



# Benewake TFmini-i LiDAR Distance Sensors Instruction Manual

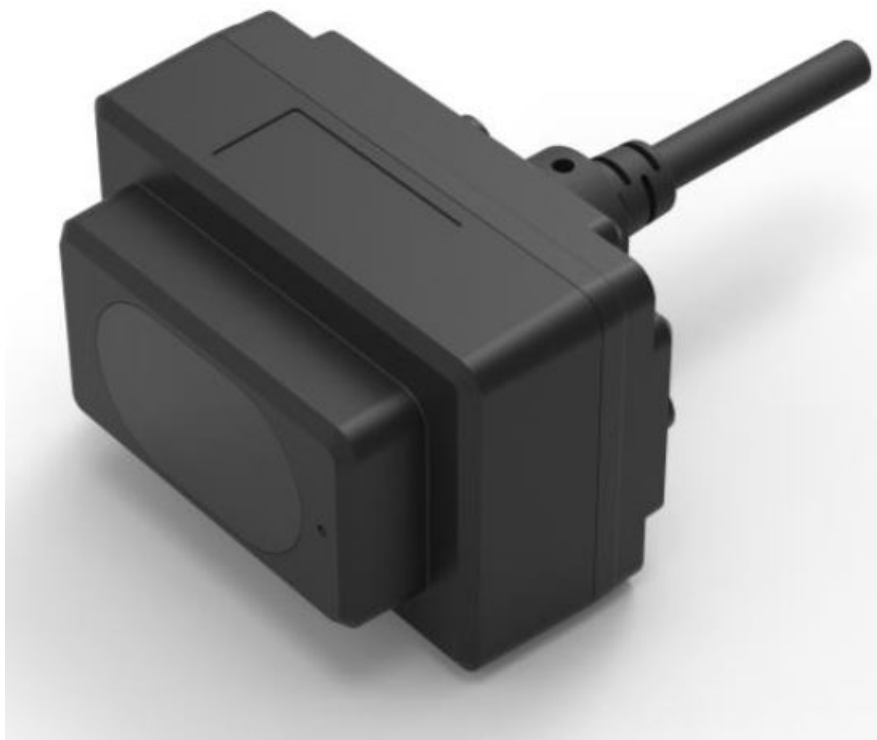
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**Benewake TFmini-i LiDAR Distance Sensors**



## Foreword

### Dear users:

Thanks for choosing Benewake products, and it's our pleasure to help you to solve any technical question. For the purpose of offering a better operation experience to you, we hereby write this manual for an easier and simpler operation of our product, hoping to better solve the common problems you maybe meet. This operation manual covers the product operation introduction and common problem solutions, but it is really hard to cover all the problems you maybe meet. So, if you have any further questions or problems, please feel free to consult our technical support service ([support@benewake.com](mailto:support@benewake.com)). We will do our best to solve any problem related to the product. If you have any other good advice or suggestions, welcome to visit our official website and offer us your feedback there (<http://en.benewake.com/support>), and we are looking forwards to your participation. We are Benewake who dedicated to making the best "Robotic Eyes" worldwide!

## Attentions

### About this Document

- This Manual provides information necessary for the use of this product.
- Please read this Manual carefully before using this product and make sure that you have fully understood its contents.

### Installation and maintenance

- This product can only be maintained by qualified professionals and only the original spare parts can be used to ensure its performance and safety.
- The working temperature of the product is -20°C~60°C; please do not use it beyond this temperature range, so

as to avoid risks.

- The storage temperature of the product is -30°C~75°C; please do not store it beyond this temperature range, so as to avoid risks.
- Do not open its enclosure for assembly or maintenance beyond this Manual; otherwise, it will affect the product performance.
- Do not twist the cable forcefully, so as to avoid damage to the product.
- The product can't be aimed directly to the sun or another TFmini-i, so as to avoid damage the detector by strong light. If there is such an application, please contact our technician.

