



# *Universal Data Logger*

## **Operation and Maintenance Manual**





# *Universal Data Logger*

## **Release History**

Version 1.0, February 2022

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## **1 PREFACE**

BPC Instruments AB (BPC) is a privately held company and market leader in the area of advanced control technologies for the commercial biogas industry, providing technologies and services that support the efficient design and operation of biogas plants & processes. The company was founded in 2006, bringing to market more than 15 years of industry leading research in the area of instrumentation, control and automation of anaerobic digestion processes.

At the end of 2009, BPC launched the Automatic Methane Potential Test System I (AMPTS I), a revolutionary product in the area of on-site lab equipment for methane potential analysis. The number of users of AMPTS I grew quickly and today there are users in more than 40 countries, located in the Americas, EMEA, and Asia Pacific regions. In April 2011 an updated version of the AMPTS was made commercially available and at the end of 2012 the BioReactor Simulator (BRS) was introduced to the market. As of January 2013, a new instrument ( $\mu$ Flow) for measuring ultra-low gas flows with high precision has been offered to the market.

The Universal Data Logger is a PC-based automatic data logger system developed by Bioprocess Control containing both hardware and software. This data logger system features a plug-and-play signal connection and an easy-to-use software program. It supports automatic data acquisition for up to 8 standard analogue input signal channels (4-20 mA). As a default, all 8 channels are designed for supporting passive analogue signals. However, one or multiple channels can be customised for supporting active analogue signals as well. Users can define the types of process signals, e.g. "Gas Flow", "pH", "Temperature", "Methane Content" and customer self-defined signal "Custom". Users can also define the scale for each channel. This provides a great flexibility for setting up an automatic data acquisition system for a wide range of on-line sensors with little effort. Other features include real-time signal and historical trend display, as well as report generation with four different time intervals, e.g., 5 minutes, 15 minutes, hour and day.

## **2 GENERAL INFORMATION**

Anaerobic biodegradation processes are gaining in interest among industry and local governments, due to their ability to produce energy and reduce sludge yields.

Process parameters such as gas flow rate, pH, methane or carbon dioxide concentration in the raw biogas represent key indicators for evaluating the anaerobic digestion process performance. For laboratory and small pilot-scale experiments, there is an increasing demand for implementing on-line real time sensors and automatic data acquisition for studying the dynamic behaviour of anaerobic digestion and other biological fermentation processes. Often data acquisition systems for laboratory and small pilot-scale experiment studies are designed and constructed in-house for each individual case, which leads to long development time, high cost and unreliable systems due to lack of sufficient test and validation.

The Universal Data Logger is a PC-based automatic data logger system developed by Bioprocess Control containing both hardware and software. This data logger system features a plug-and-play signal connection and easy-to-use software program. It provides a great flexibility for setting up an automatic data acquisition system for a wide range of on-line sensors with no time and little effort.

### **3 DELIVERY CHECKS**

At delivery, unpack and check that the contents match with what is listed below in the Section “Box Content”.

If the packaging or the equipment is broken or damaged at delivery, please:

- a) Document and take photos of the parts and packaging.
- b) Inform the transport company at the time of delivery.
- c) Make sure that the transport company documents the incident.
- d) Inform the seller of the incident.

#### **3.1 Box Content**

See also Chapter 7 (Equipment Description) for pictures of included parts.

1 Universal Data Logger

1 Ethernet cable

1 power adapter (input 100-240 V ~ 50/60 Hz, output 24 V DC / 0.5 A or higher)

1 USB memory with the Universal Data Logger Software

1 manual



## 4 PRE-COMMISSIONING

The following items are not included in the delivered Universal Data Logger, however they will/may be required to operate it:

- Additional wall socket adapters (plugs/contacts). The ones supplied are according to European, US or UK standards, depending on original purchase order.

## 5 QUALITY RULES AND RECOMMENDATIONS

- The product guarantee provided corresponds to the guarantee stipulated on the confirmed product order form and shipping documentation.
- Only the parts delivered with the product can be used with the system in order to guarantee the quality and performance of the product.
- BPC reserves the right to correct any possible text and image errors as well as changes to technical data in this manual.
- Always handle the Universal Data Logger with care, as it may be sensitive to shock.
- **Warning:** Make sure to connect devices with **active** analogue output signals to a channel that has been **designated for active** analogue signals. Similarly, make sure that devices with **passive** analogue output signals are connected to a channel **designated to passive** analogue signals. Connecting them in **any other way may cause damage** to electronic components in the Universal Data Logger, which will not be covered by the product guarantee.

### BEFORE GETTING STARTED

- Read this manual before installing and using the equipment.
- Keep the instruction manual for future reference and make sure it is easily available for people who regularly use the Universal Data Logger.
- For any questions regarding use of the  $\mu$ Flow Gas Flow Meter with the Universal Data Logger, please refer to the  $\mu$ Flow Gas Flow Meter Operation and Maintenance manual.

## 6 SAFETY CONSIDERATIONS

- Always be cautious when handling electrical devices close to water and other liquids.
- **Warning:** Make sure to connect devices with **active** analogue output signals to a channel that has been **designated for active** analogue signals. Similarly, make sure that devices with **passive** analogue output signals are connected to a channel **designated to passive** analogue signals. Connecting them in **any other way may cause damage** to electronic components in the Universal Data Logger.

## 7 EQUIPMENT DESCRIPTION (DESIGN/FUNCTION)

### 7.1 Hardware

The PC-based Universal Data Logger consists of a hardware module controlled by an easy-to-use software program. The hardware module has 8 plug & play terminal connectors that provide connections for 8 analogue input channels. Each channel has an AI plug & play terminal to which you can connect a current signal. The module has a common terminal, COM, which is internally connected to the isolated ground reference of the module.

As a default, all 8 channels are designed for supporting **passive analogue signals**, which are used with the  $\mu$ Flow Gas Flow Meter and standard temperature probes. However, one or multiple channels can be **customised for supporting active analogue signals**, i.e. sensors that require their own power source. Such sensor devices may include pH measuring systems, oxidation-reduction potential (ORP) systems, gas composition sensors for CH<sub>4</sub> and CO<sub>2</sub>, etc.

The main characteristics of the hardware module are presented below:

- 8 analogue current input channels
- Standard 4 to 20 mA input ranges
- Each channel can individually be set to a parameter from a selection of five. (Gas Flow, pH, Temperature, Methane Content or Custom.)
- Adjustable scale setting for each channel in the software interface
- 16-bit resolution, 200 kS/s aggregate sampling rate
- Indoor application only

## 7.2 Universal Data Logger Software

The Universal Data Logger Software is needed in order for the Universal Data Logger hardware to work with a PC. It is delivered on a USB memory together with the Universal Data Logger hardware. Please notice that the Universal Data Logger Software is delivered with a license control and can only work together with the Universal Data Logger hardware delivered at the same time.



## 8 OPERATION

### 8.1 Before Start up

#### FIRST TIME CONNECTING AND SETTING UP THE NETWORK

**Important!** Make sure the computer is not connected to a wireless network. If possible, temporarily completely disable the wireless capability.

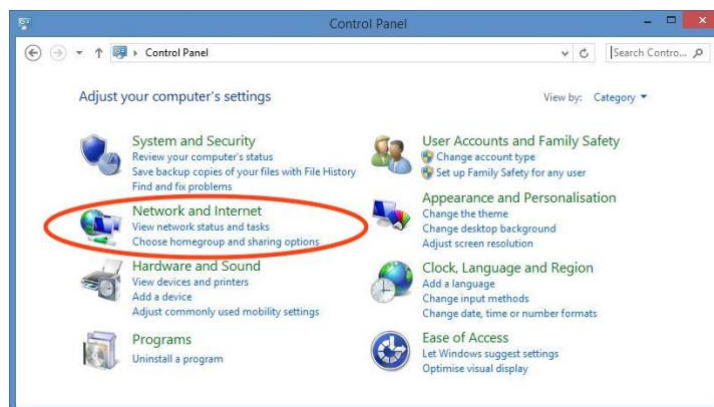
- a) Connect the shielded Ethernet cable to the Universal Data Logger.
- b) Connect the shielded Ethernet cable to a computer.

**Important!** Make sure that the network cable is connected prior to connecting the power.

- c) Connect the power supply (24 V DC 0.5 A or higher) to the Universal Data Logger hardware, and then to a standard 100-240 V ~ 50/60 Hz power socket.

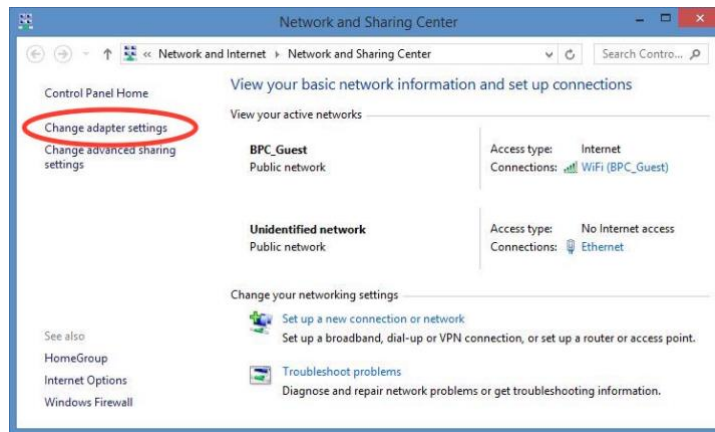
#### WINDOWS 8

- a) Select “Network and Sharing Center” by one of the two options below:
  1. Open the Windows Start Menu and select “Control Panel”. Then choose “Network and Sharing Center”.

