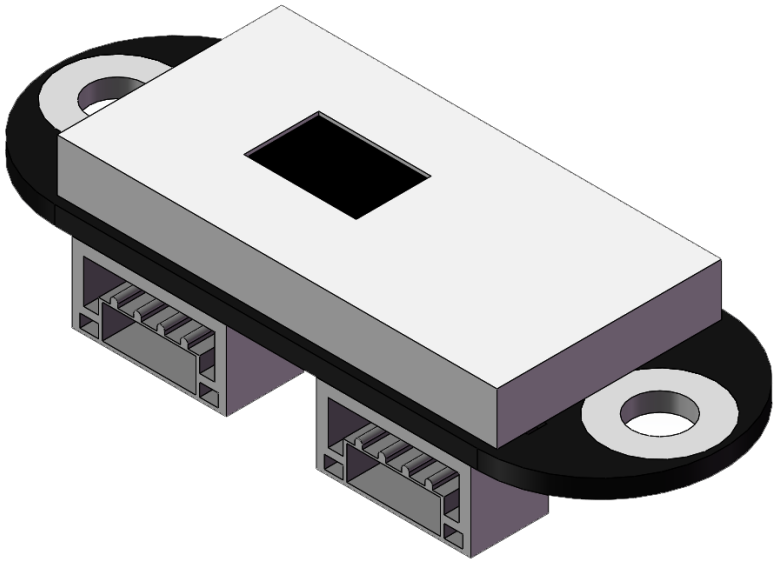
TOFSense User Manual V2.0



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Product Series: TOFSense

Contents

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1 Introduction

This document mainly introduces how to use TOFSense system and the matters need to note during the usage. You may need to refer to the following documents to facilitate the understanding:

- TOFSense Datasheet.pdf

2 UART Output

2. 1 Active Output

UART active output mode can only be used under the single module. The module actively outputs the measuring information with the frequency of 10Hz under this mode and the output format follows NLink_TOFSense_Frame0 protocol.

UART active output mode configuration is shown as Figure 1.

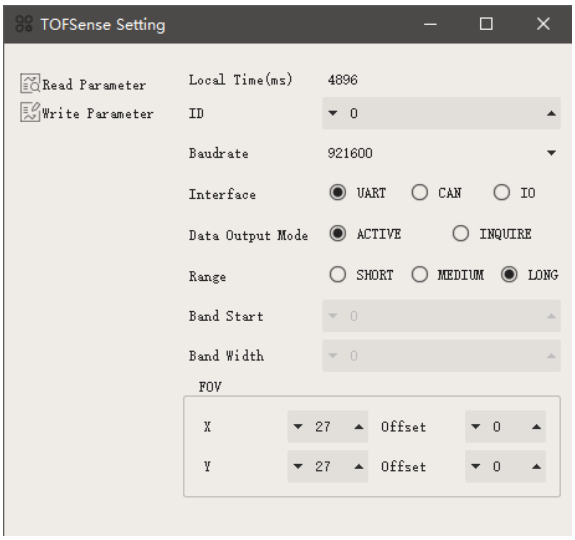

Figure 1: UART Active Output Mode Configuration Diagram

2. 2 Inquire Output

UART inquire output mode can be used during the single module and cascade connection. Under this mode, through the controller sends inquire command including this module ID to the expected inquire mode, and the module can output one frame of measuring information. The inquire frame format follows the protocol NLink_TOFSense_Read_Frame0, and the output frame format follows the protocol NLink_TOFSense_Frame0. UART inquire output mode configuration is shown as Figure 2.

