

## D-Flow demo controller user's guide

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### 1 Introduction

This users guide is intended to be used with the D-Flow Demo Engineering kit. The kit includes a flowmeter body complete with the electronics and interface for connection to a PC. The electronics includes a D-Flow UFO2 ASIC programmed with a software for flow measurement.

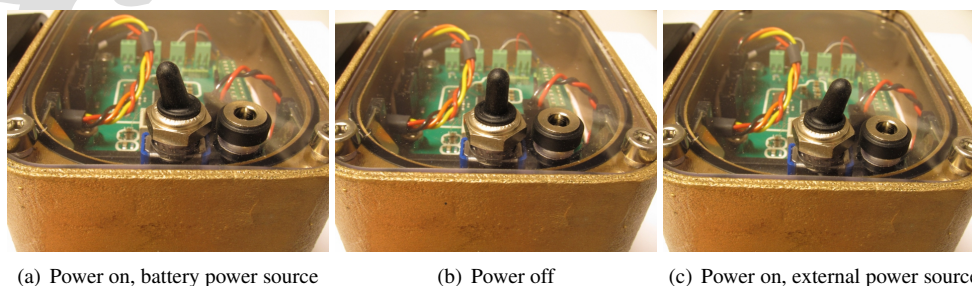
The flow meter is connected to a PC via USB serial interface and controlled by D-Flow Demo Controller Software. This user guide is intended to use with D-Flow Demo Controller Software version 2.0.

#### 1.1 Operation system requirements

The D-Flow Demo Controller software will run under Windows OS only.

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(a) Power on, battery power source

(b) Power off

(c) Power on, external power source

Figure 1: The power switch on the D-Flow evaluation unit.

## 1.2 Setup

### 1.2.1 Hardware

Mount the flow meter in the desired flow path. Preferably the flow path should be easy to degauss, especially for zero flow measurements.

The flow meter can be powered by the internal battery or an external power source. The power source is chosen with the power switch on top of the flow meter as illustrated in fig. 1. The external power source is connected to a contact on the top of the flow meter, which is of the EIA RC-5320 class 2 standard. The positive end should be connected to the center pin of the contact. If a cable is supplied with the flow meter, the strand that is marked with white is the positive one. The absolute maximum voltage from the external power source is 15V, but we recommend a maximum voltage of 12V and a minimum voltage of 4V.

### 1.2.2 Software

The flow meter will be controlled with the D-Flow Demo Controller Software on a PC. Communication between the PC and the flow meter will be done by USB/serial communication.

Start by connecting the cable from the flow meter to the USB on the PC. Use the device manager on the PC to find out which COM-port that is used. The USB-cable must be connected to the computer before the D-Flow Demo Controller Software is started.

Open the D-Flow Demo Controller Software and power up the flow meter. In the upper left corner of the software are the communication settings. Choose the COM-port to use and set baud rate to 57600. Open the COM-port by pressing the "Open COM port"-button.

If the correct COM-port is not shown, try to rescan the ports by pressing the "Scan ports"-button.

### 1.2.3 Default values

If an .xml-file with default values has been delivered with the D-Flow Demo Engineering Kit this should be loaded into the program as described in chapter 6.2 'Load settings'.

## 2 Zero flow calibration

Due to differences in signal paths the delays in the transit times are unbalanced. To compensate for this a zero flow calibration can be performed. It is done in the following way:

- Select correct flow meter size from the first drop-down menu.
- Select which type of measurement to use from second drop-down menu. This should be the same as the one the flow meter is set up for. Press 'next' button.

- In the zero flow calibration area, choose how long the zero flow calibration should be run. The default is 60s, but a shorter time period could be sufficient. Also input the fluid temperature in degrees Celsius. The accuracy of the temperature will influence the accuracy of the dsos.
- Make sure that the flow meter has been powered down since the last measurement or zero flow calibration.
- Press the 'start' button in the zero calibration area and wait for the zero flow calibration to finish.
- When the calibration is finished the calculated dzc and dsos is shown in the data grid on the right hand side. dzc should be a couple of  $\pm 100\text{ps}$  and dsos should be about  $1\mu\text{s}$
- Power down the flow meter.

The calculated dzc and dsos will be used when doing calculations during measurements.

### 3 Troubleshooting

For troubleshooting purposes it is possible to do AGC and HFC manually. Another troubleshooting possibility is to toggle the sel\_bp function. This is done in the graph tab, in the rightmost section.

#### 3.1 AGC

Choose in which direction to do the AGC, standard or reverse.

Do the AGC by pressing the 'Do AGC'-button. This will generate a pop-up window with the current AGC-values.

#### 3.2 HFC

Do the HFC by pressing the 'Do HFC'-button. This will generate a pop-up window with the current HFC-value.

