



Document Number: LF2016001-Test

## Test Description Using I<sup>2</sup>C – USB Converter and UI

For Liquid Flow Sensor LF2000 Series

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## Preface

This document contains two portions. The first portion is the description of the I<sup>2</sup>C – USB converter and its connection with LF2000. The second portion is the introduction of the User Interface (UI) program that is used to configure the sensor and obtain test data from the sensor.

## 1. I<sup>2</sup>C – USB Converter

### 1.1 Brief Description

The converter is as Figure 1. One end is for the USB port of a PC and the other end is for connecting with the sensor LF2000. It communicates between the PC and the sensor.

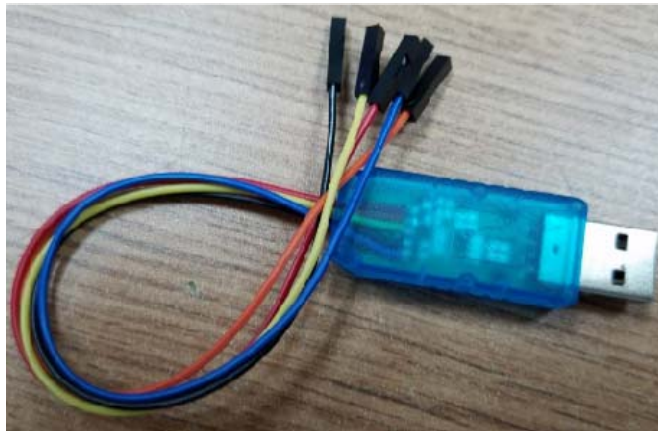


Figure 1.1: The image of the I<sup>2</sup>C – USB converter.

### 1.2 Wire Definition

The converter has five wires differentiated by colors. The black connectors on the wire end are chosen to mechanically match with the LF2000 pins. The definition of each wire is as Table 1.1.

Table 1.1: Converter color code and its connection with LF2000.

Wire color	To LF2000 Pin	Definition	Description
Yellow	1	SCL	I <sup>2</sup> C clock
Black	2	GND	Ground
Red	3	5V	Power supply of LF2000

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Blue	5	SDA	I <sup>2</sup> C data
Orange	N/A	3V	Reserved for other product

### 1.3 Sensor Pin Definition

The pin layout and definition of LF2000 are shown in Figure 1.2 and Table 1.2 respectively.

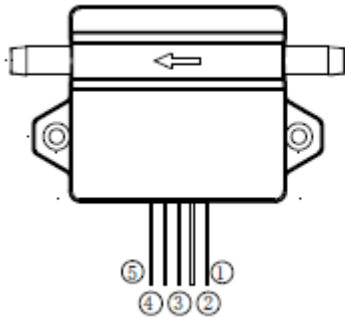


Figure 1.2: Pin layout.

Pin	Definition
1	SCL (I <sup>2</sup> C clock)
2	GND (ground)
3	Vcc (DC supply)
4	Vout (analog voltage output)
5	SDA (I <sup>2</sup> C data)

Table 1.2: Pin definition.

#### Serial Data (SDA) Pin

Serial Data Line (SDA) is bidirectional data line, SDA requires a pull-up resistor connected with VCC.

#### Serial Clock Line (SCL)

Serial Clock Line (SCL) is used to synchronize all data transferred over the I2C bus. It also requires a pull-up resistor connected with VCC.

#### Power Supply (VCC)

VCC range:  $3.6V \leq VCC \leq 6.0V$

## 2. The User Interface (UI) Program

### 2.1 Software Setup

Unzip the compressed file “TestStudioforI2C\_V0102\_LF2000.zip”, there will be an executable file “TestStudioforI2C\_LF2000.exe” in the folder. Doubly click it, a screen as Figure 2.1 will show.

