Benewake

TF40-S User Manual

Benewake (Beijing) Co., Ltd

PREFACE

Dear users:

Thanks for choosing TF40-S product and it's our pleasure to help you with any technical question.

To have a better experience, please read this manual carefully. We try to include all common problems and hope you find the deployment and installation easy and fun.

This manual will guide you through the installation and operation process and show you some solution to common problems. It is still possible that you encounter some difficulties that are not included, please check our support service and don't hesitate to contact our technical support engineers or leave a message on feedback page of our official website.

Contact Information

Official website: en.benewake.com

TEL：+86-10-57456983

Technical questions，please contact：support@benewake.com

Consult sale information or request brochure，please contact：bw@benewake.com

Manufacturer

Benewake(Beijing) Co.,Ltd

3rd Floor, Haiguo Jiaye Sci-Tech Park, Haidian District, Beijing, China

Copyright

Warning

Since some electronic components of the module are exposed, and the ToF sensor is based on CMOS, it is vulnerable to ESD damage. Wearing anti-static gloves or anti-static wrest strap when handling the product. Do not touch the electronic components with hands or metal objects to prevent static electricity from damaging the module.

CONTENTS

1 Overview

1.1 Introduction

TF40-S is a high-precision ranging LiDAR module, based on ToF principle and built in TDC (Time-to-digital Converter) architecture, mainly used for different kinds of robots including vacuum cleaning robot, drone and intelligent household appliances. This product is easy to operate and install, and supports UART communication.

1.2 Accessory

Table 1 Accessories

No.	Type	Description
1	TF40-S	Rangefinder Module
2	Accessories (The actual shipping list shall prevail)	Connection Cable (5Pin interval 1.25mm，length 10CM)

1.3 Maintenance and cleaning

- Before turning on the product, please check whether the exposed window is clean. If it is dirty, clean it in time.
- After usage, check whether the optical device is polluted. If it is polluted, clean it in time.
- The product works in harsh environments for a long time, clean the optical elements regularly.
- Before regular cleaning, please disconnect the power supply. When the product is turned off, use cotton cloth to gently wipe the window, avoid repeated and unnecessary wiping to damage the window.
- For a deep cleaning of internal optical elements, please contact bw@benewake.com for professional support.

1.4 Disclaimer

- The warranty period of this product is one year. During this period, the company is responsible for repairing, replacing or compensating for the after-sales problems of the product itself.
- If there are after-sales problems caused by the product itself after the warranty, please provide the necessary proof to the company. The company will deal with the problem honestly and faithfully.
- The products must be purchased through formal channels, so that the company can trace the after-sales problems of the products.

1.5 Key Features

The key parameters of TF40-S are shown in the table below, in which the measurement range and accuracy are measured under the condition of diffuse reflection board (90% reflectivity). The field of view Angle is the theoretical value, but the actual Angle value has some deviation.

Table 2 TF40-S Key parameter list

Parameters		**Standard**
Product Parameters	Range	0.05-40m@90% reflectivity，0.05-20m@10% reflectivity
	Accuracy	±2mm
	Resolution	1mm
	Frame rate	5Hz
	Repeatability	1σ：<2mm
	Working Temperature	-10~50℃
	IP rate	/
Optical Parameters	Light Source	LD
	Central Wavelength	635nm
	Eye Safety	CLASS 2（EN 60825）

	FoV	<1mrad
Electronic Parameters	Power Supply	3.3V[1]
	Average Current	≤180mA
	Power Consumption	≤0.6W
	Peak Current	≤180mA
	Communication Level	LVTTL(3.3V)[1]
	Communication Interface	UART
Others	Dimensions	31mm*59mm*13mm（L*W*H）
	Shell	/
	Storage Temperature	-30~70℃
	Weight	10g±2g
	Cable Length	10cm

[1] *TF40-S is not 5V voltage tolerant. While interfacing LiDAR with micro-controller, please make sure that your controller's driving voltage and logical voltage are both 3.3V.*

1.6 Appearance and Dimensions

As shown in the following pictures:

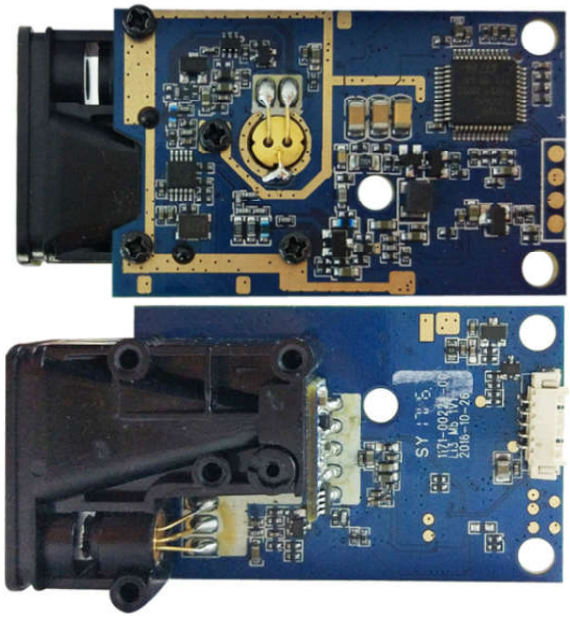

Fig.1 TF40-S Appearance Diagram

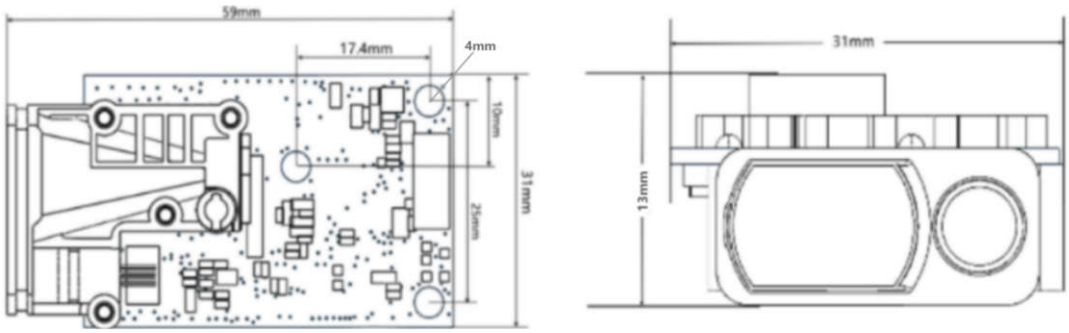

Fig.2 TF40-S Dimension Diagram（Tolerance：±2mm）

1.7 Applications

When use this product, please read the product manual and datasheet carefully, to ensure that the product is used within its rated specifications. Meanwhile, please comply with the following specifications:

1. The product is designed for these applications:

- Mobile/tablet/computer and other terminal devices
- Measuring tools
- Intelligent household
- Home robot
- Other consumer products

If the product is used without its rated specifications, please evaluate whether the reliability requirements of application are compatible with the product.

2. If the reliability and security requirements of application is strict, choose this product carefully, such as the following applications:

- Traffic control and safety equipment (planes, trains, cars, etc.)
- Traffic signal control
- Gas leakage device
- Rescue equipment
- Other equipment related to life safety and public safety

TF40-S is designed for consumer product, is not applicable to high reliability and high security scenarios.

1.8 Storage

- Store the product in an environment with a temperature of -20℃~85℃ and a relative humidity of ≤60% to ensure ventilation without the influence of corrosive gases.
- Please turn off the product and close the dust cover before storing the product, to keep the product clean.

If the storage time is over three months, have a work test before use to ensure that the product is in a normal status.

2 Installation and Usage

2.1 Notes

- Ensure that the installation environment and module lens are clean;
- Keep the module lens clean during usage, clean the dust, water and other contaminants with cotton in time;
- Do not touch the circuit board with your hands, wear anti-static gloves or anti-static wrest strap for operation;
- Any kind of debris between the module lens and the mounting surface may block the optical path and affect the measurement performance;
- Module is not suitable for long-term use in strong vibration environment. If installed in an environment with significant vibration, the front end should have a certain degree of soft fixing.

2.2 Outdoor using instructions

- The measurement capability of the module is significantly reduced in the outdoor daytime, especially in the sunlight. Therefore, it should be combined with a special reflective plate or reflective film. However, the reflection membrane may cause the signal to be too strong when measuring within 10 meters.
- The part of the lens of the direct sunlight module, or the Angle between the lens and the direct reflector of the laser beam is less than 45 degrees, may not be measured. Rain and snow can also make it impossible to measure.
- Whether indoors or outdoors, avoid reflecting surfaces that are mirror or translucent, unless specially used.