#### 3.3 Sel bp

The sel\_bp function can be toggled by setting the value to 0 or 4 and then press the 'OK'-button. Setting the value to 4 makes it possible to read the signal on bp<0:1>. The signal is accessible by opening the electronics box and connect an oscilloscope to the bp<0:1> pins on the electronics board. Setting the value to 0 turns off this function.

### 4 Flow measurement

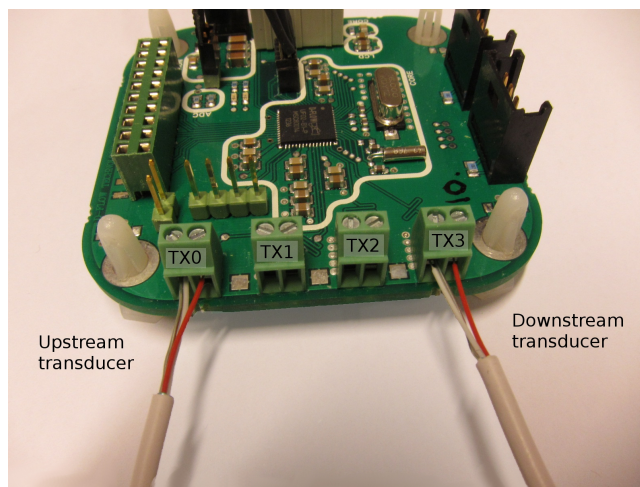
There are three different ways of doing measurements with the D-Flow Demo Controller Software. All three different ways are also possible to do in a power save mode.

In the middle panel of the D-Flow Demo Controller Software choose flow meter size, either one of the preset D-Flow flow meter sizes, or if a custom flow meter size is used, the 'custom size' option. If the 'custom size' option is chosen the LEN and DIA params in the data grid on the right has to be set. LEN is the distance between the two transducers. DIA is the flow meter diameter in the flow between the transducers.

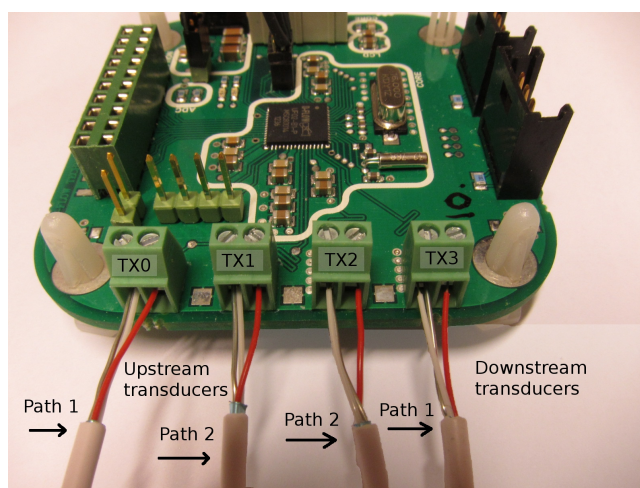
When the flow meter size is chosen, choose the desired measurement mode in the second drop down menu and press the 'next' button. There are two different measurement modes for one path flow meters and three measurement modes for two path flow meters. The differences between different measurement modes is how the transmitting and receiving transducers are set up.

**Measurement mode 1** The upstream transducer is connected to channel tx0 and the downstream transducer to channel tx3. Channel tx1 and tx2 is not used. See figure 2(a).

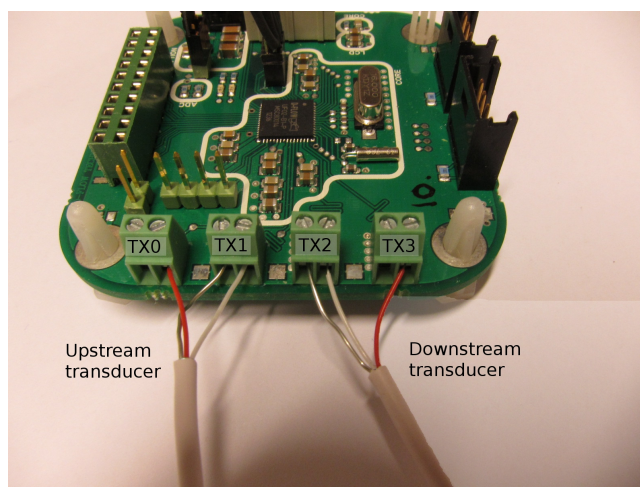
**Measurement mode 2** This mode is only possible to use when having a two path flow meter. The transducers from path 1 are connected to channels tx0 and tx3. The transducers from path 2 are connected to channels tx1 and tx2. See figure 2(b).



(a) Measurement mode 1



(b) Measurement mode 2



(c) Measurement mode 3

Figure 2: How to connect the transducers for different measurement modes.

