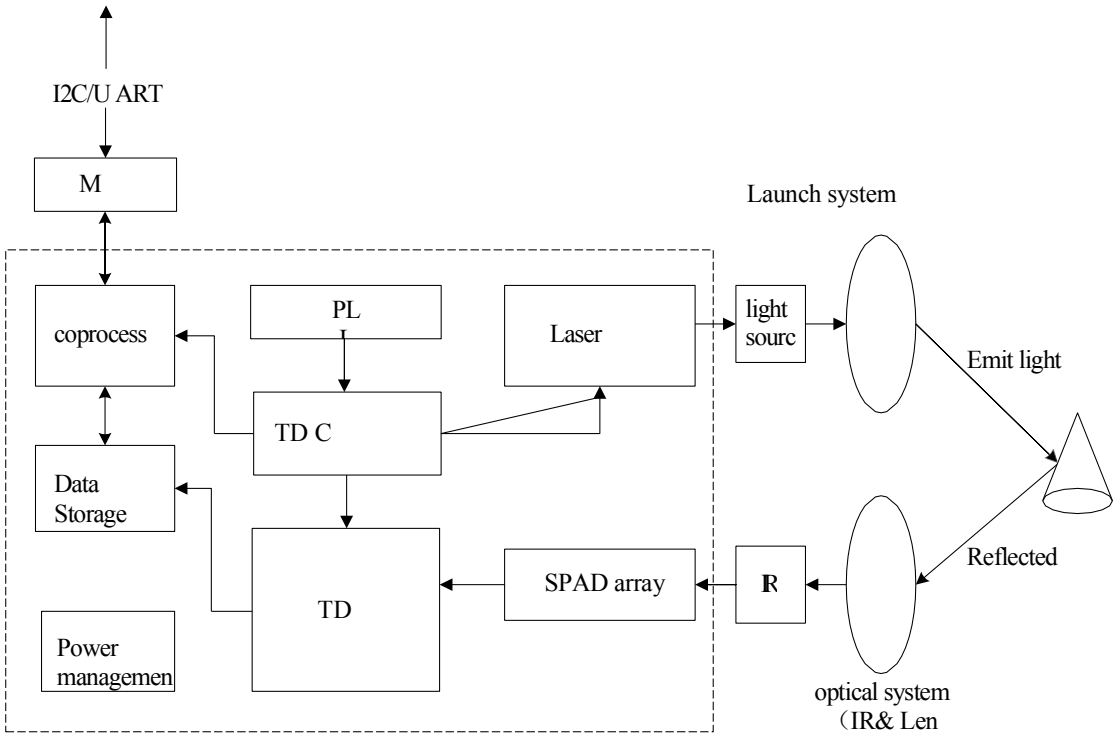


Figure 1 Schematic diagram of SDAM system

3 Pin diagram

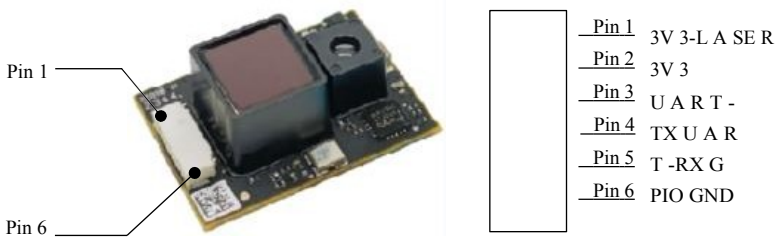


Figure 2 Schematic diagram of UART pins

The functional description of each pin is as follows:

Serial Number	port name	Line color	Port Function Description
1	3.3V LASER	red	Module laser boost circuit power supply
2	3.3V power supply	black	Module low-voltage circuit power supply
3	UART_TX I2C_SDA	yellow	The module supports two communication modes, UART and I2C, and uses GPIO (port 5) external up and down modes to select the communication mode. 1） When working in UART mode, this port is used as the TX port of UART, which is the module communication output pin; 2） When operating in I2C mode, this port is used as the SDA signal for the I2C bus;
4	UART_RX I2C_SCL	green	The module supports two communication modes, UART and I2C, and uses GPIO (port 5) external up and down modes to select the communication mode. 1） When working in UART mode, this port is used as the RX port of UART, which is the communication input pin of the module; 2） When operating in I2C mode, this port is used as the SCL signal for the I2C bus;
5	GPIO	blue	The module supports two communication modes: UART and I2C. 1） After the GPIO port is activated in an external pull-down state, the module operates in UART mode, where the GPIO pins have no function; 2） After the GPIO port is pulled up or suspended externally, the module operates in I2C mode At this point, the GPIO port serves as an interrupt output pin and outputs a high pulse indicator after one frame measurement is completed;
6	GND	white	grounding

Note: Interfaces 3, 4, and 5 are multiplexed interfaces, UART、I2C， There are two modes, please refer to the hardware interface instructions for details.

4 module structure

引脚定义	
1	3_3V_LASER
2	3V3
3	UART_TX
4	UART_RX
5	GPIO
6	DGND
G1	DGND
G2	DGND

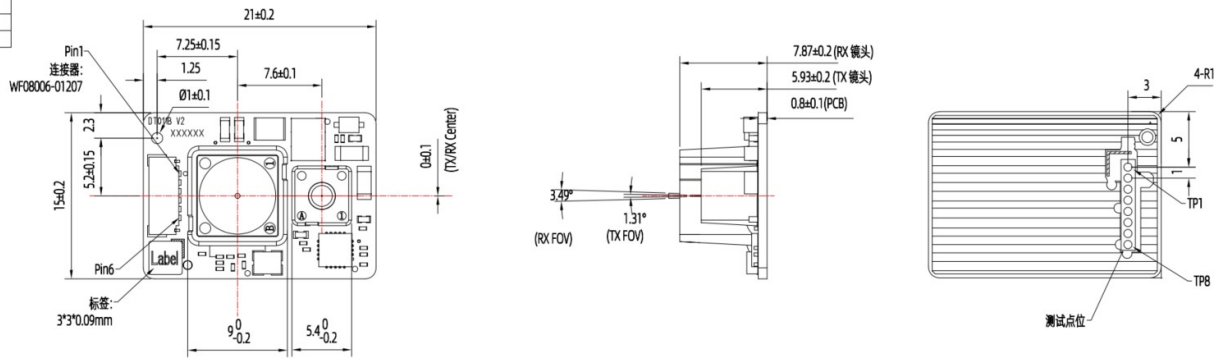


Figure 3 Module Structure Diagram

5 Precautions for use

5. 1 Selection and installation suggestions for optical shading film

Suggestions for panel selection

- The panel material has a penetration rate of over 95% in the 905nm wavelength band and a haze of less than 5%.
- The upper and lower surfaces of the panel are smooth and parallel, and the material color is not limited.
- The panel should be less than 0.5mm and the thickest should not exceed 2mm.
- The flatness of the panel surface is

less than 0.03mm. Suggestions for

panel installation

- The appropriate gap between the panel and module is 0.1mm-0.2mm.
- The parallelism between the surface of the panel and the end face of the module after assembly is less than 0.05mm.
- If there is a need for anti fog/anti salt alkali, a black rubber sleeve can be used to block the gap between the panel and the module to prevent the mirror from fogging or crystallizing.

Figure 4 Installation diagram of shading film

5.2 Spot size

SDAM laser has a certain divergence angle<2 ° , and the spot size varies at different distances. Please refer to the schematic diagram below for the spot size:

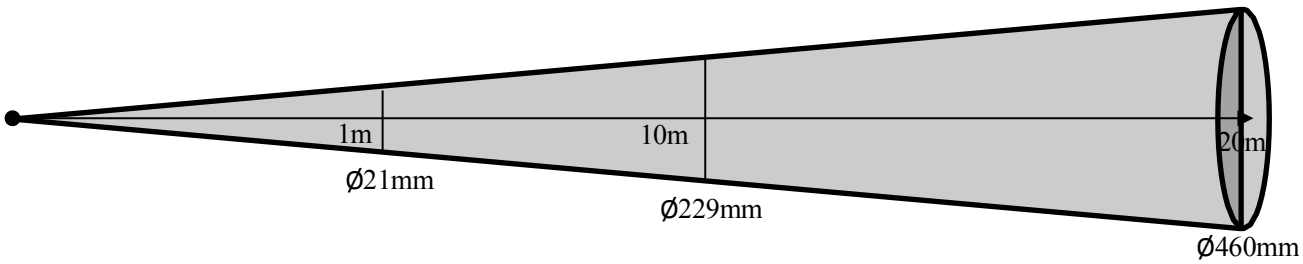
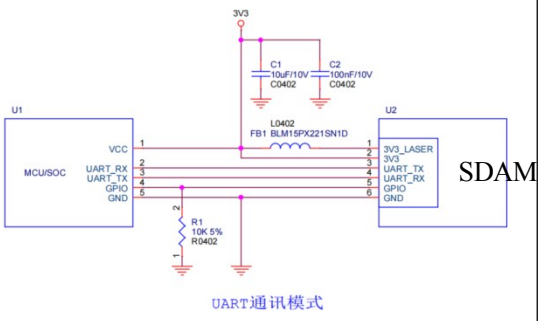
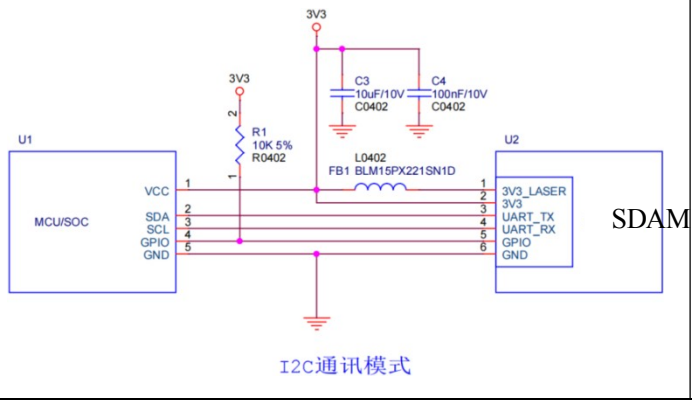


Figure 5 Schematic diagram of spot size

6 Hardware interface usage instructions

The module supports UART and IIC communication methods, but when powered on, only one interface can be selected to run. When using UART, power on to ground the GPIO pin;

When using the I2C interface, the GPIO pin needs to be pulled up with a 4.7K resistor or directly suspended when powered on;

UART	I2C
	

7 UART protocol content

This agreement adopts a master-slave communication mode, which stipulates that the host end is the upper computer and this module is the lower computer. The transmission of data from the upper computer to the lower computer is called sending, and the transmission of data from the lower computer to the upper computer is called responding.

The default communication rate for this protocol is 921600 bps.

The hardware communication format used in this article is: 1 start bit, 8 data bits, and 1 stop bit, with no other data bits. In this article, CRC16 data calculation is performed on each frame of data, which includes all data except for verification. CRC-16 verification adopts the Modbus verification method. The specific parameters are as follows:

- The polynomial is 0 × 8005
- The initial value is: 0 × ffff
- XOR value of result: 0 × 0000
- Input data reversal: Yes
- Output data inversion: Yes

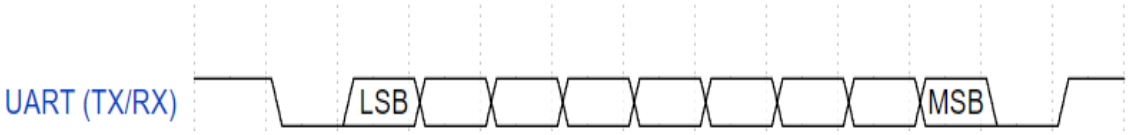


Figure 6 UART bus timing diagram

7.1 Agreement Summary Table

number	NAME	command code
1	Start streaming	0x01
2	End flow	0x02
3	VERSION	0x0a
4	set baud rate	0x10
5	Get baud rate	0x11
6	Set IIC address	0x12
7	Obtain IIC address	0x13
8	Switch frame rate	0x1A
9	Get frame rate	0x1B