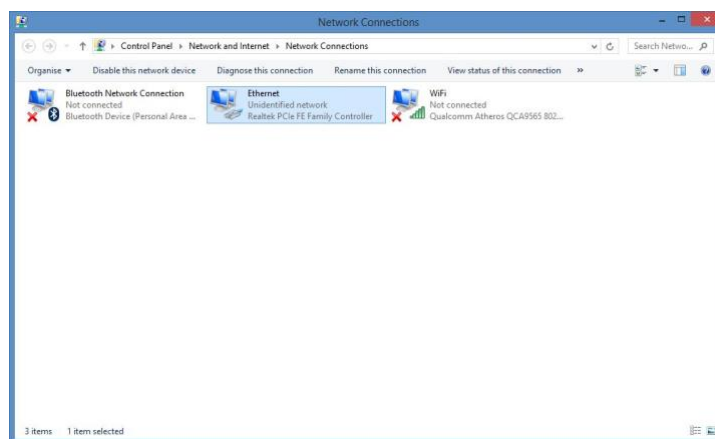


2. Click the search icon in the Windows 8 tile view and search for “Network and Sharing Center”

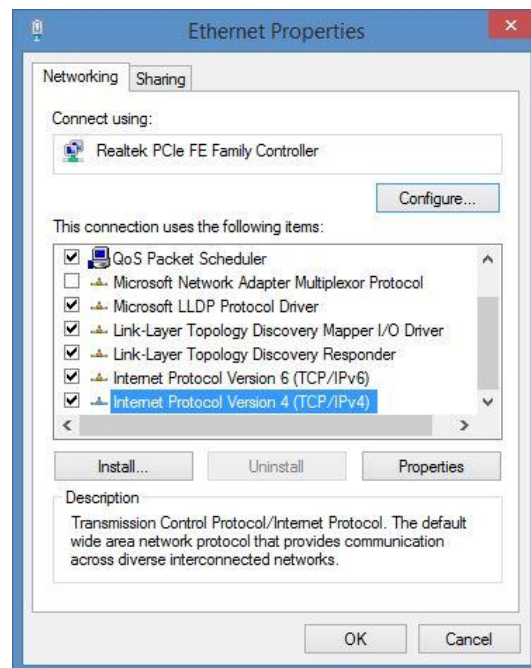
- b) On the left side of the “Network and Sharing Center” window, select “Change adapter settings”.



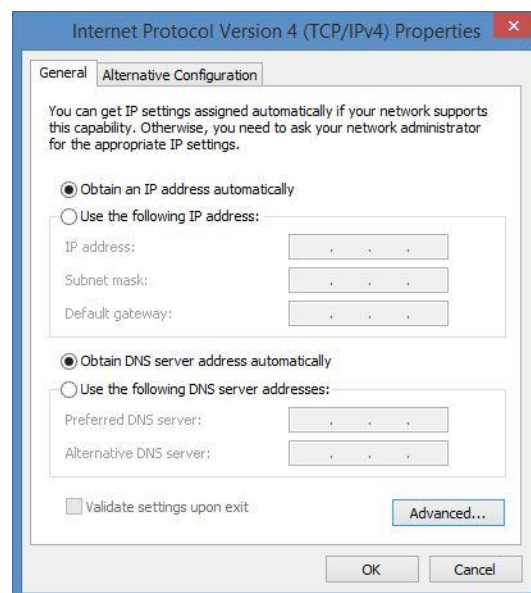
- c) Right click on the appropriate network adapter and select “Properties”. Usually this is named “Local Area Connection”, possibly followed by a number. It is important that the adapter corresponding to the connected Ethernet cable is selected.



- d) Select “Internet Protocol Version 4 (TCP/IPv4)” and click on the button marked “Properties”.



- e) Select “Obtain an IP address automatically” and “Obtain DNS server address automatically”:



- f) Select “OK”.
- g) Click “Close” in the remaining window.

## INSTALLATION OF THE UNIVERSAL DATA LOGGER HARDWARE

- a) Connect the Universal Data Logger to the computer using the Ethernet cable. The picture below shows the back of the Universal Data Logger where the Ethernet port is located.



- b) It is very important that the blue (or grey for some versions) end of the analogue output cable is used when inserting the cable into the port on the Universal Data Logger. **Please note:** Always check if the measuring device use **active or passive analogue signal processing**, and select a channel that is designed accordingly.



The picture below show the cable ports on the front of the Universal Data Logger.



- c) Insert the other end of the analogue output cable to the measuring instrument that will be used.
- d) If more reactors will be used in the experiment, repeat step b) and c) for each reactor and corresponding measuring device.
- e) When all reactors and measuring devices have been connected, plug the power adapter into the power input at the back of the Universal Data Logger. Then connect it to a wall socket.



- f) Enter the names and settings of the reactors in the Universal Data Logger Software. (See Software user guide in chapter 10.2.)



## 8.2 Start up

At this stage, it is assumed that the Universal Data Logger, as well as the measuring devices (e.g.,  $\mu$ Flow), are already installed and connected to the Universal Data Logger as described in section 8.1.

Make sure that the measuring devices are working properly, and then refer to chapter 10.2 to set up the experiment in the software interface.

## 8.3 End of Operation

- a) Generate a report in the Load Data page. Download and open the report to make sure that it has been generated properly and that no errors occurred while downloading the file.
- b) Stop the logging by pressing the “Stop” button in the Graph page. (See Chapter 10.2.) The experiment can no longer be continued after the “Stop” button has been pressed.
- c) Disconnect the power adapter from the wall socket.
- d) Disconnect the signal cables from the channel connectors and from the measuring devices.
- e) For instructions on how to end operation of the  $\mu$ Flow Gas Flow meters, please refer to the  $\mu$ Flow Gas Flow Meter Operation and Maintenance Manual.

## 9 MAINTENANCE

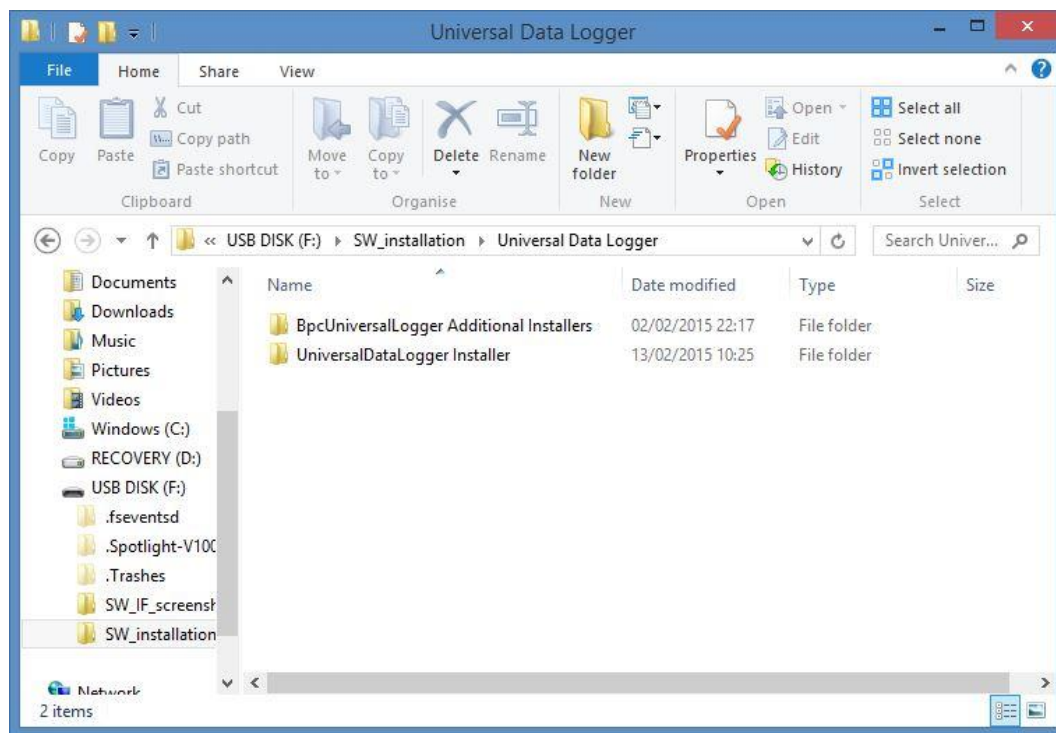
Always handle the Universal Data Logger gently, as data acquisition is sensitive to physical shock.

## 10 UNIVERSAL DATA LOGGER SOFTWARE

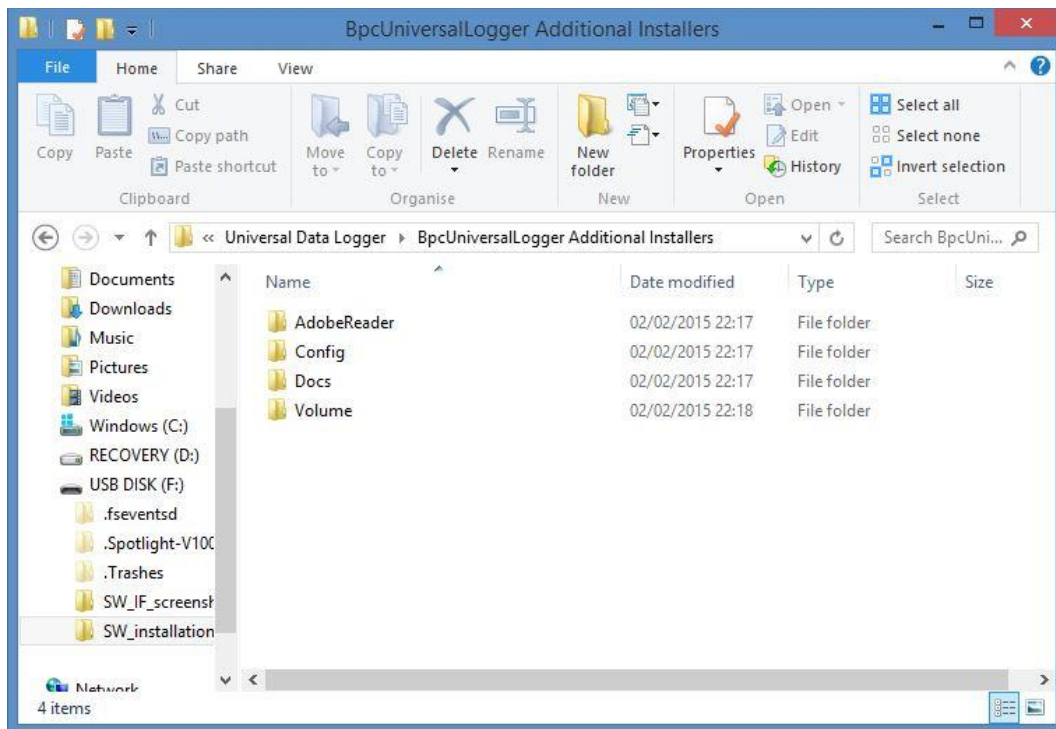
### 10.1 Installation of the Universal Data Logger Software (Windows 8)

The Universal Data Logger Software installation is divided into two steps. The files needed for the first part is collected in a folder called “BpcUniversalLogger Additional Installers”, which also includes required installations of Adobe reader and Open Office. The second part is collected in the “UniversalDataLogger Installer”.