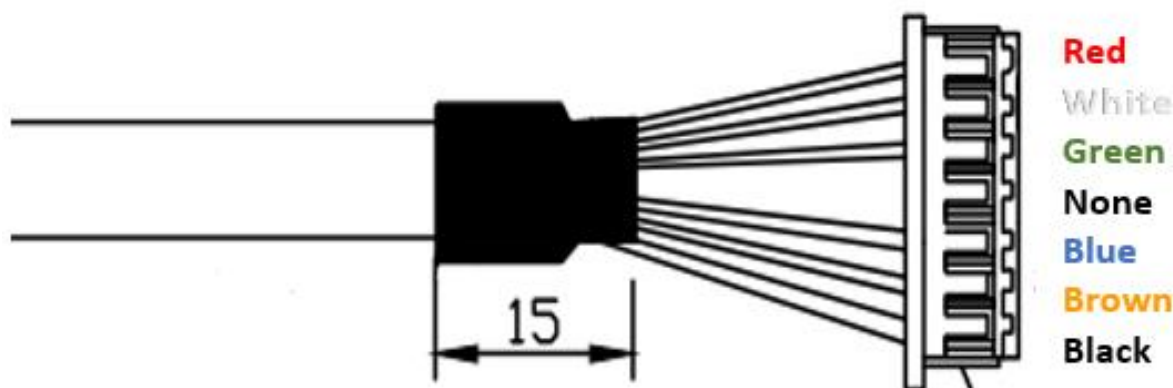
### Conditions with Potential Product Failure

- When the product transmitter and receiver lens are covered by dirt, there will be a risk of failures. Please keep the lens clean.
- The product will have a risk of failure when immersed completely in water. Do not use it underwater.
- When detecting objects with high reflectivities, such as mirrors and smooth tiles, the product may have a high risk of failure.

### Physical Interface

#### Wiring

Terminal model: MH1.25-7P-W/B, size of single wire is AWG26, the diameter of single wire is 0.404mm, and cross-sectional area is 0.129mm<sup>2</sup>.



No.	Color	Pin	Function
1	Red	VCC	Power supply
2	White	RS485-B/ CAN_L	RS485-B/CAN bus
3	Green	RS485-A/ CAN_H	RS485-A/CAN bus
4	N/A	N/A	N/A
5	Blue	UART_RX	UART receive(debug)
6	Brown	UART_TX	UART transport(debug)
7	Black	GND	Ground

**Note:** The hardware of RS485 and CAN is different; Do not mix UART cable with RS485 or CAN bus, otherwise it

will cause damage of MCU.

## Electrical Characteristics

TFmini-i has overvoltage and polarity protection.

Parameter	Typical value
Supply voltage	7V~30V
Peak current	100mA
Average current	≤65mA@12V
Average power consumption	≤0.8W@12V
Overvoltage protection	30V
<a href="#">Polarity protection</a>	<a href="#">40V</a>

## Hardware and communication protocol

There are two communication interfaces available. The hardware of RS485 and CAN is different. The interface can not be switched by command.

### Protocol of RS485

Modbus is the default setting. The parameters is shown as below. The default value of baudrate and slave ID is 115200 and 0x01.

Item	Parameter
Communication interface	RS485
Baud rate	115200
Data bit	8
Stop bit	1
Parity	None

#### Parameter configuration and description of Modbus

Baudrate of TFmini-i supports 9600 14400 19200 38400 43000 57600 76800 115200 128000 230400 256000. Based on reliability considerations, it is not recommended to use a baud rate above 115200 for communication. When Modbus protocol is enabled, the Modbus reading distance command format:

Address field	Function code	Register address		Number of registers		CRC_low	CRC_high
<b>01 default</b>	03	00	00	00	01	xx	xx

The data frame returned by TFmini-i is as follows:

Address field	Function code	Data length	Dist_high	Dist_low	CRC_low	CRC_high
<b>01 default</b>	03	02	xx	xx	xx	xx

**Parameter configuration:**

Category	Function	Instruction	Response	Description
<b>UART instructions</b>	Enable Modbus	5A 05 15 01 75	5A 05 15 01 75	Save settings and restart to take effect.
	Save settings	5A 04 11 6F	5A 05 11 00 70	
<a href="#">Modbus instructions</a>	<a href="#">Read distance</a>	<a href="#">01 03 00 00 00 01 84 0A</a>	<a href="#">01 03 02 DH DL CL CH</a>	DH and DL are 8 high-order and low-order bits of Distance;