7.2 Protocol frame format

The entire protocol has two forms of communication:

The commands 0 × 02, 0 × 0A, 0 × 10, 0 × 11, 0 × 12, 0 × 13, 0 × 1A, and 0 × 1B all use a question and answer system from the upper computer to the lower computer. command

0 × 01 adopts the format of upper computer query lower computer periodic reply (reply periodically according to the set frame rate) to send frames

Baotou	Equipment No	Device Type	**CMD**	reserved	length	**Data**	**CRC16**

Response frame format

Baotou	Equipment No	Device Type	**CMD**	reserved	length	**Data**	**CRC16**
1 byte	1 byte	1 byte	1 byte	1 byte	2 byte	N byte	2 byte

- Header: 1 byte, which is 0xA5.
- Device number: 1 byte, which is 0x03.
- Device type: 1 byte, depending on the type of evaluation board in the lower computer, 0x20.
- CMD: 1 byte, command function code, is the function that the upper computer wants the lower computer to execute.
- Reserved bit: 1 byte for future use.
- Length: 2 bytes, which is the length of the data area data (high-order before low order).
- Data [0] - Data [N-1]: N bytes, parsed according to each command.
- CRC16: 2 bytes, the result of CRC16 validation for all data (high-order before low order);
- The functions corresponding to the command code are shown in the table below, where the command code is represented in hexadecimal. Among them, the "command" in the response frame is consistent with the command in the sending frame, that is, the same command is responded to when sending the same command.

7.3 Command and parsing

Match the sending command with the corresponding response command one by one, and the data in the table or with 0x is in hexadecimal.

7.3.1 Start measuring command 0x01

command format

direction	Baotou	Equipment No	Device Type	**CMD**	reserved	length	**Data**	**CRC16**
sending	0xA5	0x03	0x20	0x01	0x00	0x00 0x00	0 bytes	According to reality International Computing
receive	0xA5	0x03	0x20	0x01	0x00	0x00 0x01	1 byte	

The upper computer sends:

Command code

area: 0x01 Data

area: None

Lower level machine response

- Example: 0 xA5 0x03 0x20 0x01 0x00 0x00 0x0E 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF 0x4B 0x03 0x5E 0x00 0x24 0x23 0x01 0x00 0xBB 0xD8
- 0x01: Open stream for command. (After sending once, the lower computer will automatically respond periodically)

- 0x00: Reserved bytes
- 0x00 0x0E: Data area length
- 0 x FF 0 x FF 0 x FF 0 x FF 0 x FF 0 x 4B 0 x 03 0 x 5E 0 x 00 0 x 24 0 x 23 0 x 01 0 x 00: Data area
- 0xFF 0xFF: Distance to secondary target
- 0xFF 0xFF: Secondary target correction
- 0xFF 0xFF: Secondary target intensity
- 0x4B 0x03: Main target distance (distance settlement is based on low order first, high order second, distance conversion is 034B=843mm)

- 0x5E 0x00: Main target correction
- 0x24 0x23: Main target strength
- 0x01 0x00: Sunshine Base
- 0xBB 0xD8: 16 bit CRC check

note: All of the above are low bits

first and high bits second 16

7.3.2 Query version number 0x0a

command format

direction	Baotou	Equipment No	Device Type	CMD	reserved	length	Data	CRC16
sending	0xA5	0x03	0x20	0x0a	1 byte	00 00	not have	According to reality International Computing
receive	0xA5	0x03	0x20	0x0a	1 byte	00 01	1 byte	

The upper computer sends:

Command code

area: 0x0a Data

area: No data

Lower computer response:

Example: 0 x A50 x 030 x 200 x 0A0 x 00 x 00 x 12 0 x 44 0 x 54 0 x 53 0 x 36 0 x 30 0 x 31 0 x 32 0 x 5F 0 x 41 0 x 50 0 x 50