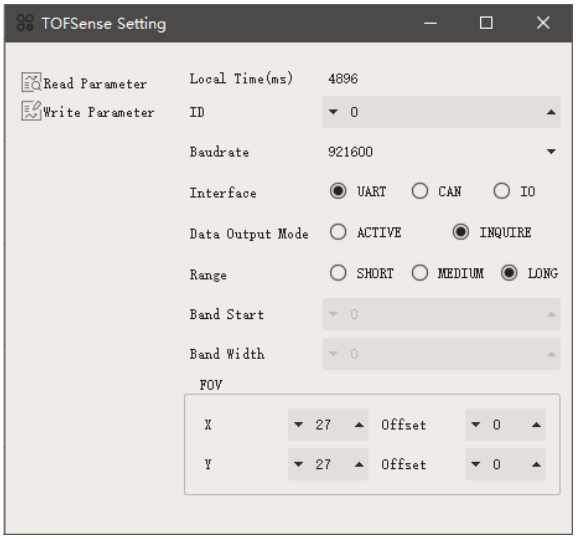

Figure 2: UART Inquire Output Mode Configuration Diagram

3 Can Output

3. 1 Active Output

CAN active output mode can be used during the single module and cascade connection. Under this mode, the module actively outputs the measuring information with the frequency of 10Hz. The output format follows the protocol NLink_TOFSense_CAN_Frame0.

CAN active output mode configuration is shown as Figure 3.

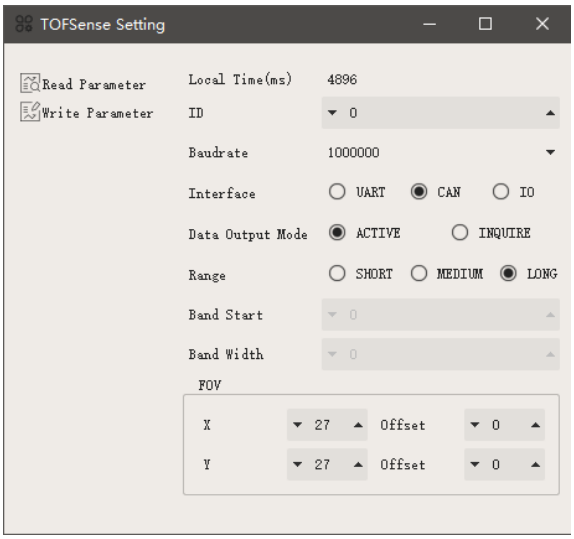

Figure 3: CAN Active Output Mode Configuration Diagram

3. 2 Inquire Output

CAN inquire output mode can be used during the single module and cascade connection. Under this mode, through the controller sends the inquire command including this module ID to the expected inquire module, and the module can output one frame of measuring information. The inquire format follows the protocol NLink_TOFSense_CAN_Read_Frame0, and the output frame follows the protocol NLink_TOFSense_CAN_Frame0.

CAN inquire output mode configuration is shown as Figure 4.

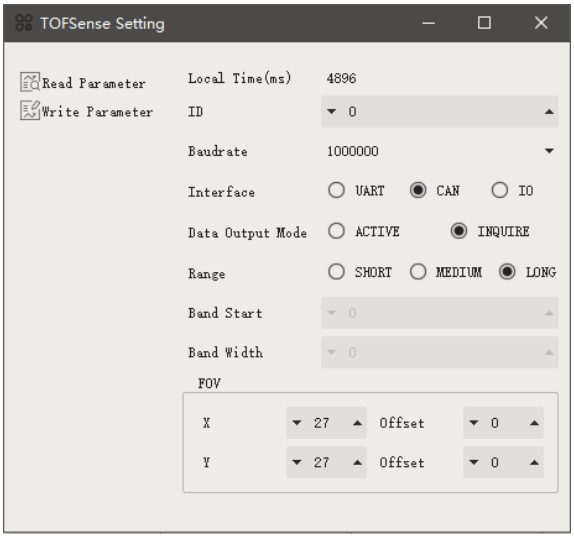

Figure 4: CAN Inquire Output Mode Configuration Diagram

4 I/O Output

Under I/O output mode, firstly set up the hysteresis band starting point Band_Start and hysteresis band width Bandwidth to determine the hysteresis band range. I/O output mode configuration is shown as Figure 5; The distance value is transformed to the high and low electric level output through the hysteresis band comparison, TX/CAN_L and RX/CAN_H output the complementary electric level. The schematic diagram of hysteresis band comparison is shown as Figure 6. It is unable to perform the cascade connection under this mode.