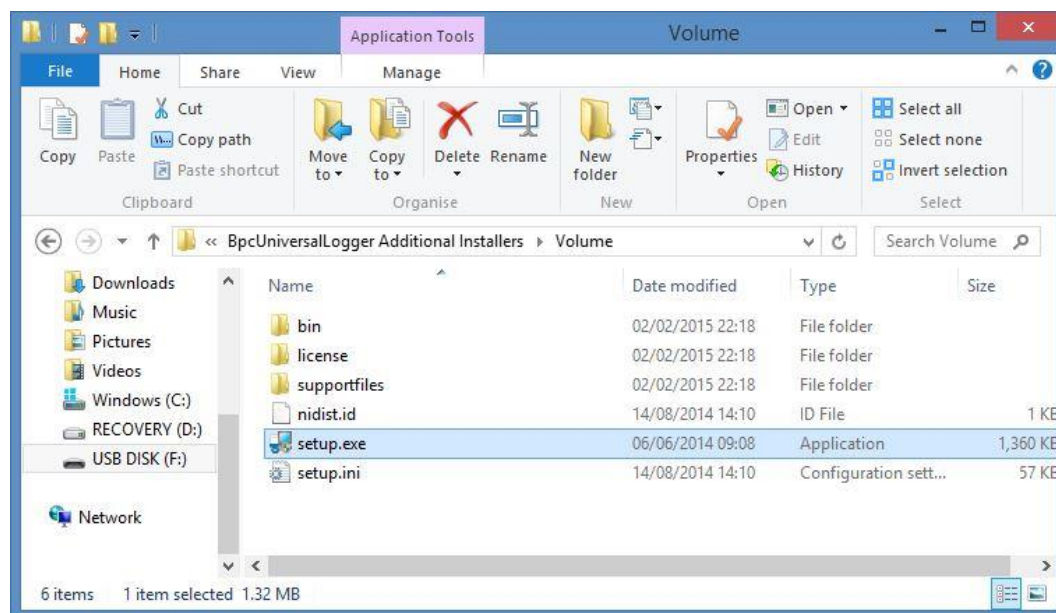
1. Start the installation by inserting the USB drive with the Universal Data Logger Software files. Open the disk drive in Windows Explorer and open the folder called “BpcUniversalLogger Additional Installers”.



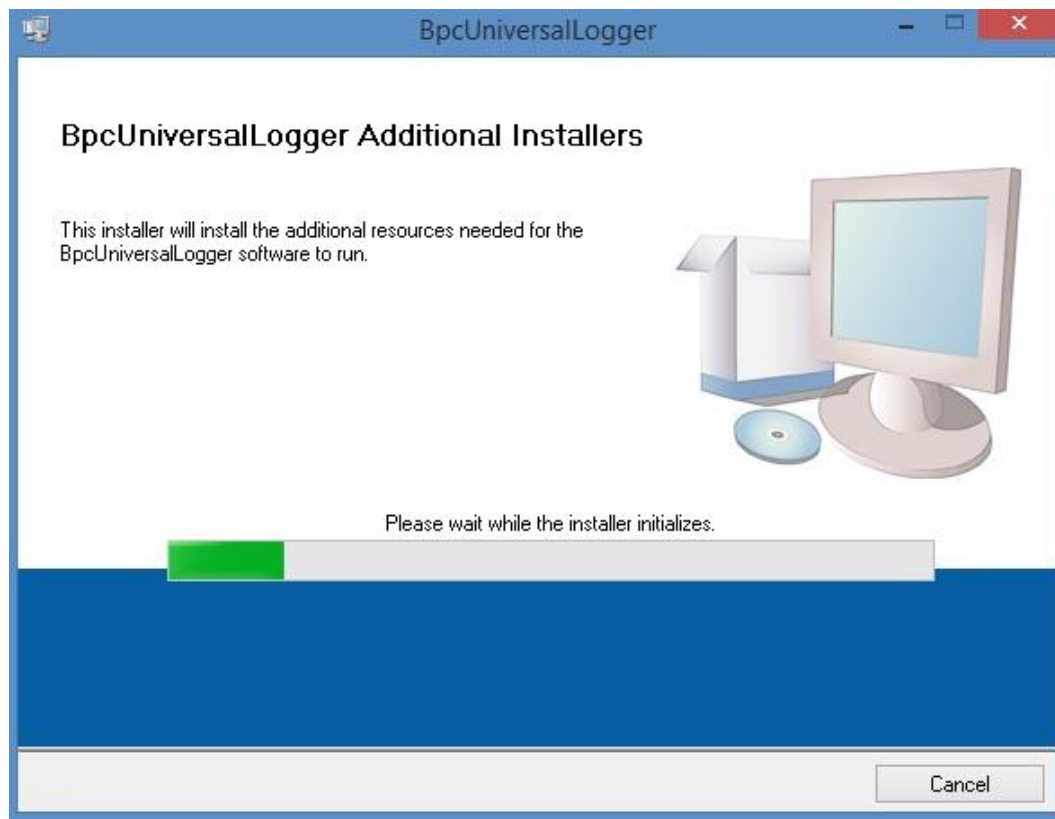
2. Next, open the “Volume” folder.



3. Select the setup.exe file and open it.



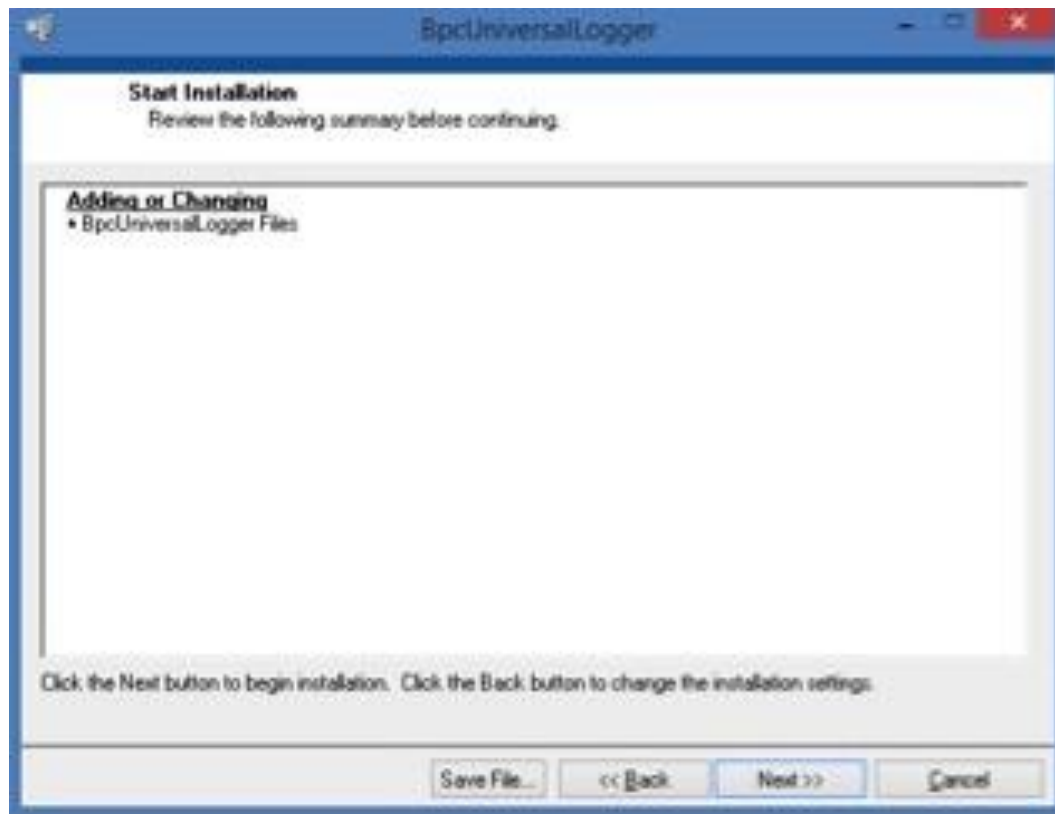
4. When the setup.exe file is opened, installation will be initialised, and a green bar will show the progress.