0×5F 0×56 0×31 0×2E 0×32 0×36 0×43 0×0F 0×0B

- 0 × 0A: Query Version Command
- 0 × 00: Reserved bit
- 0 × 00 0 × 12: Data area length (high byte before low byte)
- 0 x 44 0 x 54 0 x 53 0 x 36 0 x 30 0 x 31 0 x 320 x 5F 0 x 41 0 x 50 0 x 50 0 x 5F 0 x 56 0 x 31 0 x 2E 0 x 32 0 x 36 0 x 43: Version number DTS6012_SPP_XXXXX
- 0 × 0F 0 × 0B: 16 bit CRC check (high byte before low byte)

7.3.3 End measurement task 0x02

command format

direction	Baotou	Equipment No	Device Type	CMD	reserved	length	Data	CRC16
sending	0xA5	0x03	0x20	0x02	1 byte	0x00 0x00	not have	According to reality International Computing
receive	0xA5	0x03	0x20	0x02	1 byte	0x00 0x01	1 byte	

The upper computer sends:

Command code

area: 0x02 Data

area: No data

Lower computer response:

Example: Example: 0 * A5 0 * 03 0 * 20 0 * 02 0 * 00 0 * 00 0 * 01 0 * 00 0 * 7C 0 * C6

- 0 × 02: End measurement command
- 0 × 00: Reserved bit
- 0 × 00 0 × 01: Data area length (high byte before low byte)
- 0 × 00: Data area. Return a byte variable. Returning 0 indicates successful setup, while returning 1 indicates setup failure.
- 0 × 7C 0 × C6: 16 bit CRC check (high byte before low byte)

7.3.4 Set baud rate to 0x10

command format

direction	Baotou	Equipment No	Device Type	CMD	reserved	length	Data	CRC16
sending	0xA5	0x03	0x20	0x10	1 byte	0x00 0x01	1 byte	According to reality International Computing
receive	0xA5	0x03	0x20	0x10	1 byte	0x00 0x04	4 bytes	

The upper computer sends:

Command code area: 0x10, baud rate setting command.

Data area: 1 byte in total, 0-12 baud rate

selection code. Lower computer response:

Example: 0 × A5 0 × 03 0 × 20 0 × 10 0 × 00 0 × 00 0 × 04 0 × 00 0 × 0E 0 × 10 0 × 00 0 × 2B 0 × E0

- 0 × 10: Set baud rate command
- 0 × 00: Reserved bit
- 0 × 00 0 × 04: Data area length (high byte before low byte)
- 0 × 00 0 × 0E 0 × 10 0 × 00: The baud rate is 921600 (high byte before low byte)
- 0 × 2B 0 × E0: 16 bit CRC check (high byte before low byte)
- The relationship between baud rate selection code and baud rate:

Baud rate selection code	Baud rate
0x00	9600
0x01	14400
0x02	19200
0x03	38400
0x04	43000
0x05	57600
0x06	76800
0x07	115200
0x08	128000
0x09	230400
0x0A	256000
0x0B	460800
0x0C	921600

7.3.5 Get baud rate 0x11

command format

direction	Baotou	Equipment No	Device Type	CMD	reserved	length	Data	CRC16
sending	0xA5	0x03	0x20	0x11	1 byte	0x00 0x00	not have	According to
receive	0xA5	0x03	0x20	0x11	1 byte	0x00 0x04	4 bytes	

								reality International Computing

The upper computer sends:

Command code area: 0x11, baud rate to obtain commands.

Data area:

None. Lower computer response:

Example: 0 * A5 0 * 03 0 * 20 0 * 11 0 * 00 0 * 00 0 * 04 0 * 00 0 * 0E 0 * 10 0 * 00 0 * E7 0 * 21

- 0 × 11: Get baud rate command
- 0 × 00: Reserved bit
- 0 × 00 0 × 04: Data area length (high byte before low byte)
- 0 × 00 0 × 0E 0 × 10 0 × 00: The baud rate is 921600 (high byte before low byte)
- 0 × E7 0 × 21:16 bit CRC check (high byte before low byte)

7.3.6 Set I2C address 0x12

command format

direction	Baotou	Equipment No	Device Type	**CMD**	reserved	length	**Data**	**CRC16**
sending	0xA5	0x03	0x20	0x12	1 byte	0x00 0x01	1 byte	According to reality International Computing
receive	0xA5	0x03	0x20	0x12	1 byte	0x00 0x01	1 byte	

The upper computer sends:

Command code area: 0x12, I2C address setting command.