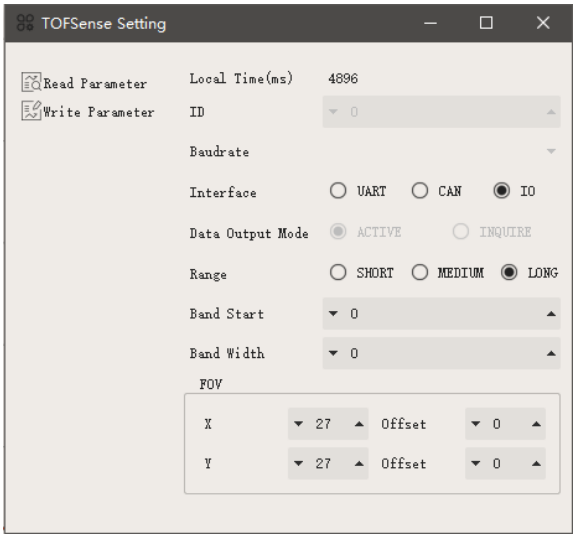

Figure 5: I/O Output Mode Configuration Diagram

In which, the value range for Band_Start and Bandwidth is [0~5000], and the unit is mm.

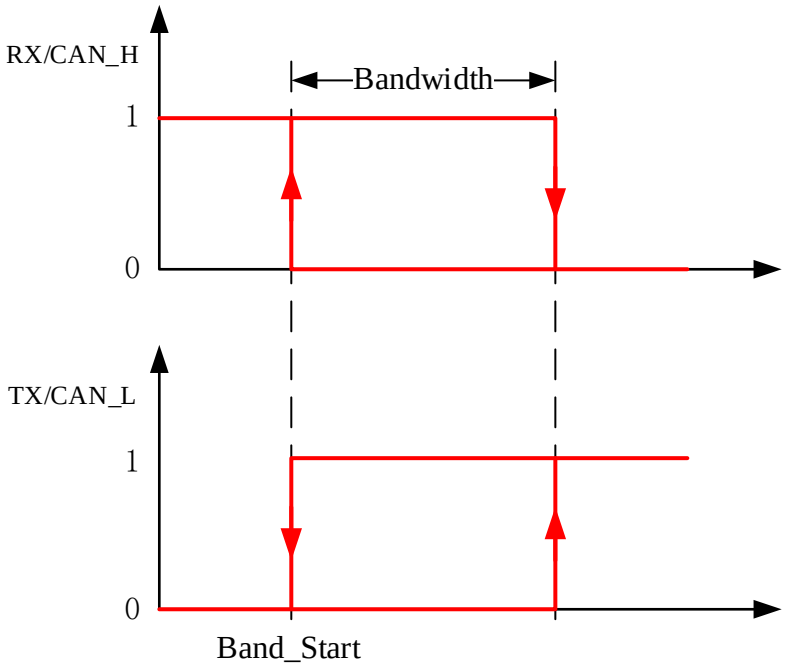

Figure 6: Schematic Diagram of Hysteresis Band Comparison

5 FOV

The initial field angle parameters of module are fov.x=27°, fov.y=27°, fov.x_offset=0°, fov.y_offset=0°. Through setting up the field angle at X is direction 25° and the field angle at Y direction is 15°, offset at X direction is 1°, and offset at Y direction is -1°, it is able to change the interest zone of module to as shown in Figure 7.