**Measurement mode 3** The upstream transducer is connected to channel tx0 (positive) and tx1 (negative) and the downstream transducer is connected to channel tx2 (negative) and tx3 (positive). See figure 2(c).

In the next step different parameters for the flow measurement should be set.

**LOOPC** Number of sing around loops to be used in measurement. The measurement result will be an average of LOOPC measurements.

**smark** The time after the excitation before the signal is expected. If powersave mode is used, the amplifier is turned of during this time.

**sspace** During this time after smark the signal is expected.

**AGC** The AGC of stage one can be done automatically or manually. If it is desired to do it manually, untick the checkbox and set the R1 and Gm1 values to use.

**AGC stage 2** To control the AGC stage 2 the parameters A2 and R2 can be set.

**PTRIG** The values of PTRIG, PTRIG\_LOW and PTRIG\_HIGH set the peak trigger levels.

After all settings are done, press next twice to get to the 'Measurement'-tab. Here, press the 'start measurement'-button to start a measurement. If a measurement or zero flow calibration has been done, make sure that the power to the meter has been broken before next measurement can be done

When the measurement is done, press the 'stop measurement'- button. Also, break the power to the flow meter.

## 4.1 Graph settings

In both 'Settings' and 'Measurement' tabs the plots to show during measurement can be chosen. This choice is for the graph only, all data will be saved and stored as mentioned in section 5 regardless of which data that is plotted on the graph.

**Transit times** The transit times in both directions.

**Velocity** The calculated flow velocity.

**Volumetric flow rate** The calculated volumetric flow rate.

**Accumulated flow** The accumulated flow volume since the start of the measurement.

**Running average** If the Velocity and/or Volumetric flow rate is plotted this choice will show a running average of those values. The numbers of values the averages is calculated over is set in the corresponding numerical box.

The volumetric flow rate and accumulated flow can be plotted in several units. The unit can be chosen in the 'Settings'-tab anytime before or during measurement.

### 4.1.1 Resolution of y-axis

When a value is choosen to be plotted the corresponding settings box for the same value is enabled (true for transit times, velocity and volume flow only). Before a measurement is started, one can choose between fixed or scalable resolution.

**Fixed** The graph will be plotted with the resolution shown in the corresponding box. The resolution can be changed by changing the value in the box and pressing 'rescale'-button.

**Scalable** The resolution will be changed during plotting if the current range is too small. The resolution can also be manually changed as in the same case as with fixed resolution. However, if the transit times are plotted and the choosen range is smaller than the difference between the two transit times, the scale will be changed to a sufficiently large enough one.



#### 4.1.2 Resolution of x-axis

The time resolution can be set in the 'Resolution, X-axis' section at the bottom/middle portion of the 'Measurement' tab. This selects how much of the signal that is shown. The default resolution is 1s/div, which gives a total plot of 20s.

## 5 Output

When doing measurements a result file will be produced. These files are stored in a folder named 'result', placed in the same folder as the software. The resultfiles are named with the starting time of the measurement. This result-file is a .txt-file where the measured values are stored. The values that are stored are:

- Error status. See more below.
- Data package number. The data packages from the flow meter are numbered sequentially.
- Amplification
- Hfconst
- Transit time in upstream direction
- Transit time in downstream direction
- Calculated velocity
- Calculated volume flow
- Accumulated volume
- Fluid temperature. This temperature is calculated from the measured speed of sound. The accuracy of the temperature is dependent on how accurate the input temperature were when doing zero flow calibration.

The velocity, volume flow and accumulated volume will be saved in the current plotting unit. If the unit is changed during a measurement this will be written in the result file.

### 5.1 Error status

The error status indicates if there were any error during communication between the flow meter and the software. The following values are possible:

0	Everything is ok.
1	One or more data packages are missing. When calculating accumulated volume it is assumed that the volumetric flow has been constant during the missing data packages.
2	No package is missing, but the package has arrived at least one second too late. Since no package is missing, no adjustments are done when calculating accumulated volume.
3	A combination of error 1 and 2. Accumulated volume is handled as when error 1 arises.

## 6 Settings files

### 6.1 Save settings

Every time a measurement is run, the current settings are stored in an xml-file. The xml-file is stored in a folder named 'configFiles', placed in the same folder as the software. The settings files are named with the starting time of the measurement.

The settings are saved automatically when the measurement is started. It is also possible to manually save the settings if needed. It is then possible to choose location and file name for the settings-file. The save button for settings files is located in the lower left corner of the 'settings' tab.

## 6.2 Load settings

It is possible to reload settings-file to the program. On the 'settings' tab, the load button for settings files is located in the lower left corner. Use it to choose the wanted settings-file, which will be loaded to the software.