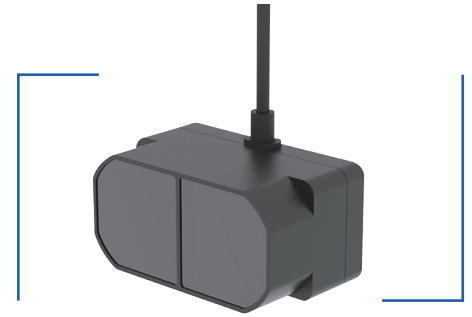


TFmini Plus is a milestone of Benewake in the process of promoting the cost-effective LiDAR. Apart from low-cost, small-size and low-power-consumption, TFmini Plus also improves the frame rate, introduces IP65 enclosures and optimizes various compensation algorithms. These new characters greatly expand the application fields and scenarios of TFmini Plus.



## ■ Technical Specifications and Parameters

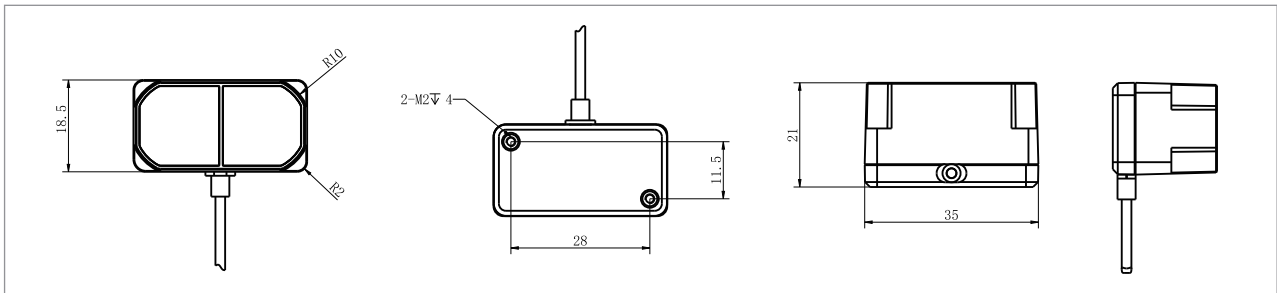
| Parameter                    |                        | Value                             |
|------------------------------|------------------------|-----------------------------------|
| <b>Product parameters</b>    | Operating Range        | 0.1m~12m <sup>①</sup>             |
|                              | Accuracy               | ±5cm@(0.1-6m)                     |
|                              |                        | ±1%@(6m-12m)                      |
|                              | Distance resolution    | 5mm                               |
|                              | Frame rate             | 1-1000Hz(adjustable) <sup>②</sup> |
|                              | Ambient light immunity | 70klux                            |
|                              | Operating temperature  | -20°C~60°C                        |
| Enclosure rating             | IP65                   |                                   |
| <b>Optical parameters</b>    | Light source           | LED                               |
|                              | Central wavelength     | 850nm                             |
|                              | FOV                    | 3.6° <sup>③</sup>                 |
| <b>Electrical parameters</b> | Supply voltage         | 5V±0.5V                           |
|                              | Average current        | ≤110mA                            |
|                              | Power consumption      | 550mW(low power mode 85mW)        |
|                              | Peak current           | 140mA                             |
|                              | Communication level    | UART,I <sup>2</sup> C,I/O         |
| <b>Miscellaneous</b>         | Material of enclosure  | ABS+PC                            |
|                              | Storage temperature    | -20°C~75°C                        |
|                              | Weight                 | 12g                               |
|                              | Wire length            | 30cm                              |

① Range based on a standard whiteboard with reflectivity 90% in indoor condition;

② Only frame rates meet the formula – 1000/n (n is Positive integer) can be set;

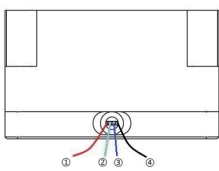
③ This is the theoretical number,the is some offset for the real number.

## Product Appearance and Structure

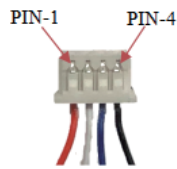


Dimensions of TFmini Plus module (Unit:mm)

## Wiring Guide



Wiring diagram of TFmini Plus



| No. | Color      | Corresponding PIN | PIN        | Function              |
|-----|------------|-------------------|------------|-----------------------|
| ①   | Red        | PIN-1             | +5V        | Power supply          |
| ②   | White      | PIN-2             | RXD/SDA    | Receiving/Data        |
| ③   | Blue/Green | PIN-3             | TXD/SCL/IO | Transmitting/Clock/IO |
| ④   | Black      | PIN-4             | GND        | Ground                |

## Communication Protocol

|                           |                    |
|---------------------------|--------------------|
| <b>Communication port</b> | UART               |
| <b>Default Baud rate</b>  | 115200(adjustable) |
| <b>Data bits</b>          | 8                  |
| <b>Stop bit</b>           | 1                  |
| <b>Parity</b>             | None               |

|                              |                  |
|------------------------------|------------------|
| <b>Communication port</b>    | I <sup>2</sup> C |
| <b>Max transmission rate</b> | 400kbps          |
| <b>Master/Slave mode</b>     | Slave            |
| <b>Default address</b>       | 0x10             |
| <b>Address range</b>         | 0x01~0x7F        |