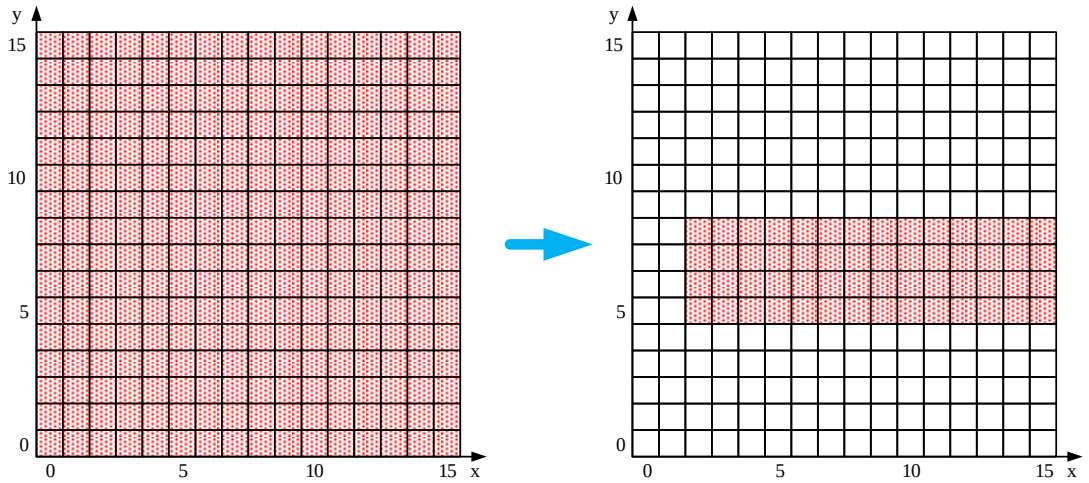

Figure 7: Schematic Diagram of FOV Configuration

The smaller FOV can enhance the detection performance of module in narrow space and minor object. However, the change of FOV field angle will also generate the impact on the longest ranging distance of module. The smaller the field angle is, the shortest the longest ranging distance. Under some scenario (indoor and while wall background), the relationship between longest ranging distance and field angle FOV is shown as Figure 8. The user needs to select the appropriate field angle according to the actual scenario.

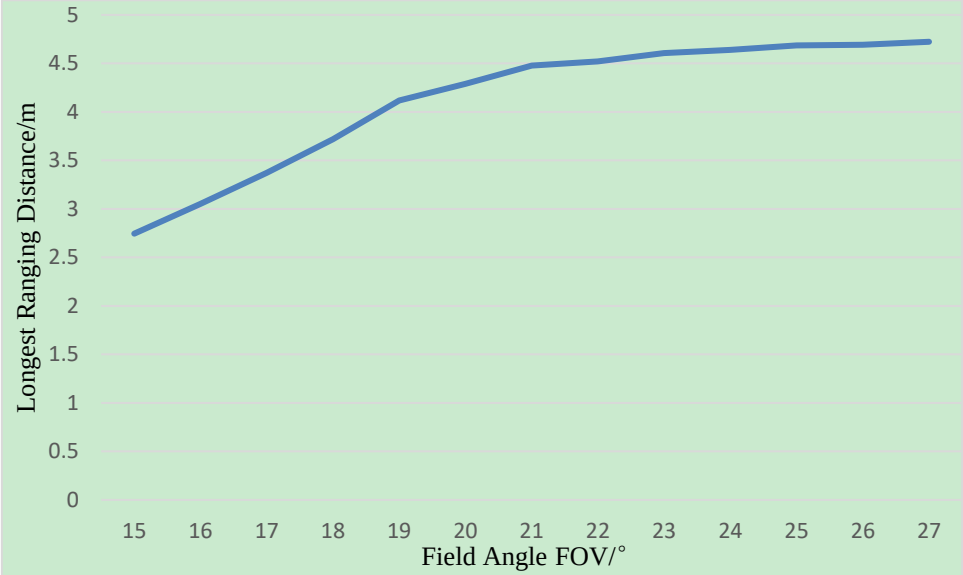

Figure 8: Relationship between Longest Ranging Distance and Field Angle FOV

6 CascadeRanging

Configure several sensors to different IDs and set up a series connection. Through one communication interface, it is able to read all ranging information of sensors. The connection is shown as Figure 9.

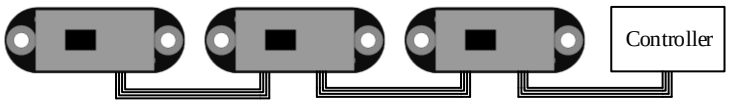

Figure 9: Schematic Diagram of Cascade Ranging

Under the cascade range, it is adaptable for three modes including UART inquire、CAN inquire、CAN active output.

7 Protocol Unpack

7. 1 Introduction

The analytical example of protocol in this Chapter is based on NLink protocol, and provides NlinkUnpack example parsing code developed based on C language, which can effectively reduce the development period of user.

According to the data status of TOFSense product and in order to express more data with as less bytes as possible, we apply the shaping to indicate the floating-point number. Through the protocol frame transmission, thus the shaping data with the multiplying power is actually the floating-point type during the unpacking, it is required to be divided by the multiplying power indicated in the protocol.