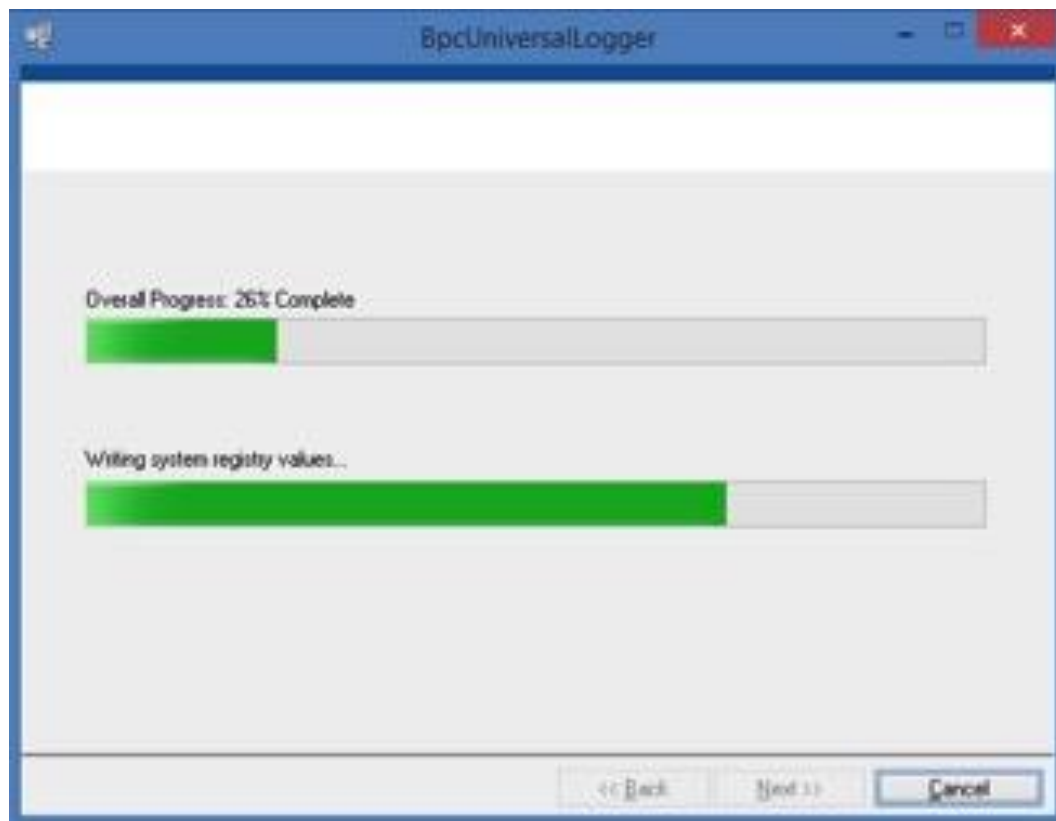
5. Select a destination directory for the “BpcUniversalLogger” program files, and for the National Instruments products files that are part of the software.



6. Start the installation by clicking “Next”.



7. A window will show the installation progress.



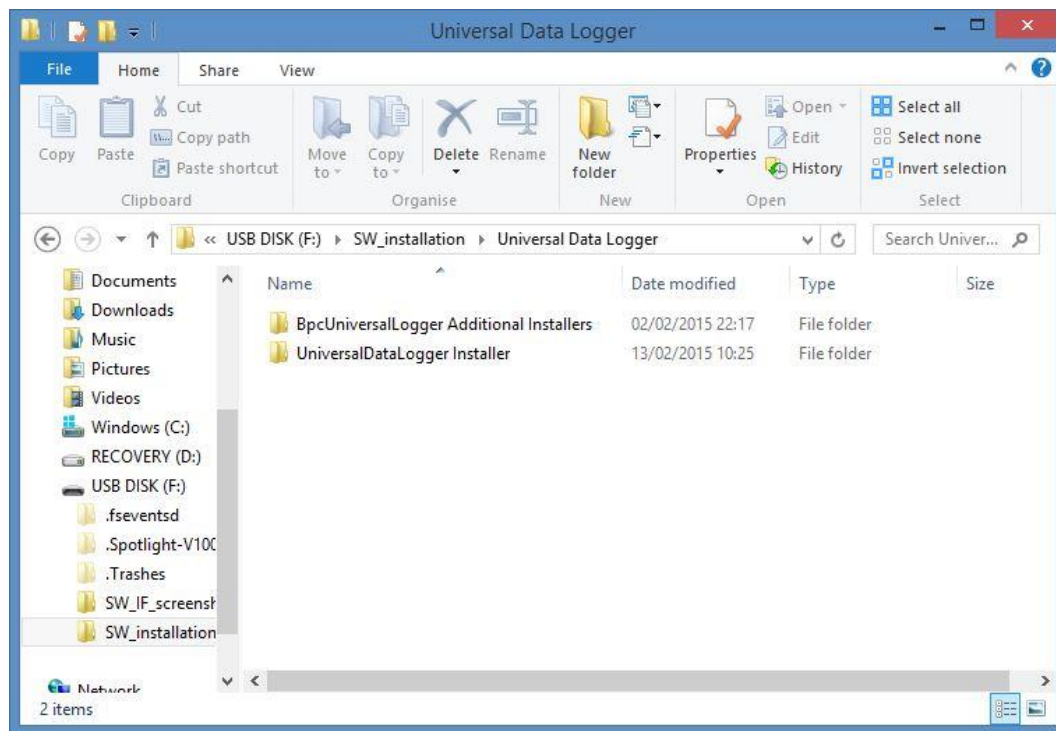
8. A message will follow when the installation is completed. Click “Next” to finalise.



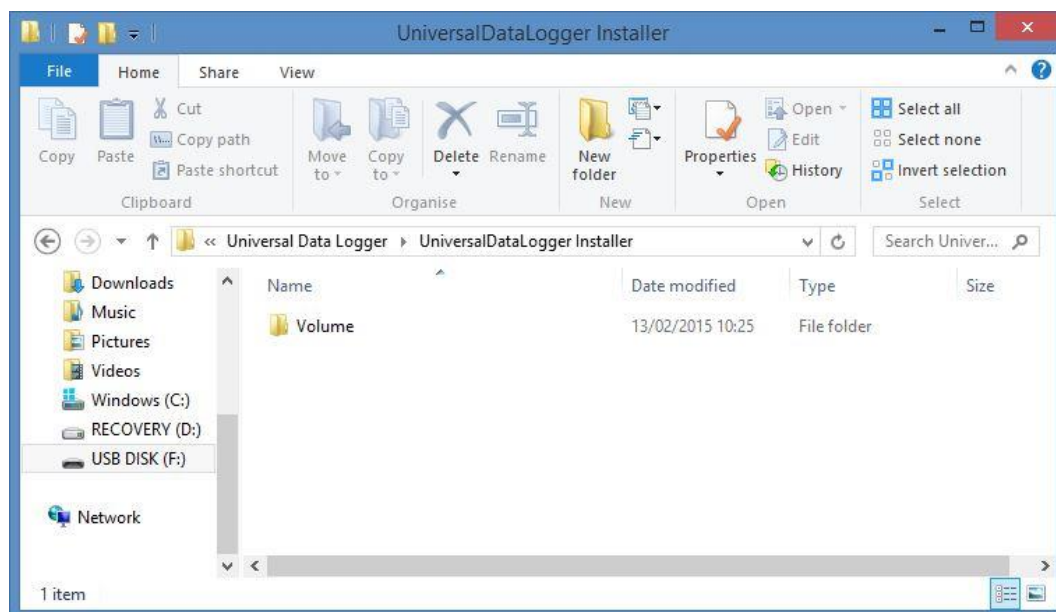
9. When the installation has been confirmed as successful, **restart the computer**.



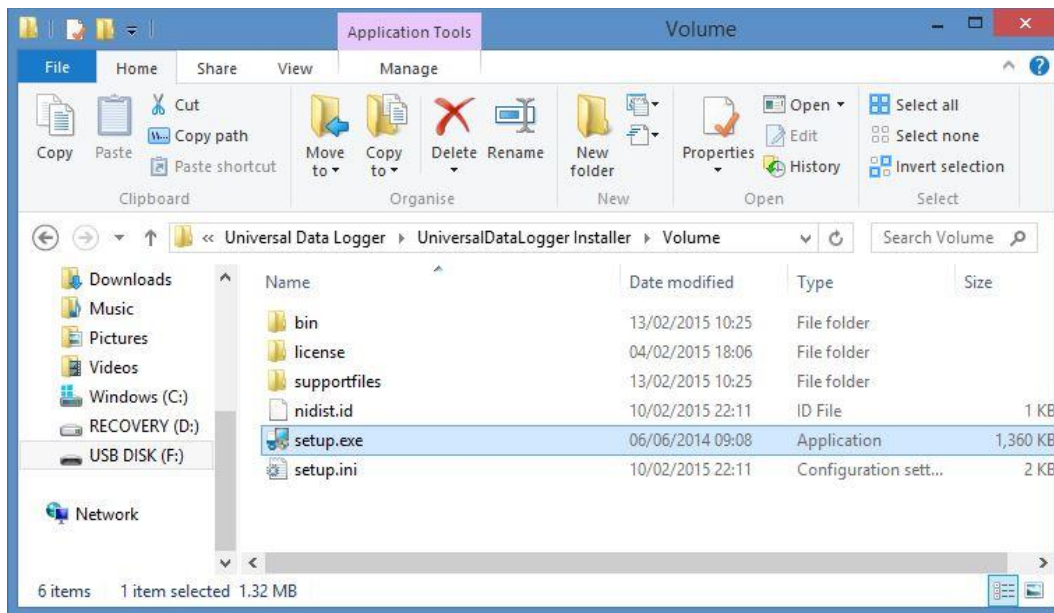
10. Start the second part of the installation by opening the folder called “UniversalDataLogger Installer”.