Data area: 1 byte in total, Data [0] is the I2C device address. (7 bits<<1+0) Lower computer response:

Example: 0 * A5 0 * 03 0 * 20 0 * 12 0 * 00 0 * 00 0 * 01 0 * A2 0 * 06 0 * 86

- 0 × 12: Set I²C Address Command
- 0 × 00: Reserved bit
- 0 × 00 0 × 01: Data area length (high byte before low byte)
- 0 × A2: Set I²C address
- 0 × 06 0 × 86: 16 bit CRC check (high byte before low byte) to obtain I2C address 0x13

7.3.7 Get I2C address 0x13

command format

direction	Baotou	Equipment No	Device Type	**CMD**	reserved	length	**Data**	**CRC16**
sending	0xA5	0x03	0x20	0x13	1 byte	0x00 0x00	not have	According to reality International Computing
receive	0xA5	0x03	0x20	0x13	1 byte	0x00 0x01	1 byte	

The upper computer sends:

Command code area: 0x13, I2C address retrieval command. Lower computer response:

Example D: 0 * A5 0 * 03 0 * 20 0 * 13 0 * 00 0 * 00 0 * 01 0 * A2 0 * C6 0 * BB

- 0 × 13: Get I ² C command
- 0 × 00: Reserved bit
- 0 × 00 0 × 01: Data area length (high byte before low byte)
- 0 × A2: Obtained I ² C address
- 0 × C6 0 × BB: 16 bit CRC check (high byte before low byte)

7.3.8 Set frame rate 0x1A

command format

direction	Baotou	Equipment No	Device Type	CMD	reserved	length	Data	CRC16
sending	A5	0x03	0x20	0x1A	0x00	0x00 0x01	1 byte	According to reality International Computing
receive	A5	0x03	0x20	0x1A	0x00	0x00 0x01	1 byte	

The upper computer sends:

Command code area: 0x1A, switch frame rate command.

Data area: 1 byte, 0x00: 50FPS 0x01: 100FPS 0x02: 250FP5。

Lower computer response:

Example: 0 * A5 0 * 03 0 * 20 0 * 1A 0 * 00 0 * 00 0 * 01 0 * 01 0 * BE 0 * 27 0 * 1A: Set frame rate command

- 0 × 00: Reserved bit
- 0 × 00 0 × 01: Data area length (high byte before low byte)
- 0 × 01: Return the set frame rate
- 0 × 00 0 × 01: Data area length (high byte before low byte)
- 0 × 01: 1 byte, 0 × 00: 50FPS, 0 × 01: 100FPS, 0 × 02: 250FPS.
- 0 × BE 0 × 27:16 bit CRC check (high byte before low byte)

7.3.9 Get frame rate 0x1B

command format

direction	Baotou	Equipment No	Device Type	CMD	reserved	length	Data	CRC16
sending	0xA5	0x03	0x20	0x1B	0x00	0x00 0x00	not have	According to reality International Computing
receive	0xA5	0x03	0x20	0x1B	0x00	0x00 0x01	1 byte	

The upper computer sends:

Command code area: 0x1B, get frame rate command.

Data area:

None. Lower

computer

response:

Example: 0 x A5 0 x 03 0 x 20 0 x 1B0 x 00 0 x 00 0 x 01 0 x 01 0 x 7E 0 x 1A

- 0 × 1B: Get frame rate command
- 0 × 00: Reserved bytes
- 0 × 00 0 × 01: Data area length (high byte before low byte)
- 0 × 01: 1 byte, 0 × 00: 50FPS 0 × 01: 100FPS 0 × 02: 250FPS.
- 0 × 7E 0 × 1A: 16 bit CRC check (high byte before low byte)

Note: When frame rate information is not set, the obtained value is default 0xff and configured as default 100fps.