Specially as for int24 type, we need to firstly transform to int 32 type. In order to keep the mark unchanged, it adopts the means of dividing 256 after moving leftwards. For example, as for the position data, we apply int 24 for expression with the multiplying power is 1000, and the parsing code is as below:

```
uint8_t byte[] = {0xe6,0x0e,0x00};//represent decimal numeral value: 3.814
//uint8_t byte[] = {0xec,0xfb,0xff};//represent decimal numeral value: -1.044
int32_t temp = (int32_t)(byte[0] << 8 | byte[1] << 16 | byte[2] << 24) / 256;
```

```
float result = temp/1000.0f;
```

Current the protocol check is mainly the single byte at the end and check for protocol frame, and the example code is:

```
uint8_t verifyCheckSum(uint8_t *data, int32_t length){
    uint8_t sum = 0;
    for(int32_t i=0;i<length-1;++i){
        sum += data[i];
    }
    return sum == data[length-1];
}
```

7. 2 Example

This Document takes the single module connection ranging as the application scenario.

7. 2. 1 NLink_TOFSense_Frame0

Data Source: Connect module with upper computer, configure as UART active output mode, NLink_TOFSense_Frame0 protocol.

Original Data: 57 00 ff 00 9e 8f 00 00 ad 08 00 00 03 00 ff 3a

Table 1: NLink_TOFSense _Frame0 Parsing Sheet

Data	Type	Length (Bytes)	Hex	Result
Frame Header	uint8	1	57	0x57
Function Mark	uint8	1	00	0x00
reserved	uint8	1	…	*
id	uint8	1	00	0
System_time	uint32	4	9e 8f 00 00	36766ms
dis*1000	uint24	3	ad 08 00	2.221m
dis_status	uint8	1	00	0
signal_strength	uint16	2	03 00	3
reserved	uint8	1	…	*
Sum Check	uint8	1	3a	0x3a

7. 2. 2 NLink_TOFSense_Read_Frame0

Data Source: Connect module with upper computer, configure as UART inquire output mode, id is 0，and send the following data through upper computer to realize the data inquire.

Original Data: 57 10 FF FF 00 FF FF 63

Table 2: NLink_TOFSense_Read_Frame0 Parsing Sheet

Data	Type	Length (Bytes)	Hex	Result
Frame Header	uint8	1	57	0x57
Function Mark	uint8	1	10	0x10
reserved	uint16	2	…	*
id	uint8	1	00	0

reserved	uint16	2	…	*
Sum Check	uint8	1	63	0x63

7.2.3 NLink_TOFSense_CAN_Frame0

Data Source: Module is configured as CAN active output mode, id is 1, connect CAN reception equipment.

Original Data: StdID:0x201 **+ Data:** AD 08 00 00 03 00 FF FF

Table 3: NLink_TOFSense_CAN_Frame0 Parsing Sheet

Field name	Part	Level	Type	Length(bits)	Hex	Result
Start Of Frame	SOF		*	1	*	*
Arbitration Field	ID		*	11	0x200+id	0x201
	RTR		*	1	*	*
Control Field	IDE		*	1	*	*
	r0		*	1	*	*
	DLC		*	4	*	*
Data Field	dis*1000		uint24	24	ad 08 00	2.221m
	dis_status		uint8	8	00	0
	signal_strength		uint16	16	03 00	3
	reserved		uint16	16	…	*
CRC Field	CRC		*	15	*	*
	CRC_delimiter		*	1	*	*
ACK Field	ACK Slot		*	1	*	*
	ACK_delimiter		*	1	*	*
End Of Frame	EOF		*	7	*	*

	Dominant level
	Dominant or recessive level
	Recessive level

7.2.4 Link_TOFSense_CAN_Read_Frame0

Date Source: Module is configured as CAN inquire output mode, id is 1, connect CAN inquire equipment, inquire equipment id_s is 2.

Original Data: StdID:0x402 **+ Data:** FF FF FF 01 FF FF FF FF

Table 4: NLink_TOFSense_CAN_Read_Frame0 Parsing Sheet

Field name	Part	Level	Type	Length(bits)	Hex	Result
Start Of Frame	SOF		*	1	*	*
Arbitration Field	ID		*	11	0x400+id_s	0x402
	RTR		*	1	*	*
Control Field	IDE		*	1	*	*
	r0		*	1	*	*
	DLC		*	4	*	*
Data Field	reserved		uint24	24	…	*
	id		uint8	8	01	id = 1

	reserved		uint32	32	…	*
CRC Field	CRC		*	15	*	*
	CRC_delimiter		*	1	*	*
ACK Field	ACK Slot		*	1	*	*
	ACK_delimiter		*	1	*	*
End Of Frame	EOF		*	7	*	*

	Dominant level
	Dominant or recessive level
	Recessive level

8 FAQ

Q1. Can is be used under the outdoor (high light) condition?

