Quick Implementation of TFmini-Plus-IIC and Computer Communication Operation Instructions

1. Overview

This document enables first-time users to quickly understand the tools and methods for conducting IIC communication tests, connect the LiDAR to the PC by consulting the corresponding instruction manual, and complete product testing under the IIC communication protocol by sending commands to obtain distance values and modify the slave address.

This document applies to the product model: TFmini-Plus (verify the product hardware version and firmware version before testing).

2. Test Preparation

2.1. Necessary Tools

Serial port testing tool (Serial Assistant), USB-UART converter, USBCOM2I2C converter[1], 4P DuPont Line, TFmini-Plus LiDAR.

2.2. Communication Protocol Switching

TFmini-Plus factory default communication protocol is UART serial communication. If you want to test IIC communication protocol, you need to convert the communication protocol by sending commands in UART communication mode. The specific operation steps are as follows:

Step 1: Connect TFmini-Plus to PC via USB-UART converter (any TTL-USB board with 3.3V/5V logical voltage can be used) as shown in Figure 1 (the TTL-USB board shown in the picture is manufactured by Benewake but you can use any TTL-USB board). Check whether the computer COM drivers are installed. If the board is not recognized by the computer, the drivers may not be installed, please install the driver[2].

Fig.1 USB-UART converter connecting TFmini-Plus-IIC to PC

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[1] https://fr.aliexpress.com/item/32830015255.html

https://www.ebay.com/itm/UsenDz-USBCOM2I2C-USB-serial-port-to-I2C-UART-to-I2C-COM-to-I2C-USB-to-I2C-/312761534249

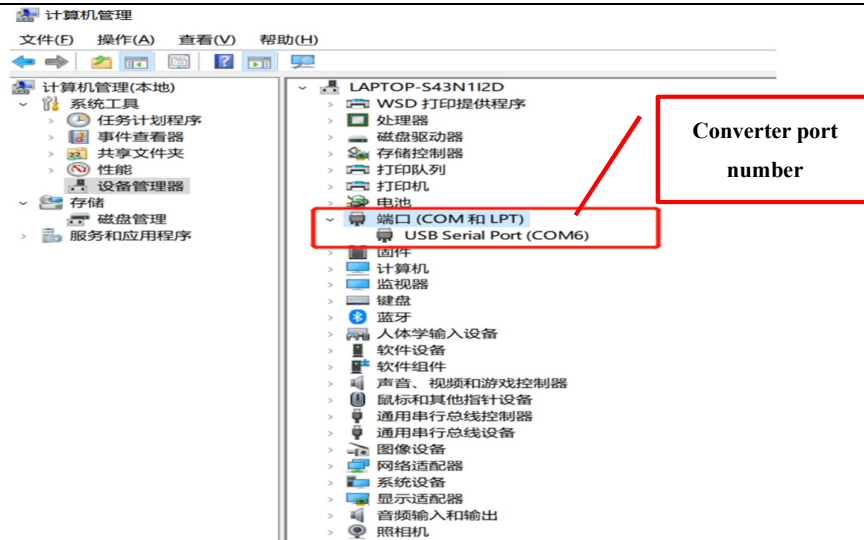[2] https://drive.google.com/drive/folders/1aWltEhSFPEp-iFsVmaRzotptOLwmhoA5?usp=sharing

Table 1 Line Sequence Description

Number	Colour	PIN	Function
1	Red	PIN-1	+5V
2	White	PIN-2	RXD/SDA
3	Green	PIN-3	TXD/SCL
4	Black	PIN-4	GND

Fig.6 USBCOM2I2C converter

Table 2 Description of the USBCOM2I2C converter IIC interface

Signal	Function	Explanation
SCL	Output	IIC Bus Clock
SDA	Input/Output	IIC Bus Data
GND	Power	GND
VCC	Power	3.3V output, support max. current 200mA
5V	Power	3.3V output, depends on USB port power capability

