TFmini Datasheet

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1. Main Product Characteristics

This product is based on ToF (Time of Flight) principle and integrated with unique optical and electrical designs, so as to achieve stable, precise, high sensitivity and high-speed distance detection.

Product Name	TFmini
Operating range	0.3m-12m
Maximum operating range at 10% reflectivity	5m
Average power consumption	0.6W
Applicable voltage range	4.5V-6V
Acceptance angle	2.3°
Minimum resolution ratio	1cm
Frequency	100Hz
Accuracy	1% (less than 6m), 2% (6m-12m)
Distance detection unit	cm
Wavelength	850nm
Size	42mm×15mm×16mm
Operating temperature	-20℃-60℃
Light sensitivity	70,000lux
Weight	4.7g
Communication interface	UART
Electromagnetic Compatibility(EMC)	EN 55032 Class B
Main applications	Drone altitude holding and terrain following Machine control and safety sensor Robot distance detection

Table 1 Product characteristics and applications

2. Electrical Characteristics

Item	Symbol	Typical value	Unit
Input voltage	DC	5	V
Average power	P	≤600	mW
Average current	I	120	mA
Serial port TTL voltage level	V_{TTL}	3.3	V

Table 2 TF_mini electrical characteristics

3. Optical Characteristics

Parameter	Symbol	Condition or description	Typical value	Unit
FOV	β		2.3	Degree
Resolution	Re	Sensitivity to distance change	1	cm
Wavelength	λ		850	nm

Table 3 Optical characteristics

4. Measurement Range and FOV

TFmini measurement range

1) Indoor conditions:

The object to be detected has 90% reflectivity and the effective detection distance is 12m;

The object to be detected has 10% reflectivity and the effective detection distance is 5m;

2) Outdoor conditions:

Under the general sunshine condition (with illumination of lower than 70klux), the effective detection distance is 7m;

Under the high sunshine condition in summer (with illumination of above 100klux) or the condition with outdoor black background board, the effective detection distance is 3m.

Note: All distance parameters are set under the opposite direction with the object to be detected.

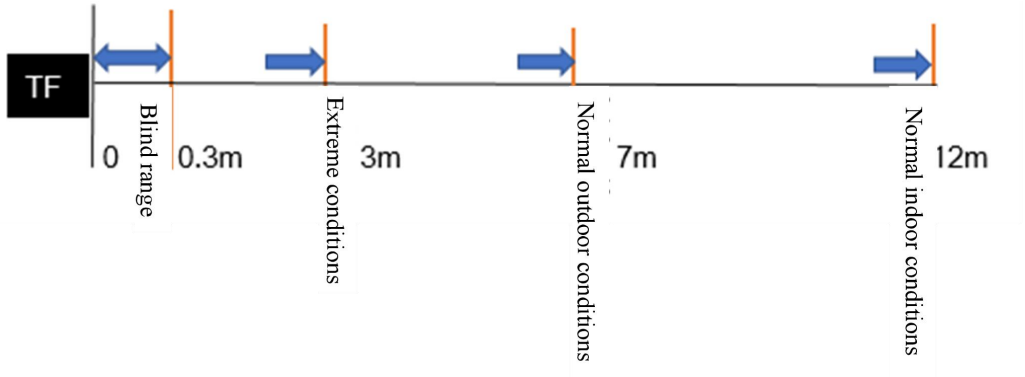

Fig. 2 Measurement range schematic diagram

TFmini FOV

The FOV of TFmini is 2.3˚, which determines the side lengths of different detection ranges of LiDAR (the detection range is similar to a square shape).

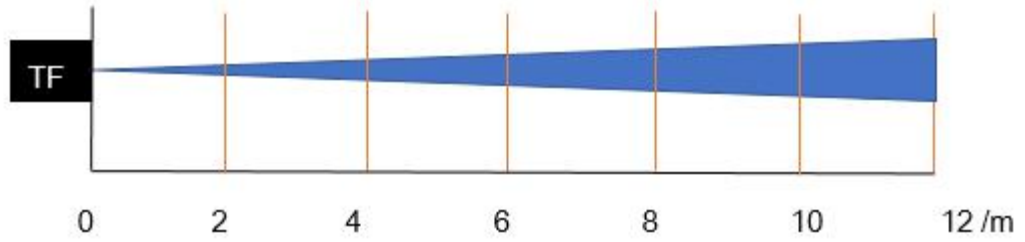

Fig. 3 Detection range (acceptance angle) schematic diagram

Distance/m	2	4	6	8	10	12
Detection range side length/mm	80	160	240	320	400	480

Table 4 Relationship between detection range and distance

Description: The distance in the table represents the vertical length between the detection object and the sensor, expressed in meters; the side length of detection range is expressed in millimeters. In general, only if the side length of the object to be detected is more than the detection range side length, the output data from LiDAR can be trusted; if the side length of the object to be detected is less than the detection range side length, the output data of LiDAR may be fluctuated and the error may be increased.