The module can be affected by the natural light. Generally speaking, the higher the natural light is, and the larger the impact will be. It is demonstrated that the ranging distance becomes shorter, the precision becomes poorer and the fluctuation becomes larger. Under the high light condition (e.g. sun light), it is usually recommended to use in the scenario of short-distance detection.

Q2. Is there any interruption using several modules?

There is no interruption. When several modules are working at the same time, even though the infrared light among them will be across or aim at the same position, which will not affect the actual measurement.

Q3. Why doesn't TOFSense have the data output?

All modules are all delivered after the strict test. If there is no data, please check whether the configuration e.g. mode, wiring connection, Baud rate etc. is correct; As for CAN output mode, please check whether it contains the terminal resistance (it is usually 120 Ω).

Q4. What attention needs to be paid during the installation?

It is required to avoid any blocking in FOV angle during the installation. In addition, it is required to pay attention to the height with ground, it is required to avoid the similar reflection surface e.g. ground blocking etc. in FOV.

Q5. Do UART and CAN of module use the same interface?

UART interface and CAN interface of module share the same physical interface, it is able to change the corresponding line sequence according to the different communication modes.

Q6. How to configure the module as UART or CAN communication mode?

Under UART communication mode, it is able to configure the module as CAN communication mode through the upper computer; Under CAN communication mode, it is required to press the key before powering on the module. When the indicator turns to slow-speed flash, release the key. The module will compulsively enter UART mode, and it is able to write UART configuration through the upper computer.

Q7. Does the module output the shortest distance, longest distance or average distance?

It is able to obtain several groups of ranging values when measuring the module for single time, and obtain the distance with the highest proportion after being processed by the inner processor.

Q8. Does the module support the Cloud information of output point?

The module can only output one distance for single time, and it temporarily doesn't support the output of point cloud information.

Q9. How to output the distance during the range scale and out-range under the different ranging modes?

During the ranging scope under short-distance mode, the fixed value of distance output is -0.01 with a hexadecimal 0xFFFFF6.

During the ranging scope under medium-distance mode, the distance output is 1-2m with a random change. And then it is able to refer to the signal strength and distance status to make a judgement.

During the ranging scope under long-distance mode, the data output is 1-2m with a random change. And then it is able to refer to the signal strength and distance status to make a judgement.

Q10. Why can't inquire the data under CAN inquire mode?

First of all, ensure the line sequence among CAN equipment is correct. Secondly TOFSense terminal doesn't contain 120R matching resistance,and ensure the equipment resistance to be queried is matched.

Finally test whether the inquire frame format to be sent follows NLink_TOFSense_CAN_Read_Frame0 protocol, and pay a special attention to the correctness of standard frame ID.

Q11. Why can't enter UART configuration mode by pressing the key?

The function keys have been tested before the delivery, please try several times if can't enter UART mode. Please note that the key needs to be pressed before powering on, and release after the light flashes slowly.

9 Reference

[1] TOFSense Datasheet

10 Abbreviation and Acronyms

Table 5: Abbreviation and Acronym

Abbreviation	Full Title
TOF	Time of Flight
FOV	Field of View
HW	Half Wave
VCSEL	Vertical Cavity Surface Emitting Laser

11 Update Log

Table 6: Update Log

Version	Firmware Version	Data	Description
1.0	1.0.0	20190817	1. Release first-edition Manual
1.1	1.0.4	20190923	1. Add example setting up FOV through UART 2. Add FOV setup description 3. Add FAQ 4. Modify error in Manual
1.2	1.0.6	20191213	1. Add description to FOV setup 2. Modify error in Manual
2.0	2.0.0	20200730	1. Add I/O mode description 2. Expand FAQ 3. Modify error in Manual

12 Further Information

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