Fig.7 connect TFmini-Plus-IIC and USBCOM2I2C converter

Fig.8 USBCOM2I2C converter connecting TFmini-Plus-IIC to PC

3. Test Steps

3.1. TFmini-Plus-IIC Connecting with PC
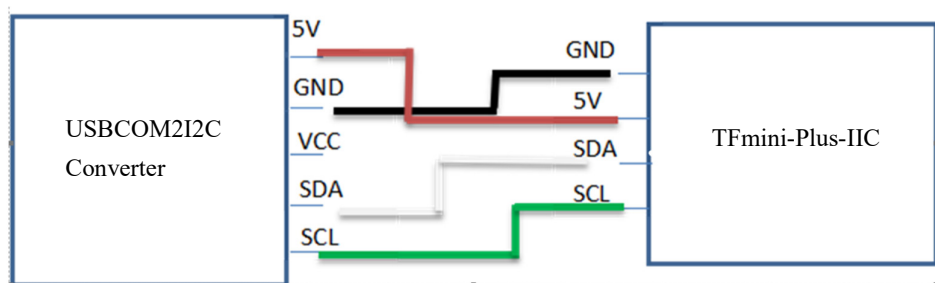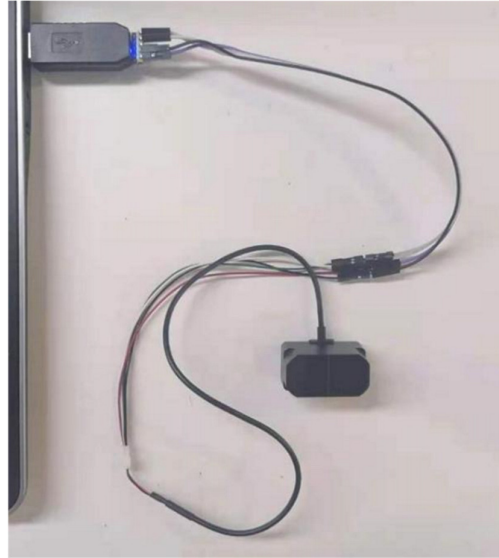
Connect the LiDAR to PC according to Figure 7 and check if the PC COM driver recognizes the converter *(Note: If the USBCOM2I2C converter is not recognized, please refer to the "USBCOM2I2C converter User Manual" to view the driver download address, download and install the driver)*.

Open the Serial Assistant, select the correct port number, baud rate: 9600, cancel the RTS option, no checksum (select "none" for checksum), and open the serial connection.

Unlike serial communication, IIC communication is initiated by the host, and the LiDAR as a slave can only passively send and receive data. After the host writes the configuration instruction frame to the LiDAR, it needs to wait long enough for the instruction to be processed before reading the feedback operation, the recommended waiting time is 100ms. Communication timings for TFmini-plus-IIC mode are as follows:
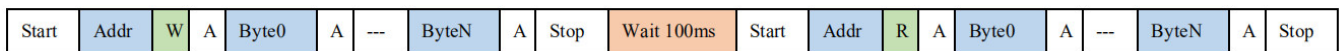
Start	Addr	W	A	Byte0	A	---	ByteN	A	Stop	Wait 100ms	Start	Addr	R	A	Byte0	A	---	ByteN	A	Stop

Fig.9 TFmini-plus IIC Mode Communication Timing

3.2. Get the Distance Value

The command to obtain the measured distance of TFmini-Plus-IIC via serial port is: **53 20 05 5A 05 00 01 60 50 53 21 09 50**. Send the command as shown in the figure below.

Command Explanation:

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0x53: S (start) command of the USBCOM2I2C converter, initiating the "start" signal.

0x20: Write operation (The IIC protocol specifies that the high 7 bits represent the address of the slave node; the lowest bit represents the read/write: 0 for write operation and 1 for read operation. The TFmini-Plus default slave address is 0x10 (HEX), and 0x10 in binary is 00010000. Since the higher 7 bits represent the address, first shift 00010000 one bit left to 00100000; because this instruction sends a "write" operation, the lowest bit is 0, i.e. 00100000, which is 0x20 in HEX).

