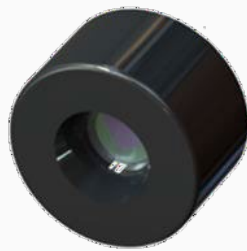




US5 DEVELOPMENT MANUAL (ALPHA)



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1 WORKING MECHANISM

1.1 Model

US5 system has 3 working modes: IO mode, UART mode, and UART REQ mode. The output frequencies are all 100Hz.

- **IO mode:** When the US5 is powered on, the default is IO mode. When a soft material is recognized, the TX output is low; when a hard material is recognized, the TX output is high. The output frequencies is 100Hz.
- **UART mode:** When the US5 enters the UART mode, it outputs the specified data according to the communication protocol. The output frequencies is 100Hz.
- **UART mode:** The user sends a command to query the output results. The maximum query frequency is 100Hz.

1.2 Measuring Principle

This product is based on the ultrasonic time-of-flight (ToF) principle, and is equipped with related acoustics, electricity and algorithm design, and realizes high-precision distance measurement through the energy difference of ultrasonic echo signals on the surface of different materials, and output millimeter-level distance information and its echo energy intensity value, and can also output flag bits to distinguish soft and hard materials.

2 SYSTEM COMMUNICATION

2.1 Communication Mechanism

US5 communicates commands and data with external devices through the serial port. When an external device sends a system command to US5, US5 resolves the system command and returns a corresponding reply message. According to the command content, US5 switches the corresponding working status. According to the content of the message, the external system can parse the message and obtain the response data.

Note: The US5 data communication adopts the little-endian mode, least significant bit first.

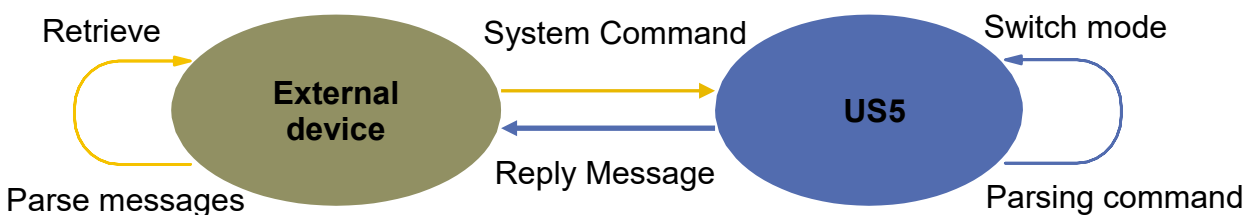


FIG 1 US5 SYSTEM COMMUNICATION

2.2 Communication Protocol

CHART 1 US5 COMMUNICATION DATA PROTOCOL

Packet Header	Command Code	Response Length	Data Segment	Check Code
2 Bytes	1 Byte	1 Byte	...	1 Byte

The command message and the working message are formulated according to the data protocol in Table 1, and the communication baud rate is 115200.

2.3 Command Message

The external system can set the corresponding working status of US5 and obtain corresponding data by sending related system commands. The system commands issued by US5 to external are as follows:

CHART 2 US5 SYSTEM COMMAND

System Command	Description	Answer Mode
0x40	Reset module	No response
0xF8	Set to IO mode	Single response
0xFE	Set to UART mode	Single response
0xFA	Set to UART REQ mode	Single response
0xFC	Obtaining measurement data in UART REQ mode	Single response

Setting the IO mode:

Packet Header		Command Code	Response Length	Data Segment	Check Code
0xAA	0xAA	0xF8	0x01	0x00	0x4D

Setting the UART mode:

Packet Header		Command Code	Response Length	Data Segment	Check Code
0xAA	0xAA	0xFE	0x01	0x00	0x53

Setting the UART REQ mode:

Packet Header		Command Code	Response Length	Data Segment	Check Code
0xAA	0xAA	0xFA	0x01	0x00	0x4F

Obtaining measurement data in UART REQ mode:

Packet Header		Command Code	Response Length	Data Segment	Check Code
0xAA	0xAA	0xFC	0x01	0x00	0x51

2.4 Response Message

The response message is the message returned by the system according to the received command. Different commands have different response content of the response message, and the response message is a single response; No response means that the system did not receive and parse the system command correctly.

Response message:

Packet Header		Command Code	Response length	Data Segment	Check Code
0xAA	0xAA	0xFF	0x01		CS

- **Data:** The command code in the command message parsed by the US5: 0xF8, 0xFE in Chart 2.

2.5 Data Message

Data message is the message that the system outputs the measurement results, which will be output at a rate of 100Hz in the UART mode. In UART REQ mode, every time a 0xFC command is sent, a measurement result is returned.

Packet Header		Command Code 0xFD	Response length 0x04	Data Segment	Check Code CS
0xAA	0xAA				

- **Data:** The meaning is as follows:

CHART 3 THE MEANING OF THE DATA SEGMENT OF THE DATA MESSAGE

Packet Header	Distance Value	Intensity Value
1 Byte	2 Bytes	1 Byte

- **Blanket sign:** 1 means with blanket, 0 means no blanket;
- **Distance value:** the unit is mm;
- **Intensity value:** a numerical value representing the strength of the ultrasonic signal;

For example:

Packet Header		Command Code 0xFD	Response length 0x04	Data Segment 0x00 0x25 0x00 0x96	Check Code CS
0xAA	0xAA				

Data segment parsing:

- **Blanket not detected (0x00);**
- **The distance is 37mm (0x25 + 0x00<<8);**
- **Intensity value is 150 (0x96).**

2.6 Frequency Calibration

The frequency of the ultrasonic transducer has been calibrated at the factory, and usually does not need to be calibrated again. If necessary, a hard material object can be placed 19mm in front of the end face of the module, such as steel plate, wood board, etc., and ensure that the end face is parallel to the plane of the hard material object, and then operate according to the following steps.

1、 Sending the calibration mode command

Packet Header		Command Code	Response length	Data Segment	Check Code
0xAA	0xAA	0xD0	0x01	0x00	0x25

Note that this instruction needs to be sent three times in a row for the reply packet to occur.

2、 Staring the calibration mode command:

Packet Header		Command Code	Response length	Data Segment	Check Code
0xAA	0xAA	0xDC	0x01	0x00	0x31

3、 Check whether calibration has completed:

Packet Header		Command Code	Response length	Data Segment	Check Code
0xAA	0xAA	0xEC	0x01	0x00	0x41

4、 Query response for calibration completion:

Packet Header		Command Code	Response length	Data Segment	Check Code
0xAA	0xAA	0xFF	0x01		CS

A value of 0 indicates that the calibration is not complete, while a value of 1 indicates that the calibration is complete.

2.7 Check Code

The check code uses single-byte accumulation to verify the current data packet. Only the check code itself does not participate in the check operation. The check code solution formula is:

$$\text{CheckSum} = \text{ADD}_1^{\text{end}}(C_i) \quad i = 1, 2, \dots, \text{end}$$

$\text{ADD}_1^{\text{end}}$ is an accumulation formula, which means to accumulate the numbers from subscript 1 to end in the element.

3 ATTENTION

- 1) There may be a jump in the output result at the critical point of the range, and the host side needs to judge the data.
- 2) Avoid splashing water in the use environment, which will cause abnormal output results.

4 REVISION

Date	Version	Writer	Content
2021-12-09	0.1.0	Leo	The 1st release
2022-02-10	0.1.1		1) Add an example of data packet parsing; 2) The check code indicates that it is changed from ADD8 to CS
2022-11-24	0.2.0		1) Add reset instructions 2) Add the UART REQ mode description 3) Add frequency calibration instructions