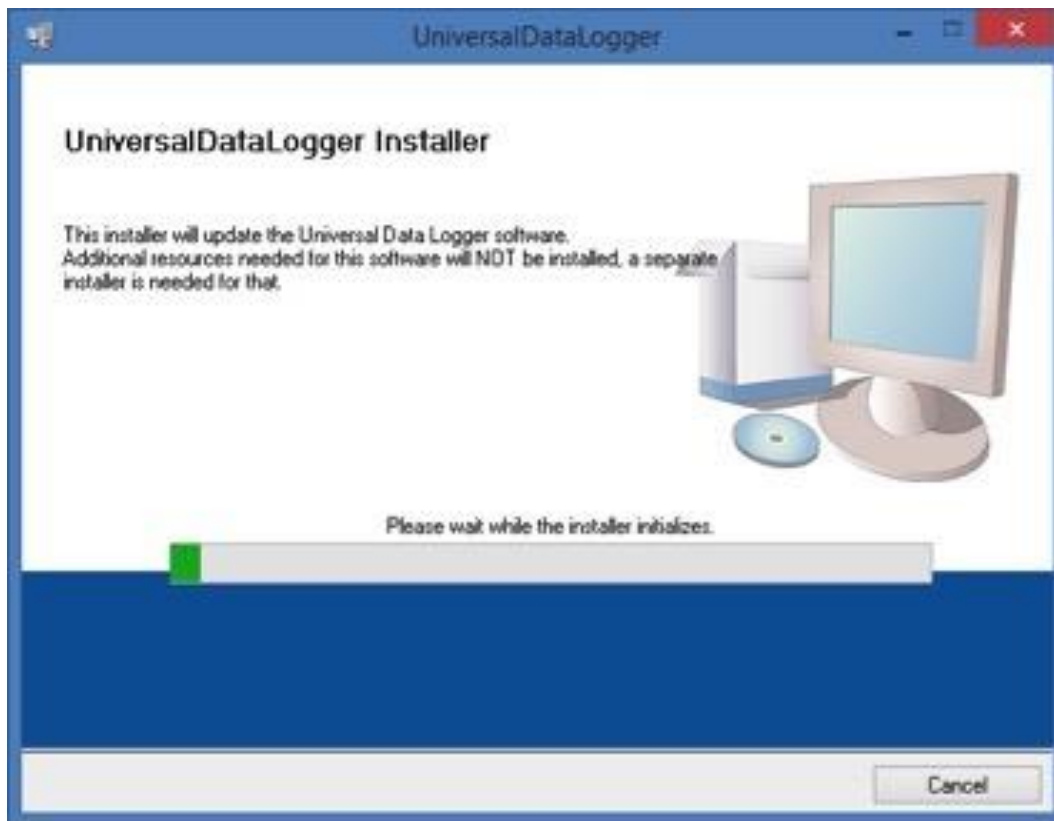
11. Next, open the “Volume” folder.



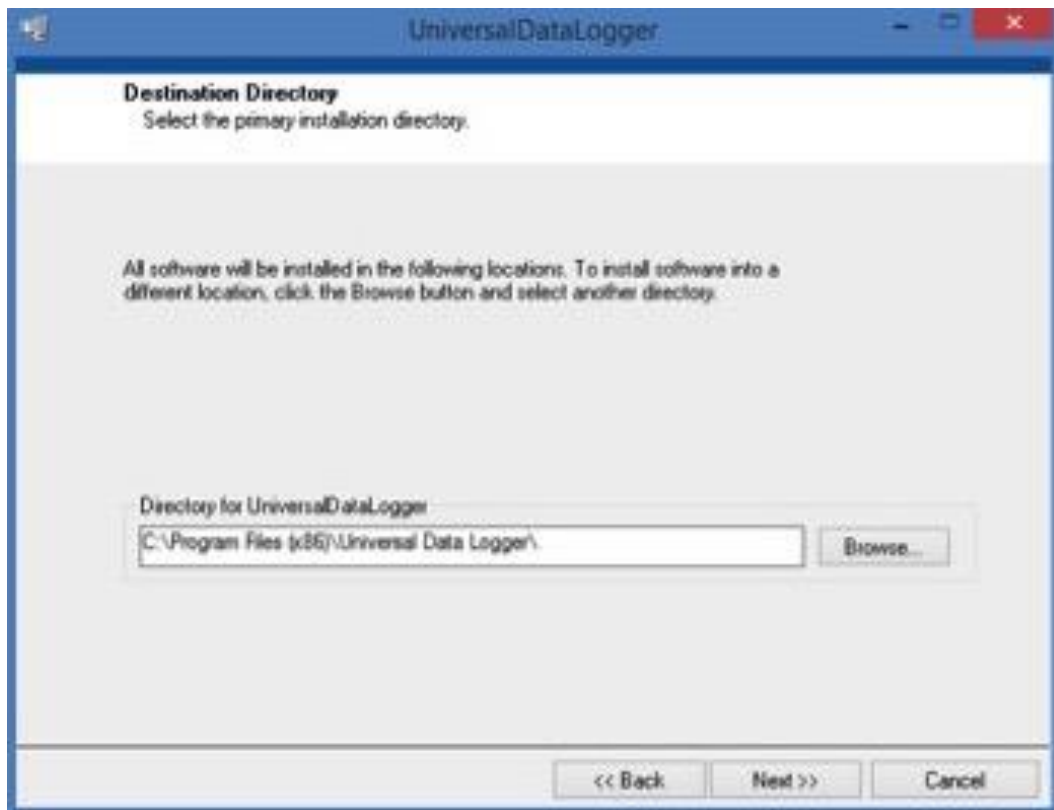
12. Select the setup.exe file.



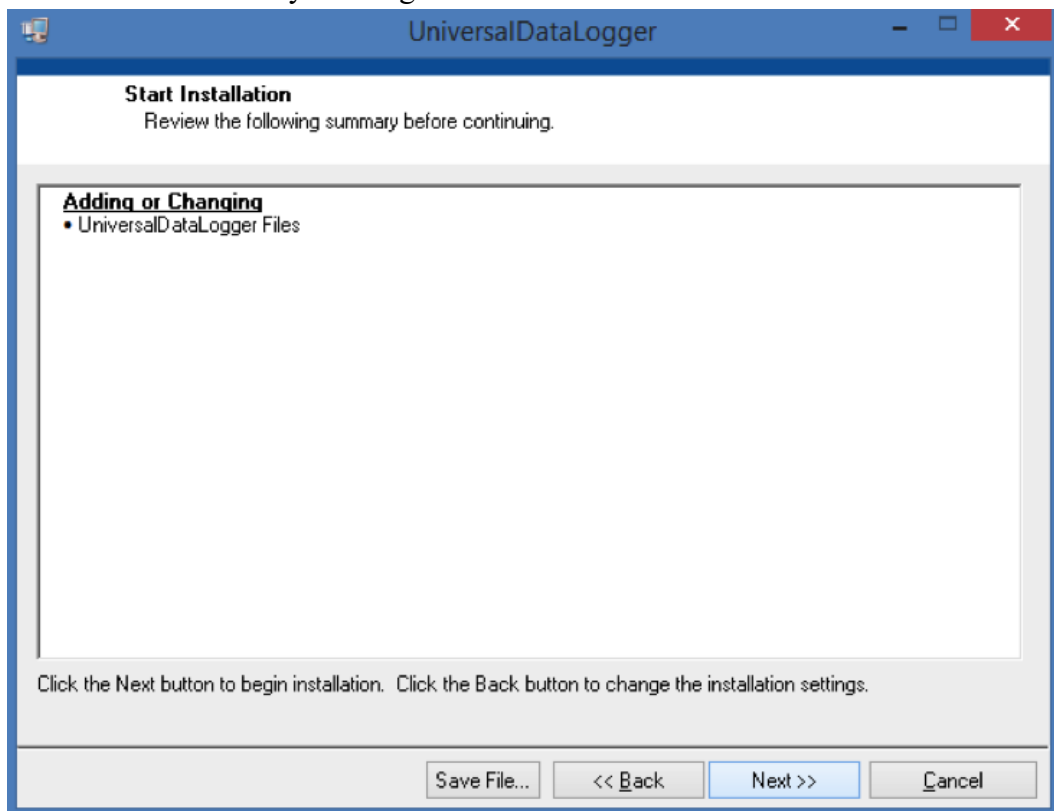
13. The installation is started, and a green status bar shows the progress.



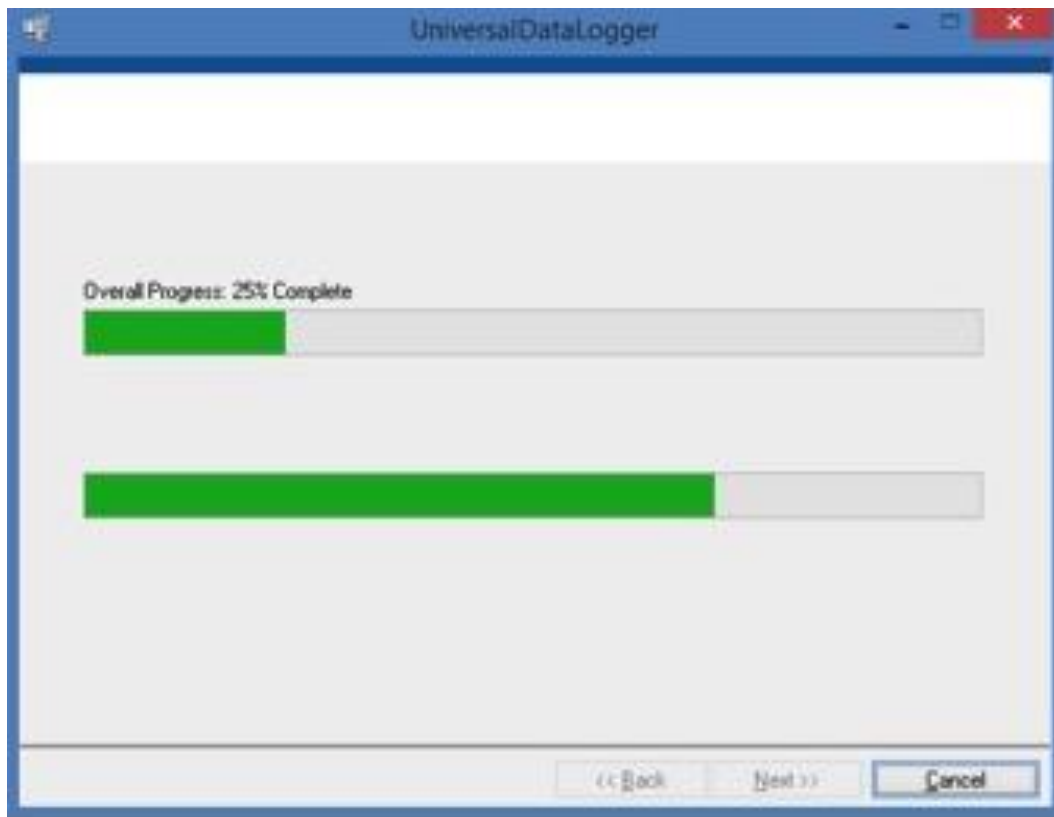
14. Select a file directory for the files.