				CH and CL are 8 high-order and low-order bits of CRC.
				DH and DL are 8 high-order and low-order bits of
	Read distance and	01 03 00 00 00 02 C4	01 03 04 DH DL SH SL	Distance;
	signal strength	0B	CL CH	SH and SL are 8 high-order and low-order bits of signal Strength.
	Read software	01 03 00 06 00 02 24 0A	01 03 04 00 VM VS VC	VM,VS,VC are the major, minor and revised version number.
	version		CL CH	
				BH1,BH2,BL1,BL2 are high , secondary high, secondary low
		01 06 00 83 BH1 BH2	01 06 00 83 BH1 BH2 CL	and low bytes of baud rate.
	Set Baud rate	CL CH 01 06 00 84 BL1 BL2 CL	CH 01 06 00 84 BL1 BL2 CL	For example, set baud rate to 9600 BH1=00 BH2=00 CL=78
		CH	CH	CH=22,
				BL1=25 BL2=80 CL=D2

			CH=D3
			IH,IL are high and low bytes of
Set Slave ID	01 06 00 85 IH IL CL CH	01 06 00 84 IH IL CL CH	ID. Set ID to 2 IH=00 IL=02
			CL=19 CH=E2
			FH,FL are high and low bytes of
Set output rate	01 06 00 86 FH FL CL CH	01 06 00 86 FH FL CL CH	frame rate. Set frame rate to 100 FH=00
			FL=64 CL=69 CH=C8
			H,LL are high and low bytes of
Set low-power consumption mode	01 06 00 88 LH LL CL CH	01 06 00 88 LH LL CL CH	low power sampling rate. Set it to 5HZ low-power consumption mode, LH=00
			LL=05 CL=C9 CH=E3
Save settings	01 06 00 80 00 00 88 22	01 06 00 80 00 00 88 22	Save settings and restart to take effect
Restore factory setting	01 06 00 89 00 00 58 20	01 06 00 89 00 00 58 20	
Disable Modbus	01 06 00 82 00 01 E8 22	01 06 00 82 00 01 E8 22	Save settings and restart to take effect

Note: Only RTU mode is supported for communication in UART link.

### Function code of TFmini-i Modbus

Function code	Description
<b>03</b>	Read register
<b>06</b>	Write register

### Register address description

1. All register addresses are hexadecimal and register values are 16bit;
2. After setting parameter, save and restart to take effect;

Register address list using function code: 0x03(read only)

Register address	Definition	Description
<b>00 00</b>	Dist	Distance, unit: cm
<b>00 01</b>	Strength	Signal strength
<b>00 03</b>	High16bit of timestamp	2 high-order bits of timestamp represent relative time of radar start up, unit: ms
<b>00 04</b>	Low16bit of timestamp	2 low-order bits of timestamp represent relative time of radar start up, unit: ms
<b>00 06</b>	High16bit of software version	00 + major version number
<b>00 07</b>	Low16bit of software version	Minor version number + revised version number

Register address list using function code: 0x06(write only)

Register address	Definition	Description
<b>00 80</b>	Save settings	Write any value to save settings
<b>00 81</b>	Power off/Restart	Register value 0-Power off unavailable currently 1-Restart
<b>00 82</b>	Disable Modbus	Register value 1-Disable Modbus Others-Error reply
<b>00 83</b>	Baud rate High	Set baud rate. Restart to take effect
<b>00 84</b>	Baud rate Low	Set baud rate. Restart to take effect
<b>00 85</b>	Slave ID	Set TFmini-i's ID. Restart to take effect(default 0x01)
<b>00 86</b>	fps	Set fps. Restart to take effect(default 100hz)



00 87	Working mode	Set working mode. Restart to take effect after saving Register value: 0- Continuously detection mode(default) 1-Trig gering mode Others-Error reply
00 88	Low-power consumption mode	Set low-power consumption mode Restart to t ake effect after saving Register value: 0-Disable(default) >0 and≤10-Enable(the value is inside sampling frequent)
00 89	Restore default	Write any value. Restart to take effect after saving

#### Examples:

1. Enable Modbus protocol
  1. 5A 05 15 01 75 // Enable Modbus
  2. 5A 04 11 6F // Save settings
2. Disable Modbus protocol
  1. 01 06 00 82 00 01 E8 22 // Default address 01, disable Modbus
  2. 01 06 00 80 00 00 88 22 // Default address 01, save setting

#### Protocol of CAN

The data protocol of CAN is shown in Table 4. Each data frame consists of 8 bytes and the data contains the distance(unit: cm), signal strength and timestamp(unit: ms) information.