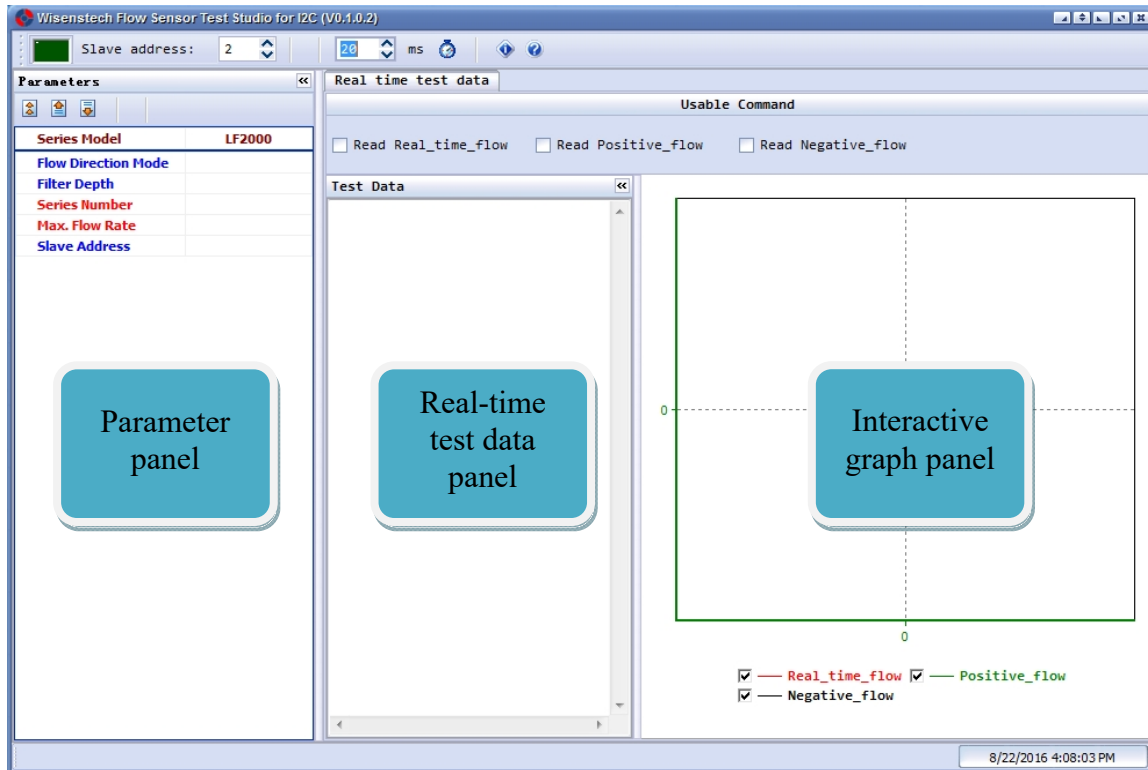


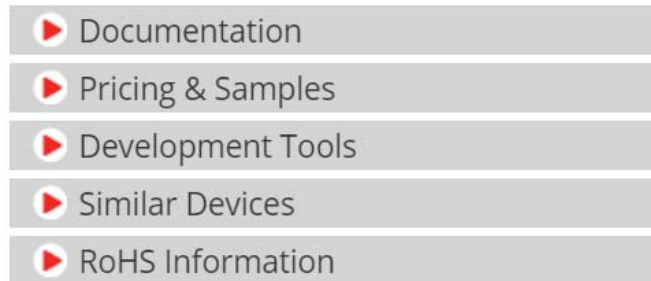



Figure 2.1: The main screen of the user interface program.

The small dark green window  at the upper left corner shows that it is not ready for communication yet. As soon as the converter is plugged into the computer, the dark green window will become light green  which means the converter is recognized by the computer and it is ready for communication. If the dark green window persists and Windows can't find the driver automatically, this can be fixed by manually install the converter driver. Follow below steps to install.

1. Go to <http://www.microchip.com/wwwproducts/en/MCP2221>.
2. Scroll down to the bottom of the page, lines as below image will be shown.

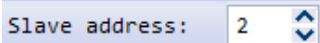


3. Click “Documentation”. Under "Software", choose “MCP2200/MCP2221 Windows Driver & Installer”, this will start to download the driver package "MCP2221 Windows Driver 2014-10-09.zip".
4. Once the download is finished, unzip it, then click folder "Driver Installation Tool". If the computer system is 32-bit, then enter folder "x86", run the application file in the folder. Use folder "x64" if the computer system is 64-bit.

After the installation, re-open the file “TestStudioforI2C\_LF2000.exe”, the light green window  will be shown.

### 2.2 General Introduction

In Figure 2.1, there are mainly three panels on the screen. They are parameter panel, real-time test data panel and interactive graph panel. They will be described in detail in the following sections.