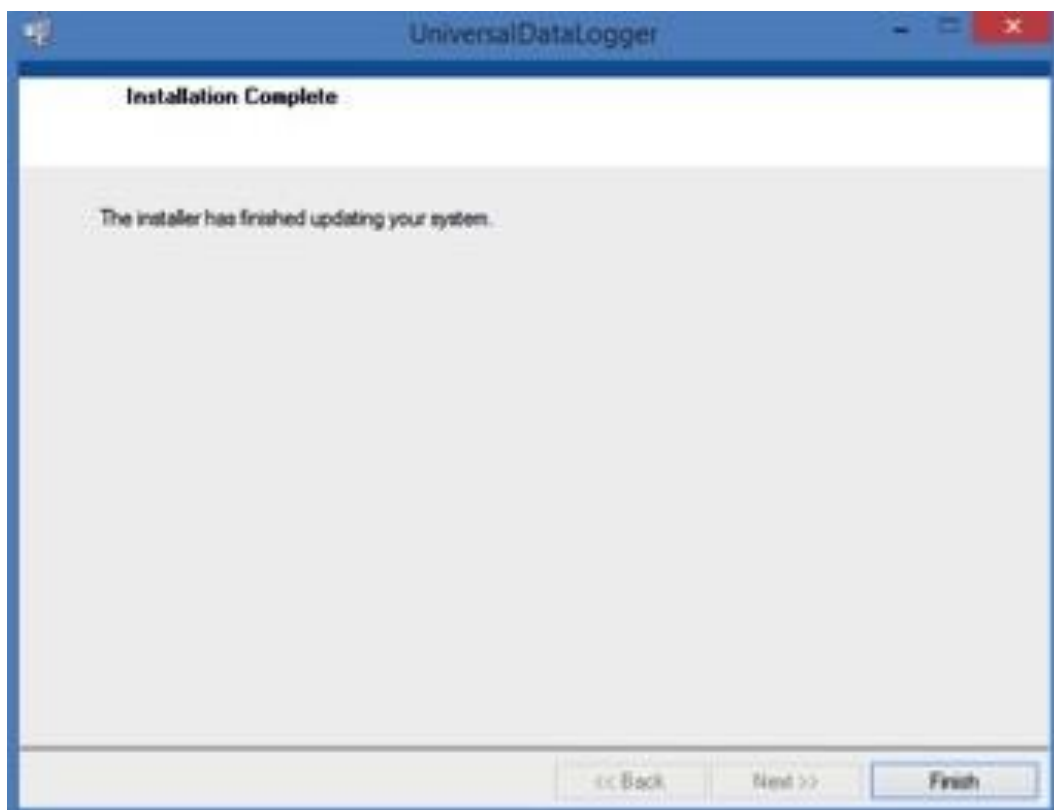
15. Start the installation by clicking “Next”.



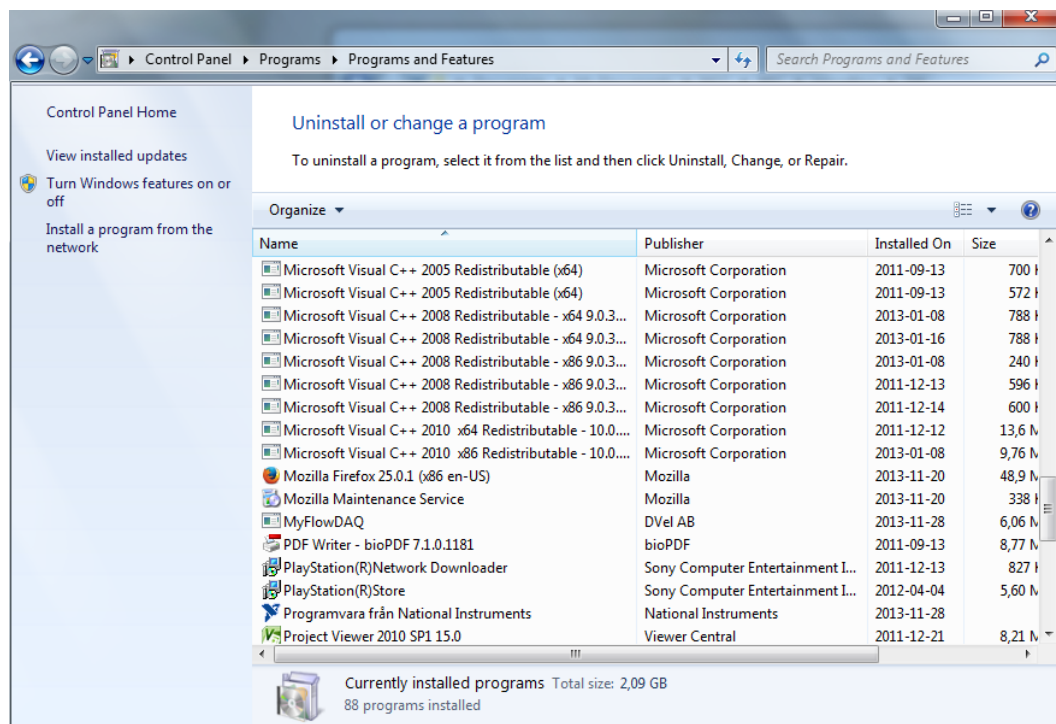
16. The green status bars show the progress.



17. Click Finish to complete the installation.



18. When the software installation has finished, connect the Universal Data Logger to a computer using the Ethernet cable. Then connect the Universal Data Logger to a power outlet, and the drivers will be installed on the computer. This will complete the installation.
19. The Universal Data Logger Software can be uninstalled in the Windows Control Panel. The National Instruments files needs to be uninstalled separately.



## 10.2 Universal Data Logger Software User Guide

The software interface is organised in a number of pages, all reachable from the start page named “Home”. The pages are laid out in the same order that an experiment is set up, executed, monitored and finally documented. Below is an overview of the pages available, and their main functions:

### ***Home***

This page is shown when the software is started. The different pages can be accessed through the five tabs at the top. Under the tabs, links will lead the user to information such as the user manual, the technical specification and product information sheets.

### ***Settings***

In the Settings page, the user prepares an experiment by applying settings for each reactor/line (represented by channels in the Universal Data Logger system). In the Channel Setup page, each channel can be set to measure different properties, such as Gas Flow, pH, Temperature and Methane Content. In the Scale Setup page, an output range and unit can be set for each property.

### ***Graph***

The Graph page is where an experiment is started and stopped. The graph provides a visual representation of the gas flow rates vs. time. It is possible to scroll and zoom in the graph, and also to export pictures of it. Each channel and property can be selected to show up or be hidden in the graph view.

### ***Load Data***

The Load Data page allows the user to load data from a specific time interval, and to generate a report of it. The report contains experiment data for each reactor/line.

### ***System***

This page contains general information related to the software version, Universal Data Logger hardware and contact details.

## DETAILED GUIDE FOR EACH PAGE

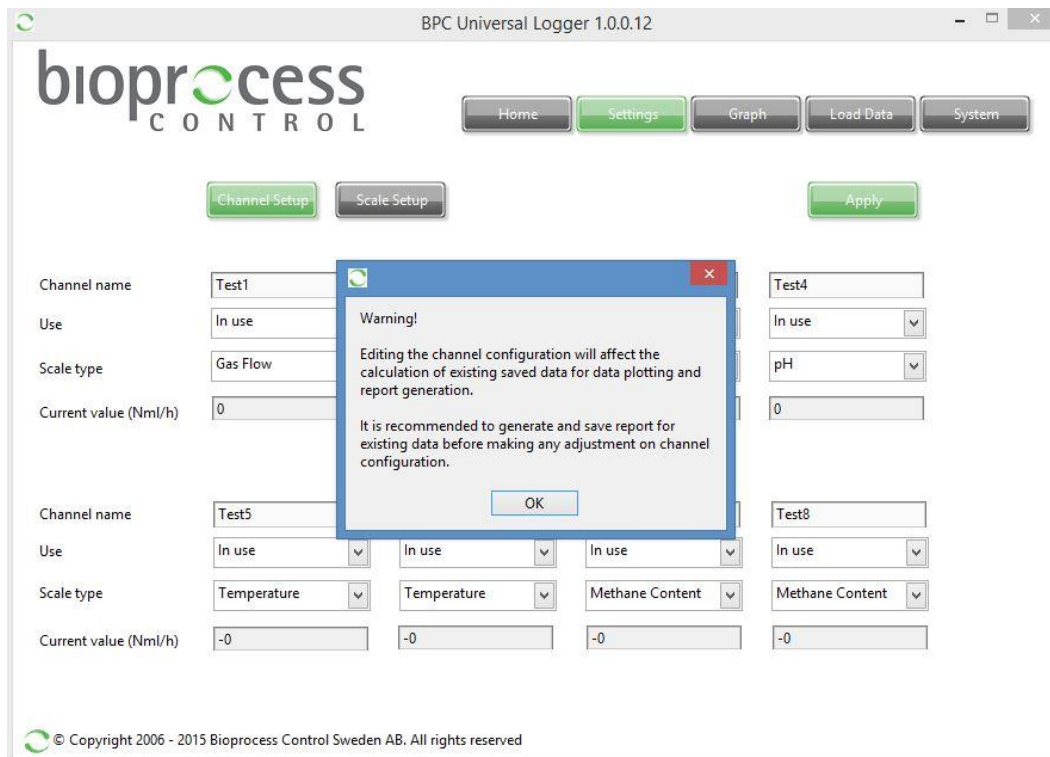
In each page it is possible to find additional menus by right clicking in different areas. Not all the functions shown in these menus are activated in this application, and only the ones that are useful for experiments with the  $\mu$ Flow Gas Flow Meter are explained here.