3 Interface and Communication Protocol

3.1 Interface Definition

The product internal and interface as the picture below shows,

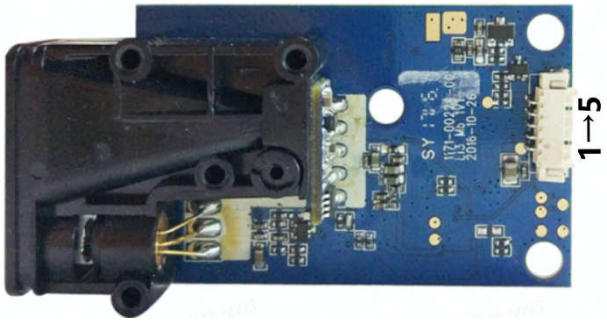

Fig.3 TF40-S interface PIN diagram

Table 3 TF40-S PIN functions

No.	PIN	Descriptions
1	VCC	3.3V power supply
2	GND	Ground
3	TTL_TXD	Transmitting
4	TTL_RXD	Receiving
5	EN_PWR	EN is set to high, the sensor is awakened and initialized EN is set to low, the sensor enters low power mode

3.2 Data Communication Protocols and Common Instructions

3.2.1 Communication Protocol

The default baud rate of the ToF module is 9600. When setting UART parameters, the Settings of the main control board also need to be synchronized. The parameters are set as follows:

Table 4 TF40-S Communication Protocol

Communication Protocol	UART
Baud rate	9600
Data Bit	8
Stop Bit	1
Parity Bit	None

When the main control board and the ToF module communicate directly with the UART, the transmitted data is Modbus protocol. The format of the Modbus read distance command of TF40-S is as follows:

Table 5 TF40-S Modbus commands protocol

Address	Functional Code	Register Address		Number of registers		CRC_low	CRC_high
01 (Default)	03	00	0F	00	02	XX	XX

TF40-S ranging data format:

Table 6 TF40-S Modbus data protocol

Address	Functional Code	Data Length	Dist_high	Dist_low	CRC_low	CRC_high
01	03	04	XX	XX	XX	XX

3.2.2 Command Instructions

TF40-S does not work on power by default, set EN pin to high level before distance measurement, the sensor is awakened and the hardware is initialized, and the sensor is ready to send the following response: 01 03 02 00 00 B8 44

After the measurement, set EN to low level and the sensor enters low power mode.

If you need to install the alignment, you can send the command to turn on the laser, and then send the command to turn off the laser after use. You can modify the baud rate of the serial port by following the command.

Table 7 TF40-S Configuration commands

No.	Configurable Items	Commands	Definitions
1	Trigger Mode	01 03 00 0F 00 02 F4 08	Single Measurement
		01 03 00 01 00 02 95 CB	Continuous Measurement（5Hz）
		01 03 00 0A 00 02 E4 09	Stop continuous measurement
2	Open Laser	01 10 00 03 00 01 02 00 01 67 A3	Use this command to turn on the laser if required.
3	Close Laser	01 10 00 03 00 01 02 00 00 A6 63	After turning on the laser, you can use this command to turn off the laser.
4	Serial Baud Rate	115200：01 10 00 00 00 02 04 00 01 C2 00 F3 0F	4800,9600,19200,38400,57600,115200 these 6 baud rates are supported. Change the baud rate enter this command at a correct baud rate.
5	Change Slave ID	01 10 00 0D 00 01 02 IH ILCL CH	IH,IL are the high and low bytes of ID. CL and CH are the low and high 8bit of CRC respectively.

3.2.3 Abnormal Data

3.2.3.1 Error Code

Table 8 TF40-S Error Code

Address	Functional Code	Abnormal Code	CRC_low	CRC_high
01（Default）	83（functional code + 0x80）	XX	XX	XX

Abnormal Code：

0x01：Function code error

0x02：Start address error

0x03：Register number error

0x04：Register value error

3.2.3.2 Abnormal Data

Table 9 TF40-S Abnormal Data

Address	Functional Code	Data Length	Register1	Register2	CRC_low	CRC_high
01	03	04	XX	XX	XX	XX

When an error occurs, registers 1 and 2 represent the error code, which is of the following types:

Table 10 TF40-S Exception Code

Error Code	Definitions
0xFF000000	Miscalculation, remeasure
0xFE000000	Accept the reflected light is weak or the measurement time is too long, the reflective surface should be more reflective, or use a cutting board, white paper, etc
0xFD000000	The target is too reflective. Don't aim at the bright light
0xFC000000	Measuring range exceeded, please measure within the distance of the instrument