The  right next to the green window shows the device address (also called slave address) at power up. The default address from manufacturer is 2. Refer section 2.3.3 for more details about slave address.

### 2.3 Parameter Panel

The parameter panel is shown as Figure 2.2. Some of its operations are shown in Figure 2.2 as well. There are two types of parameters differentiated by colors. The ones in blue can be changed by users. The red ones are for manufacturer.

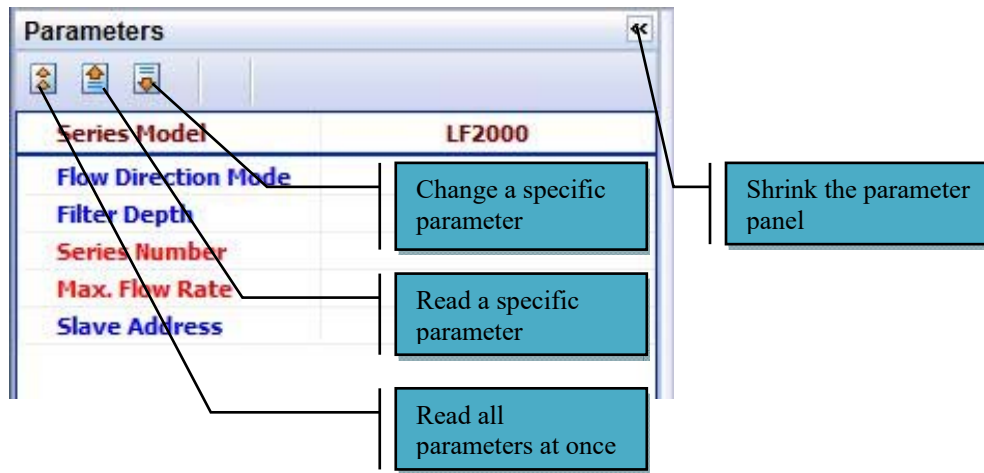




Figure 2.2: Parameter panel and its operations.

### 2.3.1 Flow Direction Mode

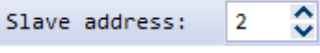
There are three modes for the sensor's flow direction: positive direction (parameter 0), negative direction (parameter 1) and bi-direction (parameter 2). When sensor is at positive direction mode, only positive direction flow rate can be read, and negative direction flow rate is always 0; and vice versa for the negative direction. When sensor is at bi-direction mode, flow rate of both directions can be read. When the number is positive, the flow is in positive direction; when the number is negative, the flow is in negative direction. Positive direction is defined as the arrow on the sensor enclosure. To change the value of the flow direction mode, simply input the value into the space behind the parameter, then hit "enter" from the keyboard, or click  button.

### 2.3.2 Filter Depth


The value of the filter depth is between 0 ~ 256. When filter depth is equal or less than 2, no filtering is applied. The larger the filter depth value is, the more stable the measurement (reading of flow rate) is, but the response time is slower. To change the value of filter depth, simply input the

value into the space behind the parameter, then hit “enter” from the keyboard, or click  button. Follow the instruction if it prompts. Note: early models of LF2000 don't have this feature.

### 2.3.3 Slave Address

The I<sup>2</sup>C interface of the LF2000 sensor adopts the slave-master mode, making it easy to establish connection and simplify the commands. The slave address is always an even number between 2 and 254, i.e., totally there are 127 available slave addresses. Multiple LF2000 board can be configured as a single-master multi-slave bus for multi-device communication, provided that each board (i.e., slave board) has a unique address. The default address is 2. To change the slave address, use the same way as changing other parameters. After the successful change of the slave address, the slave address window at the upper left corner as  will be automatically changed to the new address to maintain successful communications. The new address will be remembered by the program so that when it is started next time the new address will be shown in the slave address window.

### 2.4 Real-time Test Data Panel

To read flow rate from the sensor, one of the usable commands have to be checked. Then set the data interval from the space before the clock , hit the clock button to start automatic data acquisition. The minimum interval is 10 ms and the maximum is 5000 ms. Note: the data interval here is only a guidance, it can't be used to calculate the exact time information.

Right click any area of the data panel will allow users to save the date, calculate the average as well as delete all data. The data is saved as the TXT format.