Note: The detection range side length is not equal to the object resolution ratio at the corresponding distance.

5. .Serial Port Data Communication Protocol and Line Sequence

The following section describes the connections and communications between TFmini and external devices, including the encoding format of the sending data, the communication protocol between the module and the external devices, the hardware line connection indications, and the related precautions.

Communication protocol	UART
Baud rate	115200
Data bit	8
Stop bit	1
Parity bit	0

Table 5 External communications

5.1 Standard Data Format of Serial Port

The module data is a hexadecimal output data; each frame data is encoded with 9 bytes, including 1 distance data (Dist); each distance data has corresponding signal strength information (Strength); the frame end is the data parity bit.

Byte1-2	Byte3	Byte4	Byte5	Byte6	Byte7	Byte8	Byte9
0x59 59	Dist_L	Dist_H	Strength_L	Strength_H	Int.time	Reserved	CheckSum_L

Data encoding interpretation	
Byte1	0x59, frame header, all frames are the same
Byte2	0x59, frame header, all frames are the same
Byte3	Dist_L distance value is a low 8-bit. Note: The distance value is a hexadecimal value, for example, Distance 1,000= 03 E8 (HEX)
Byte4	Dist_H distance value is a high 8-bit.
Byte5	Strength_L is a low 8-bit.
Byte6	Strength_H is a high 8-bit.
Byte7	Int.time Integration time
Byte8	Reserved bytes
Byte9	Checksum parity bit is a low 8-bit, Checksum = Byte1 + Byte2 + ... + Byte8, Checksum is the sum of the first 8 bytes of actual data; here is only a low 8-bit.

Table 6 Data encoding format and detailed description

5.2 Line sequence description

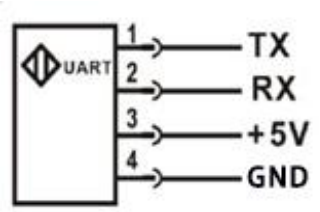

Fig. 4 TFmini line sequence description

TFmini line sequence is shown in "TF_mini line sequence description" in Fig. 4; generally, there are provided with the wiring terminals, among which, the green line corresponds to TX, the white line corresponds to RX, the red line corresponds to +5V, and the black line corresponds to GND.

6. Interface Description of Serial Port Upper Computer

The upper computer is currently supported with the windows system and applied for TF series of products output from Benewake (Beijing) Co. Ltd. in accordance with the serial communication protocol; the specific operations are detailed as below.