## HOME



## SETTINGS

When the Settings page is entered, a warning will pop up to inform that any change of settings in this page will affect the existing saved data. Therefore, it is recommended that a report is generated and saved before changing any settings in this page.

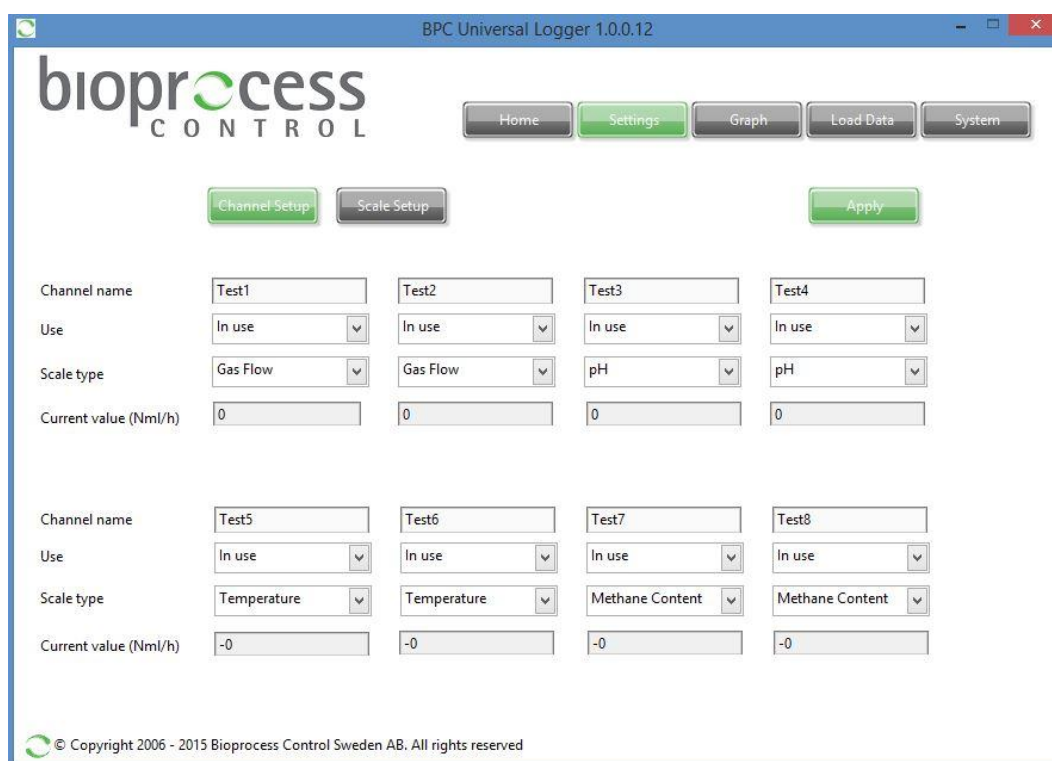


The Settings page is used to set up an experiment. There are two buttons to select between the “Channel Setup” and the “Scale Setup” views.



## SETTINGS – CHANNEL SETUP

1. Enter the name of the first reactor/line in the field to the top left. (The top row show channel 1 to 4 from left to right, and the lower row similarly show channel 5 to 8. A channel name is limited to 10 characters.)



BPC Universal Logger 1.0.0.12

bioprocess CONTROL

Home Settings Graph Load Data System

Channel Setup Scale Setup Apply

Channel name	Test1	Test2	Test3	Test4
Use	In use	In use	In use	In use
Scale type	Gas Flow	Gas Flow	pH	pH
Current value (Nml/h)	0	0	0	0

Channel name	Test5	Test6	Test7	Test8
Use	In use	In use	In use	In use
Scale type	Temperature	Temperature	Methane Content	Methane Content
Current value (Nml/h)	-0	-0	-0	-0

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- Set the “Use” attribute to “In use” for the channels that will be used during the experiment.



BPC Universal Logger 1.0.0.12

bioprocess CONTROL

Home Settings Graph Load Data System

Channel Setup Scale Setup Apply

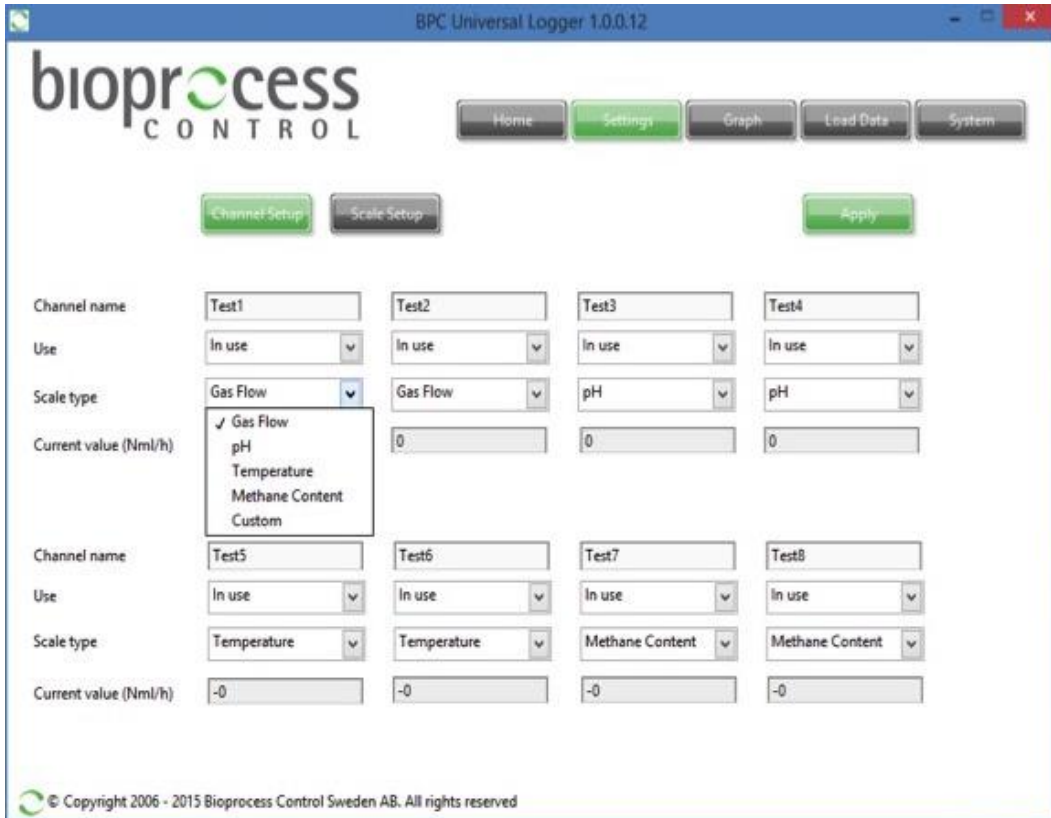
Channel name	Test1	Test2	Test3	Test4
Use	In use	In use	In use	In use
Scale type	✓ In use N/A	Gas Flow	pH	pH
Current value (NmL/h)	0	0	0	0

Channel name	Test5	Test6	Test7	Test8
Use	In use	In use	In use	In use
Scale type	Temperature	Temperature	Methane Content	Methane Content
Current value (NmL/h)	-0	-0	-0	-0

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3. Select a “Scale Type” value for each channel that will be used in the experiment.

**Important:** If the Universal Data Logger has been customised to have one or several channels for **active** analogue signal processing, or **if probes with active analogue signal processing** will be used, please refer to chapter 7.1 about Hardware description.



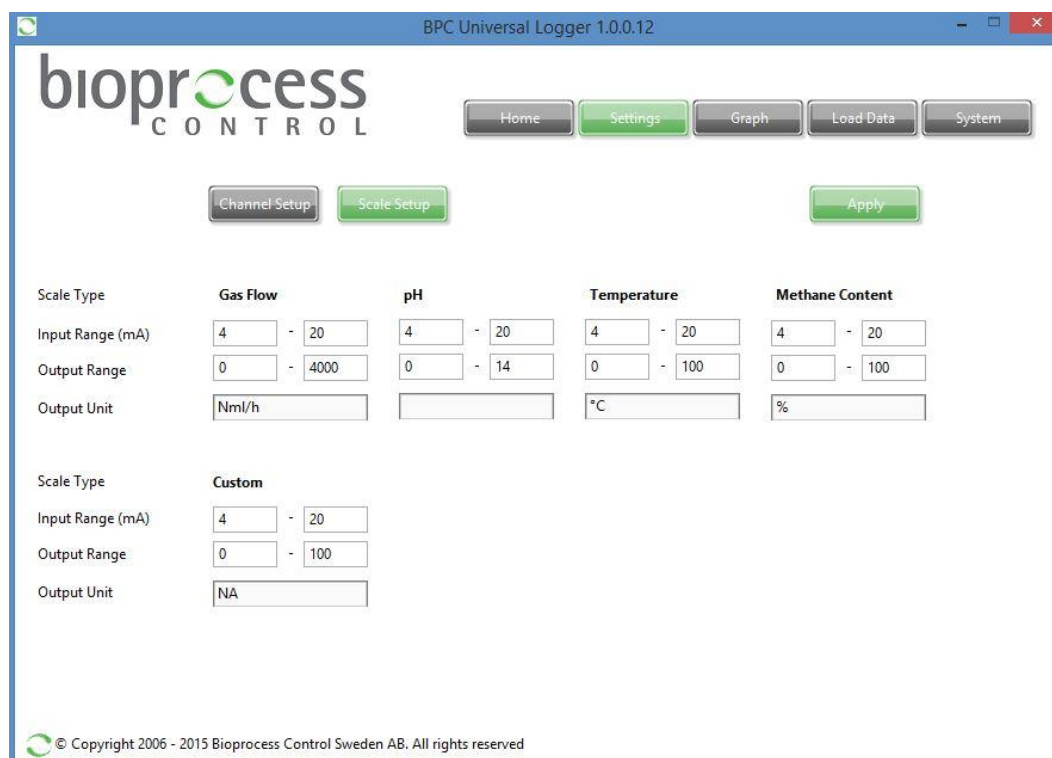
Save the above settings by pressing the “Apply” button.