0x05: Write 5 bytes of data.

5A 05 00 01 60: Get the distance value (command of TFmini-plus).

0x50: P (stop) command of the USBCOM2I2C converter, initiating the "stop" signal.

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0x53: S command of the USBCOM2I2C converter, initiating the start signal.

0x21: Read operation (the IIC protocol specifies that the high 7 bits represent the address of slave node; because 0x21 in binary is equal to (0010 0001) so 0010000 in HEX is equal to 0x10 which is the address of LiDAR, while the lowest bit represents the read/write: 0 for write operation and 1 for read operation. The TF02-Pro default slave address is 0x10 (HEX), and 0x10 in binary is 00010000. Since the higher 7 bits represent the address, first shift 00010000 one bit left to 00100000; because this instruction sends a "read" operation, the lowest bit is 1, i.e. 00100001, which is 0x21 in decimal).

0x09: Read 9 bytes of data.

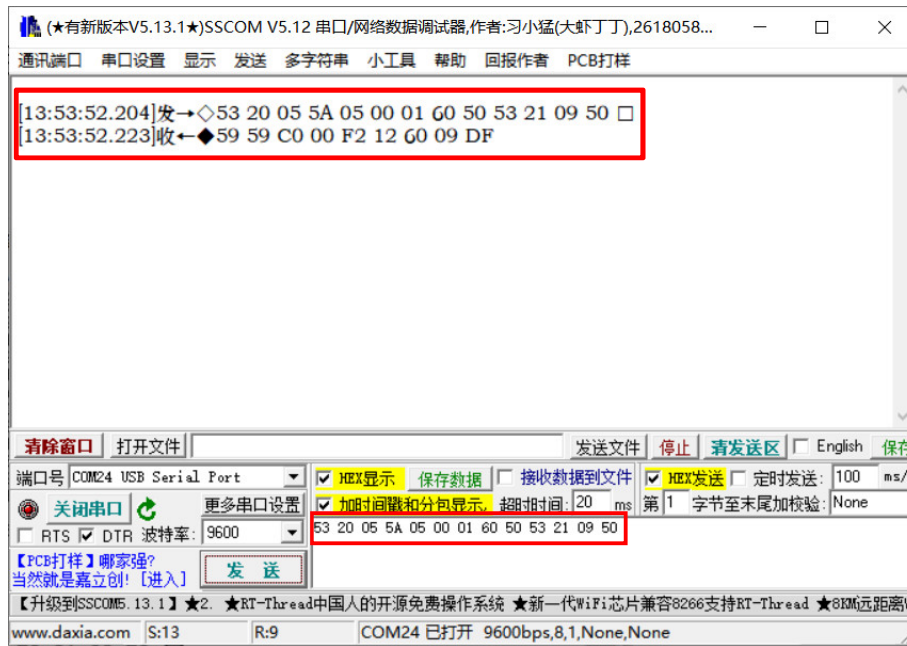**0x50**: P command of the USBCOM2I2C converter, initiating the "stop" signal.

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Fig.10 Acquisition of distance values

After sending the above command, the TFmini-Plus-IIC returns 9 bytes of data in the following format.

Table 3 Data frame 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
Explanation of data codes							
Byte0	0x59, Frame header(same for each frame)						
Byte1	0x59, Frame header(same for each frame)						
Byte2	Dist_L, Low octet of distance						
Byte3	Dist_H, High octet of distance						
Byte4	Strength_L, Low octet of strength						
Byte5	Strength_H, High octet of strength						
Byte6	Temp_L, Low octet of temperature						
Byte7	Temp_H, Low octet of temperature						
Byte8	The cumulative sum of the first eight bytes of data, taking the lower eight bits						

For example, the returned data: 59 59 A9 00 0F 3E 60 09 11. The interpretation of the returned data is explained as follows.