## Data Format

The data frame contains 9 bytes, 2 bytes of frame head, 2 bytes of distance value (Dist\_L and Dist\_H), 2 bytes of signal strength (Strength\_L and Strength\_H), 2 bytes of temperature (Temp\_L and Temp\_H) and 1byte of checksum. All the data and commands are transmitted in hexadecimal format.

| Byte0-1 | Byte2  | Byte3  | Byte4      | Byte5      | Byte6  | Byte7  | Byte8    |
|---------|--------|--------|------------|------------|--------|--------|----------|
| 0x59 59 | Dist_L | Dist_H | Strength_L | Strength_H | Temp_L | Temp_H | Checksum |

| Data code explanation |   |
|-----------------------|---|
| Byte0                 | 0x59, frame header, same for each frame   |
| Byte1                 | 0x59, frame header, same for each frame   |
| Byte2                 | Dist_L distance value lower by 8 bits   |
| Byte3                 | Dist_L distance value higher by 8 bits  |
| Byte4                 | Strength_L low 8 bits   |
| Byte5                 | Strength_L high 8 bits  |
| Byte6                 | Temp_L low 8 bits (suit for version later than V1.3.0)                                |
| Byte7                 | Temp_H high 8 bits (suit for version later than V1.3.0)                               |
| Byte8                 | Checksum is the low 8 bits of the cumulative sum of the numbers of the first 8 bytes. |

## ■ Configurable parameters

| Configurable item       | Description                         | Factory setting |
|-------------------------|-------------------------------------|-----------------|
| Communication interface | UART,I <sup>2</sup> C and I/O       | UART            |
| Frame rate              | 1~1000Hz                            | 100Hz           |
| Baud rate setting       | 9600~921600bps                      | 115200          |
| Trigger source          | Measure automatically or by trigger | auto            |
| Reset to factory        | All of setting reset to factory     | /               |

## ■ Common configuration commands

### Convention

- (1) Little endian transmission has been applied in multi byte data,i.e. low byte of data will be saved in lower address
- (2) Downlink frame:data from master computer to LiDAR
- (3) Uplink frame: data from LiDAR to master computer or other terminal

### Frame Definition

| Byte        | 0    | 1   | 2  | 3-Len-2 | Len-1    |
|-------------|------|-----|----|---------|----------|
| Description | Head | Len | ID | Payload | Checksum |

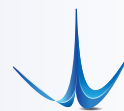
Head: frame head of command frame(0x5A)

Len: length of the frame, head and checksum included

ID: identifier code of command

Payload: data segment. Little endian format

Checksum: sum of all bytes from Head to payload. Lower 8 bits.



## Commands

| Commands                     | Downlink frame                 | Uplink frame                   | Description   |
|------------------------------|--------------------------------|--------------------------------|---|
| Obtain firmware version      | 5A 04 01 <b>5F</b>             | 5A 07 01 <b>01 02 03 SU</b>    | Represent V3.2.1  |
| System reset                 | 5A 04 02 <b>60</b>             | 5A 05 02 <b>00 SU</b>          | 00-Succeeded<br>01-Failed                               |
| Set update rate              | 5A 06 03 <b>00 00 SU</b>       | 5A 06 03 <b>00 00 SU</b>       | Set Frame rate<br>(1~1000Hz) <sup>①</sup>               |
| Set measurement unit         | 5A 05 05 <b>01 SU</b>          | 5A 05 05 <b>01 SU</b>          | 01-cm<br>06-mm  |
| Set baud rate                | 5A 08 06 <b>00 00 00 00 SU</b> | 5A 08 06 <b>00 00 00 00 SU</b> | Set baud rate <sup>②</sup>                              |
| Enable/Disable output        | 5A 05 07 <b>00 SU</b>          | 5A 05 07 <b>00 SU</b>          | 0-Disable<br>1-Enable                                   |
| Communication interface mode | 5A 05 0A MODE <b>SU</b>        | /                              | MODE<br>0: UART, 1: IIC                                 |
| Modify IIC slave address     | 5A 05 0B ADDR <b>SU</b>        | 5A 05 0B ADDR SU               | Change the I <sup>2</sup> C slave address(default 0x10) |
| Obtain data frame            | 5A 05 00 01 60                 | Data Frame(9 Bytes – cm)       | Only works in I <sup>2</sup> C Mode                     |
|                              | 5A 05 00 06 65                 | Data Frame(9 Bytes – mm)       |   |
| Restore factory settings     | 5A 04 10 <b>6E</b>             | 5A 05 10 <b>00 SU</b>          | 00-Succeeded<br>01-Failed                               |
| Save settings <sup>③</sup>   | 5A 04 11 <b>6F</b>             | 5A 05 11 <b>00 SU</b>          | 00-Succeeded<br>01-Failed                               |

Bytes with yellow undertone represents checksum. Bytes with blue undertone represents data segment.

① The default frame rate is 100Hz. The customized frame rate should be calculated by the formula:  $1000/n$  (n is positive integer). Data stability will decrease with frame rate increasing.

② Only standard baud rates are supported. When setting a high frame rate, a high baud rate is recommended to ensure data security.

③ Please always send the command of save settings when try to modify parameters of TFmini Plus, otherwise the settings will not take effect after power off.