8 I2C protocol

The I2C controller address is 7 bits, 0x51, and 0 bits are read and write bits, （0x51<<1）|(w/r)。

8.1.1 I2C bus timing

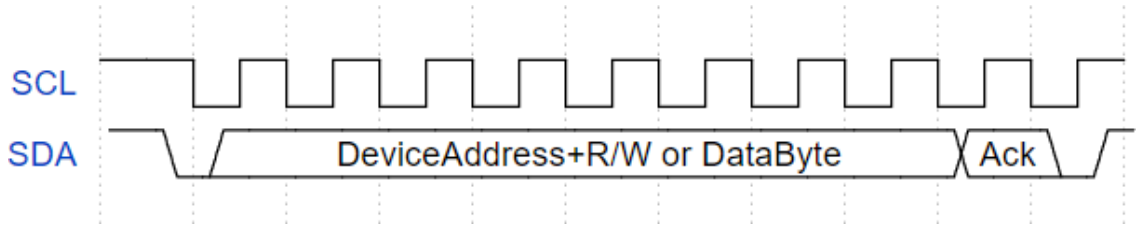


Figure 7 I2C Bus Protocol Format

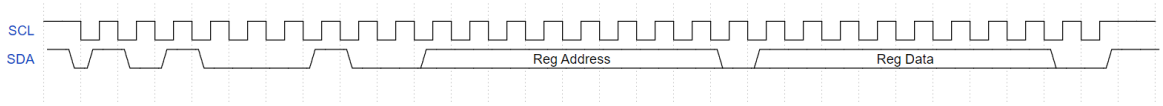


Figure 8 Single byte write operation on I2C bus

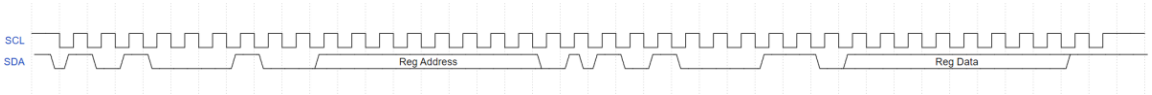


Figure 9 Single byte read operation on I2C bus

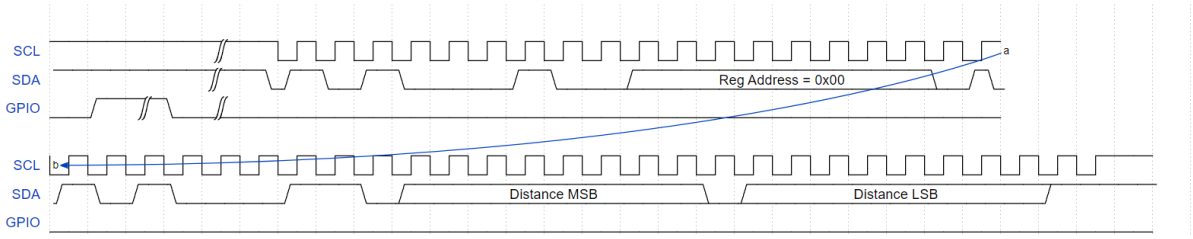


Figure 10 Typical ranging data reading operation

8.1.2 Register table:

address	Meaning of Register	read-write property	notes
0x00	Measure distance up to 8 digits high	RO	Distance is expressed in 2-byte units (in millimeters)
0x01	Measurement distance is 8 digits lower	RO	Distance is expressed in 2-byte units (in millimeters)
0x02	Start/End Measurement Command ®	RW	Write 1 to start measurement, laser turned on, distance data started refreshing, write 0 End the measurement and turn off the laser.
0x03	Test Register	RO	Default value 0x3B

Note: Due to different firmware versions, distance information may be output without the need to start measuring commands

9 Version information

date	version	REVISION
September 7th, 2023	1.0	Initial release
September 11th, 2023	1.1	Add 6012M UART protocol content
November 9th, 2023	1.2	Update structural dimensions
November 27th, 2023	1.3	New interface usage instructions, IIC register instructions
January 15th, 2024	1.4	Add instructions for modifying serial port baud rate and IIC address
April 23, 2024	1.5	Added precision data, added optical cover design reference, and added frame rate switching instructions
July 26, 2024	1.6	Modify the system block diagram and reference circuit diagram, and add protocol logic timing diagram

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