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0x59 0x59: Frame header.

0xA9: Lower 8 bits of the distance value.

0x00: Higher distance value 8 bits (distance value 0x00A9, 169cm in decimal).

0x0F: Signal strength value lower 8 bits.

0x3E: Signal strength value higher 8 bits (signal strength 0x3E0F i.e. 15887).

0x60: Chip temperature lower 8 bits.

0x09: Chip temperature higher 8 bits (temperature value 2400/8 - 256 = 44℃).

0x11: Checksum.

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3.3. Modify IIC Slave Address

The format of the command to modify the slave address is as follows. For example, to modify the slave address to 0x20, you need to send the command: **53 20 05 5A 05 0B 20 8A 50 53 41 05 50**.

Table 4 Command format for modifying IIC address

Function	Command	Correct return value	Factory configuration
Modify IIC_Slave_Addr	5A 05 0B ADDR SU	The same as the sent command	0x10

Command Explanation:

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0x53: S (start) command of the USBCOM2I2C converter, initiating the "start" signal.

0x20: Write operation.

0x05: Write 5 bytes of data.

5A 05 0B 20 8A: Modify the IIC slave address. To modify the slave address to 20, ADDR=20 (HEX).

0x50: P (stop) command of the USBCOM2I2C converter, initiating the "stop" signal.

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0x53: S (start) command of the USBCOM2I2C converter, initiating the "start" signal.

0x41: Read operation.

0x05: Read 5 bytes of data.

0x50: P (stop) command of the USBCOM2I2C converter, initiating the "stop" signal.

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Send the command as shown in the figure below. LiDAR returns 5A 05 0B 20 8A if the configuration is successful.
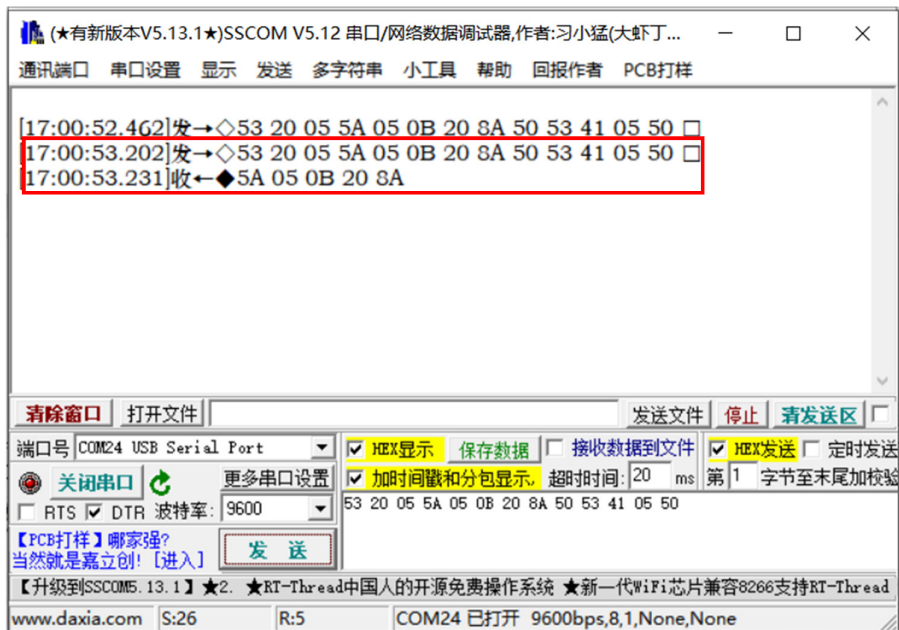
Fig.11 Modifying the IIC slave address and obtaining the range value

After modifying the address to 0x20, the command to obtain the distance value is: 53 40 05 5A 05 00 01 60 50 53 41 09 50. Refer to 3.2.2. for the explanation of the command meaning.

For more details, please refer to the *SJ-PM-TFmini-Plus A05* manual.