### 2.5 Interactive Graph Panel

The graph of the data will be shown in the graph panel. It is a plot of the data from the data panel. The horizontal axis is the data point. It doesn't necessarily contain time information. Only the parameters that are checked at the graph bottom are plotted. Figure 2.3 shows a plot of two checked parameters Real\_time\_flow and Positive\_flow.

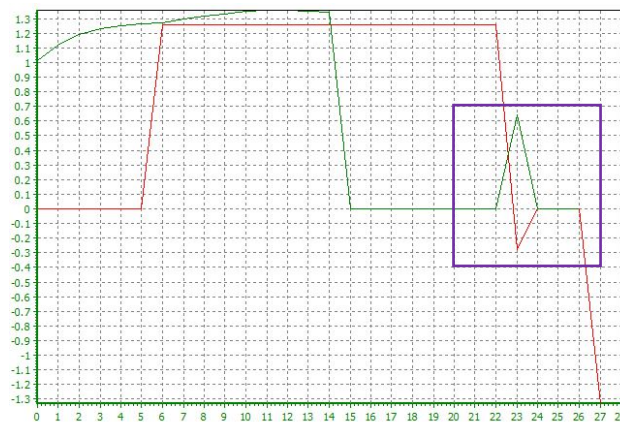


Figure 2.3: An example of the plot in graph area.

## 2.5.1 Zoom In and Zoom Out

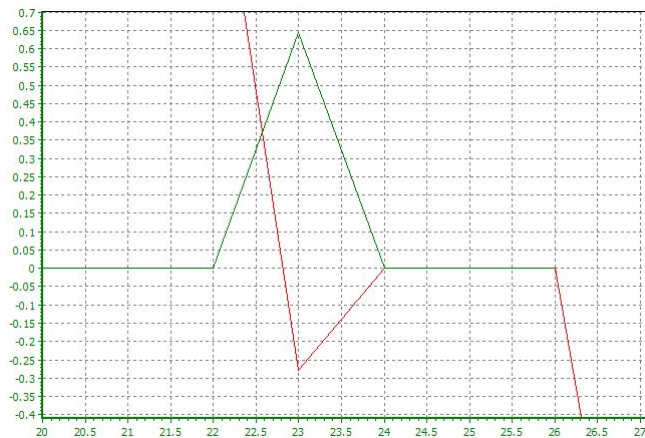
To see the details of certain area on the graph, simply hold mouse to draw a rectangular from **left to right** on the interested area, the rectangular will be expanded onto the entire graph area. Figure 2.4 shows an example.

To **zoom out**, simply draw any rectangular from **right to left**.



(a) Select an area to zoom in as the purple rectangular.





(b) The purple rectangular area in (a) is zoomed in.

Figure 2.4: Demonstration of zoom in.

## 2.5.2 Calculate Average

Right click any area of the graph panel, a few options of operation will show up. Choose “Calculate Average”, a window will pop up with the average values of parameters checked. The average of Figure 2.4 (b) is as Figure 2.5.

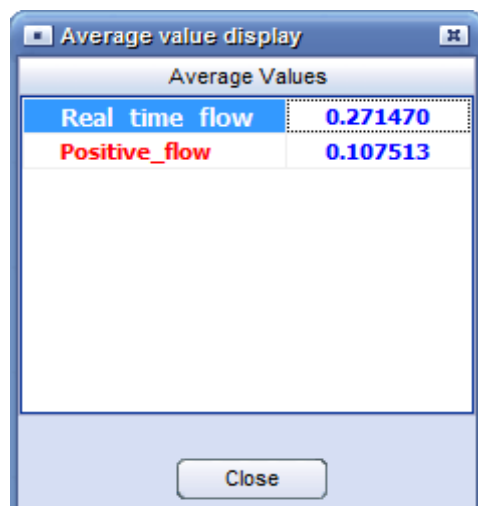


Figure 2.5: Average window of Figure 2.4 (b).

Note: this operation is to calculate the average of the parameters checked of the selected **horizontal** data period, which means even some data period on vertical scale is not shown on the graph, the

average of this data period will still be counted. This feature is very useful in drawing rectangular when the curves spread very widely since only the horizontal of the rectangular need to be correct.

### 2.5.3 Save the Graph

Right click any area of the graph, users will be able to save the graph as a picture file in JPG format. Only the graph on present screen will be saved. This feature allows users to save different zoomed areas.