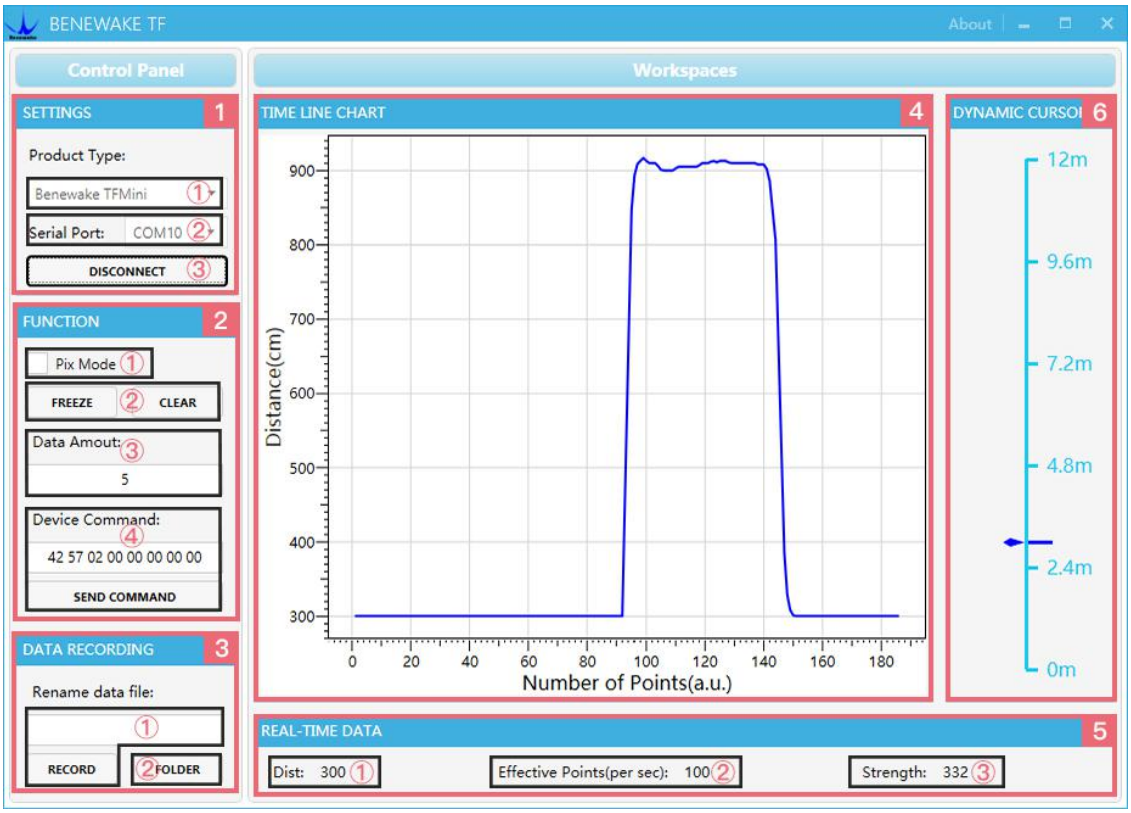

Fig. 5 Client Interface of Distance Measurement Demonstration in Windows

1. Product Type/ UART Control Zone

① Product Type (product type selection): connect the appropriate LiDAR type through the TTL-USB adapter plate on the computer. As shown in the figure, TF02 produced by our company is used, for which Benewake TF02 should be chosen.

② Serial Port (serial communication port): select the computer to identify the port number corresponding to the LiDAR.

③ CONNECT/DISCONNECT: click the [CONNECT] button to establish connection with the LiDAR ; click [DISCONNECT] button to cancel the connection.

2. Functional Area

① Pix Mode (pix mode selection): if Pixhawk Select the button to open the PIX mode; cancel the check button, resume the default output format

② FREEZE/CLEAR (freeze/clear button): clicking the [FREEZE] button may freeze the upper computer to facilitate the analysis on the image in [4]; clicking [CLEAR] button will clear the plotted curve in [4] and start plotting anew.

③ Data Amount (average of the total data amount): the default value is 5, that is, for every 5 points received by the upper computer, the average value of the 5 points will be taken for the output of a point. It can be modified as needed (in order to prevent blocking of the upper computer, the value had better be greater than or equal to 5). Enter the value and send the command by pressing Enter key on the keyboard.

④ Device Command (serial port command sending area): this window can be used to send hexadecimal serial port commands to TF to modify or set the functions. For details, please consult Benewake FAE Group.

3. Data Recording Area

① Record (data recording column): name the data to be saved in the text window. After the input is completed, press the Enter key and record the TF data using the [RECORD] button. The data will be saved in the named text file. Click the [FINISHED] button and the data recording will be ended.

② FOLDER (folder unfolding): press [FOLDER] button to unfold the folder where the data is saved.

4. Data Image Display Area: the upper computer draws a continuous distance measuring image based on the data received, with the vertical axis indicating the current distance measured and the horizontal axis indicating the number of valid points.

5. Real-Time Data Display Area

① Dist (measured distance value): in the default unit of cm.

② EffectivePoint (per sec): indicating the effective data that TF refreshes per second.

③ Strength (signal strength): In pix mode, the default Strength is 0 because there is no strength input.

6. Range scale: with real-time display of the detected distance value according to the current product type.

7. Product Size Specifications

The following is the module outline size drawing.

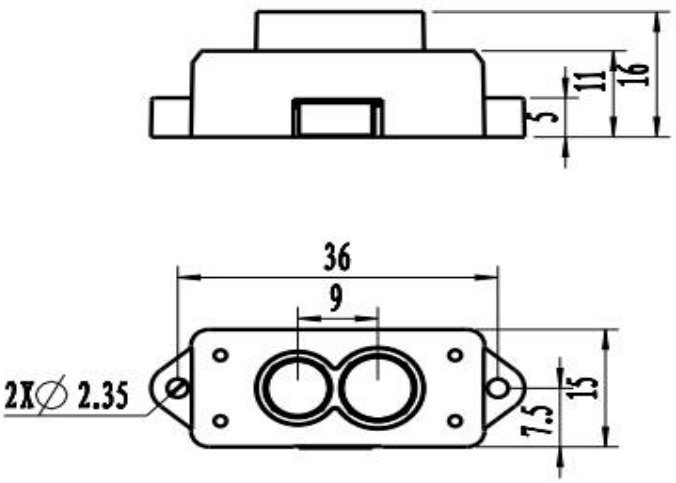

Fig. 6 TF_mini left module size drawing (unit: mm)

8. Certification

CE

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

9. Application Notice

- This product is a custom precision optical instrument and must be maintained by our engineers.
- Prevent dust or any other foreign matter from entering the lens; otherwise it may affect the light transmission.