Data byte	Definition	Description
Byte0	DIST_L	DIST low 8-bits
Byte1	DIST_H	DIST high 8-bits
Byte2	Strength_L	Signal strength low 8-bits
Byte3	Strength_H	Signal strength high 8-bits
Byte4	Timestamp	Low8bit of timestamp
Byte5	Timestamp	Secondary-low8bit of timestamp
Byte6	Timestamp	Secondary-high8bit of timestamp
Byte7	Timestamp	High8bit of timestamp

### Parameter configuration and description of CAN

The default baudrate is 250kbps, the default type is standard frame, default receive and send id is 0x00000003. The format of instruction is shown as below:

Byte	0	1	2	3	4	5-8	9-12	13
<b>Description</b>	0x5A	0x0E	0x51	Type	Baudrate	Recv_id	Send_id	Check_sum
<b>Default</b>				0	8	0x00000003	0x00000003	

Type: 0(Standard Frame), 1(Extended Frame);

Recv\_id: LiDAR receive ID, Little Endian; Send\_id: LiDAR send ID, Little Endian

The relation between Baudrate(unit: kbps) and Byte4 is shown as below:

Byte4	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Baudrate	1000	900	800	666	600	500	400	300	<b>250</b>	225	200	160	150	144	125	120	100

### 1. Examples of configuration

Example1: Standard frame, Baud rate 500kbps, receive ID=0x0010, send ID=0x0020 Command: 5A 0E 51 00 05 10 00 00 00 20 00 00 00 EE

Example2: Extended Frame, Baud rate 250kbps, receive ID=0x0000AABB, send ID=0x0000CCDD

Command: 5A 0E 51 01 08 BB AA 00 00 DD CC 00 00 D0

### 2. CAN Terminating Resistor Configuration Instructions

Enable 120Ω Terminating Resistor: 5A 05 60 01 C0

Disable(Default) 120Ω Terminating Resistor: 5A 05 60 00 BF

### 3. Others

- Other configuration instructions are the same as UART instructions of standard products, such as saving settings(5A 04 11 6F), resetting(5A 04 02 60) and so on. "Save setting" instruction must be sent after setting parameters, otherwise the parameter doesn't take effect after restarting.

2. When the command is longer than 8 bytes, it needs to be distributed into multiple CAN data frames. And the interval between every data frame can't be longer than 20ms.

## FAQ

- **Q1: Can the FOV (spot) of TFmini-i be increased or decreased?**

A1: Generally, this is a customized demand. You need to contact our sales colleague for further details. FOV is determined at the beginning of product design. Determination of FOV is also related to the optical system and the product structure. Therefore, it cannot be easily changed and needs to be customized.

- **Q2: Can I change the frequency of data output?**

A2: Yes, customization of parameter configuration is supported in TFmini-i. You may consult our sales colleague or technical support for further details. Other common questions please refer to SJ-PM-TFmini-S A01 Product Manual on our website.

## Headquarters:

400-880-9610

## Technical support:

[bw@benewake.com](mailto:bw@benewake.com) [support@benewake.com](mailto:support@benewake.com)

## Specified Product

**Product model:** TFmini-i

**Product name:** TFmini-i LiDAR



### Manufacturer

Company name: Benewake (Beijing) Co., Ltd. Address: NO.28 Xinxu Road, Haidian District, Beijing, PRC

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## Documents / Resources

	<p><a href="#">Benewake TFmini-i LiDAR Distance Sensors</a> [pdf] Instruction Manual TFmini-i, LiDAR Distance Sensors, TFmini-i LiDAR Distance Sensors</p>
	<p><a href="#">Benewake TFmini-i LiDAR Distance Sensors</a> [pdf] User Manual TFmini-i LiDAR Distance Sensors, TFmini-i, LiDAR Distance Sensors, Distance Sensors, Sensors</p>

References

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