Repeat this procedure for all the channels that will be used in the experiment, and press “Apply” after each channel has been set.

The value of the current flow rate for each channel is also displayed. The value is a mean value over the last minute.

## SETTINGS – SCALE SETUP

In this view, “Output Range” is the only attribute that can be selected. (The “Input Range” and “Output Unit” can be changed, but **will not** control these parameters.)



BPC Universal Logger 1.0.0.12

bioprocess CONTROL

Home Settings Graph Load Data System

Channel Setup Scale Setup Apply

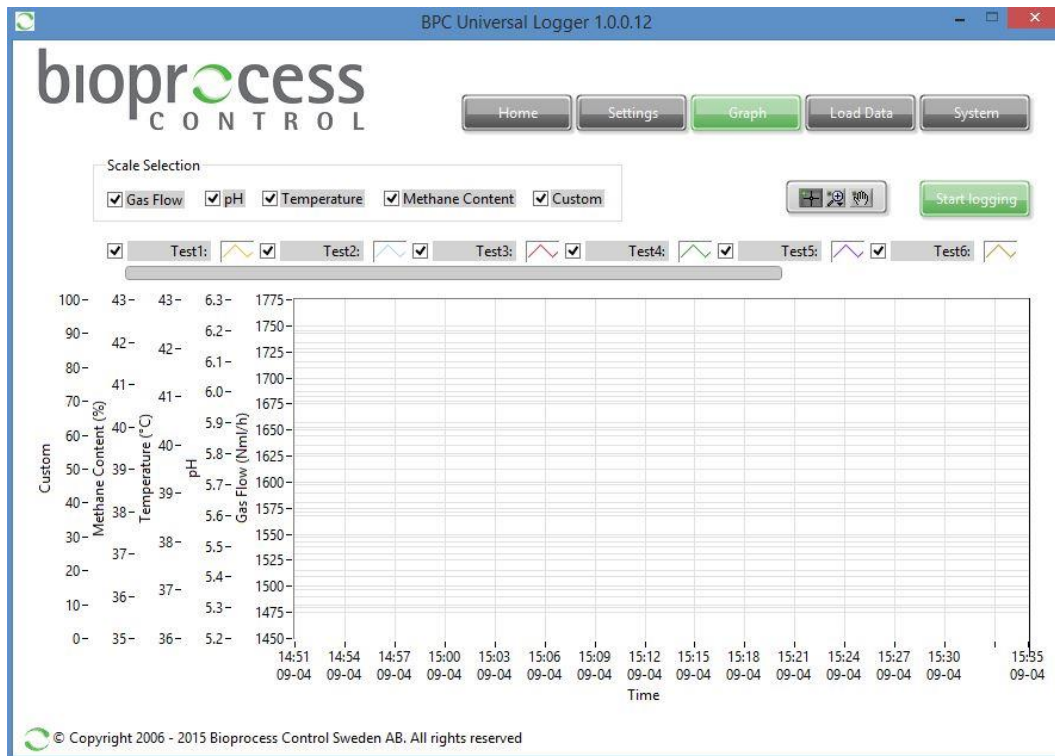
Scale Type	Gas Flow	pH	Temperature	Methane Content
Input Range (mA)	4 - 20	4 - 20	4 - 20	4 - 20
Output Range	0 - 4000	0 - 14	0 - 100	0 - 100
Output Unit	Nml/h		°C	%

Scale Type Custom

Input Range (mA)	4 - 20
Output Range	0 - 100
Output Unit	NA

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## GRAPH



This section shows the Graphs page.

### Start logging

To start data logging, the user has to press the green button labelled “Start logging”. The button will turn grey and it will change its name to “Stop logging”.

Under the “Start /Stop logging” button, there are checkboxes for each of the 8 channels. They can be used to select which channels that should show up in the graph. Check the boxes for the channels that should show up in the graph, or uncheck them boxes to hide the channels from the graph. (Use the grey scrolling bar to find Channel 7 and 8.)

The graph shows the current flow rates for the selected channels. The values in the graph are updated every 15 min after starting the logging and are normalised to 1.0 atm and 0 °C.

### Stop logging

To stop data logging, press the button “Stop logging”. The button will become green again and the system will stop recording any data. Stopping the data logging will not delete anything; it will only stop recording data until the “Start logging” button is pressed. All logged data will be stored in the database files.

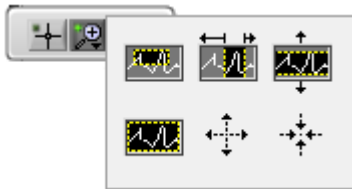
## Scrolling and zooming in the graph plot

The bar with 3 buttons shown below enables different zooming and scrolling tools for the plot area. If it is not already showing up, it can be reached through a menu showing up by right clicking in the graph plot. Choose “Visible Items” => “Graph palette” to find it.



The button with the hand icon can be used to move the graph in any direction. A left mouse click that is held down while moving the mouse will move the graph according to the mouse movement. A right mouse click that is held down will start scrolling the graph when the cursor reaches any edge of the graph, to reveal more of the graph in that direction.

The button with a magnifying glass with a plus sign opens up 6 alternatives to zooming in/out and changing the scales of the graph.



1. The top left icon allows the user to resize the graph window to a smaller subset of the visible display by first clicking on the icon and then by clicking at a suitable point in the graph and then, while still holding down the mouse button, creating a square shape. The graph window will then zoom in to display the data contained within the square shape.
2. The top middle icon allows the user to resize the graph window in a similar way to the first option but with a focus on the x-axis. The y-axis will automatically adjust to an appropriate value.
3. The top right icon allows the user to resize the graph window in a similar way to the first option but with a focus on the y-axis. The x-axis will automatically adjust to an appropriate value.
4. The bottom left icon allows the user to resize the graph window to display all available data. This action is performed by clicking once on the icon.
5. The bottom middle icon allows the user to zoom in on the graph by first clicking on the icon and then clicking in the graph window.
6. The bottom right icon allows the user to zoom out on the graph by first clicking on the icon and then by clicking in the graph window.

### Right clicking in the graph area (selected commands)

*Clear graph* will just clear the curves in the graph view, but all data that has been recorded will be kept. The graph can be reloaded by pressing the “Load Data” button in the “Load Data” window. It may take a little longer for the data to show up in the Graph window, than it does in the “Load Data” window.

#### *AutoScale X*

Automatically scales the x-axis to contain all data.

#### *AutoScale Y*

Automatically scales the y-axis to contain all data.

#### *Export*

A picture of the current view of the graph can be exported as a picture, excel file, or added to the clipboard. (To export the experiment data, see the Load Data page guide.)

### Clicking on the icon associated with a specific graph (selected commands)

Additional software features can be reached by left or right clicking the icon associated with a specific graph. Selected functions will be described below.



#### *Plot Visible*

This option toggles the visibility of the selected plot and is equivalent to the user checking the box located to the left of the specific line’s name.

### *Colour*

This setting allows the user to define a different colour for the particular line.

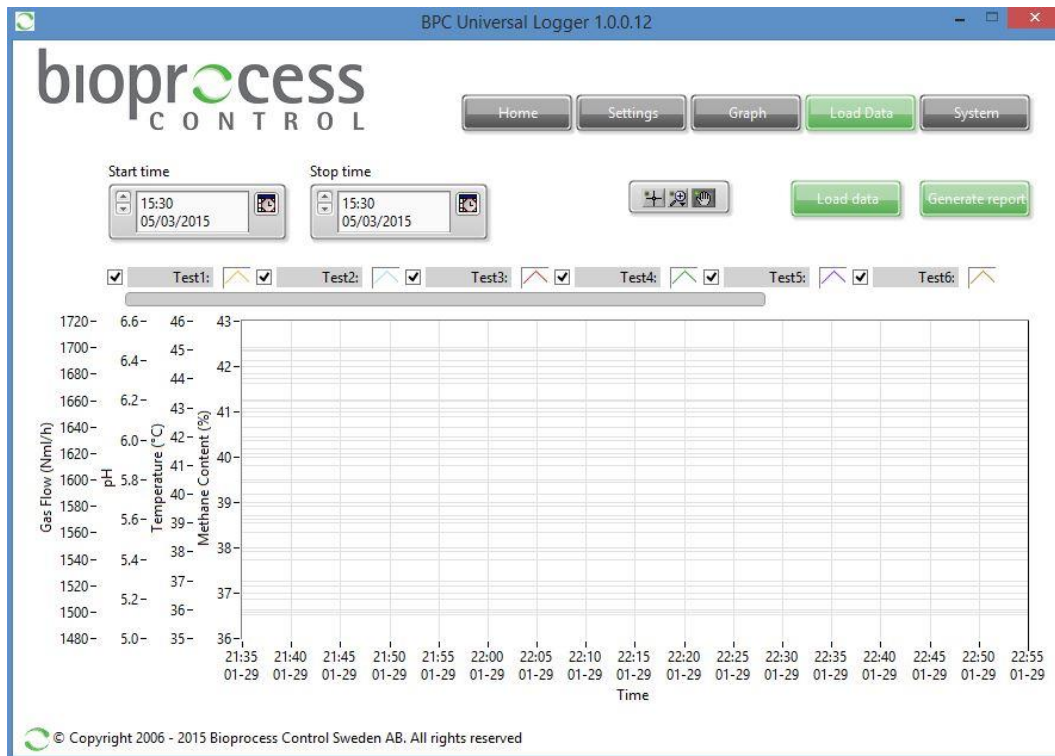
### *Export*

A picture of the current view of the graph can be exported as a picture, excel file, or added to the clipboard. (To export the experiment data, see the Load Data page guide.)



## LOAD DATA

In the “Load Data” page it is possible to generate a report.

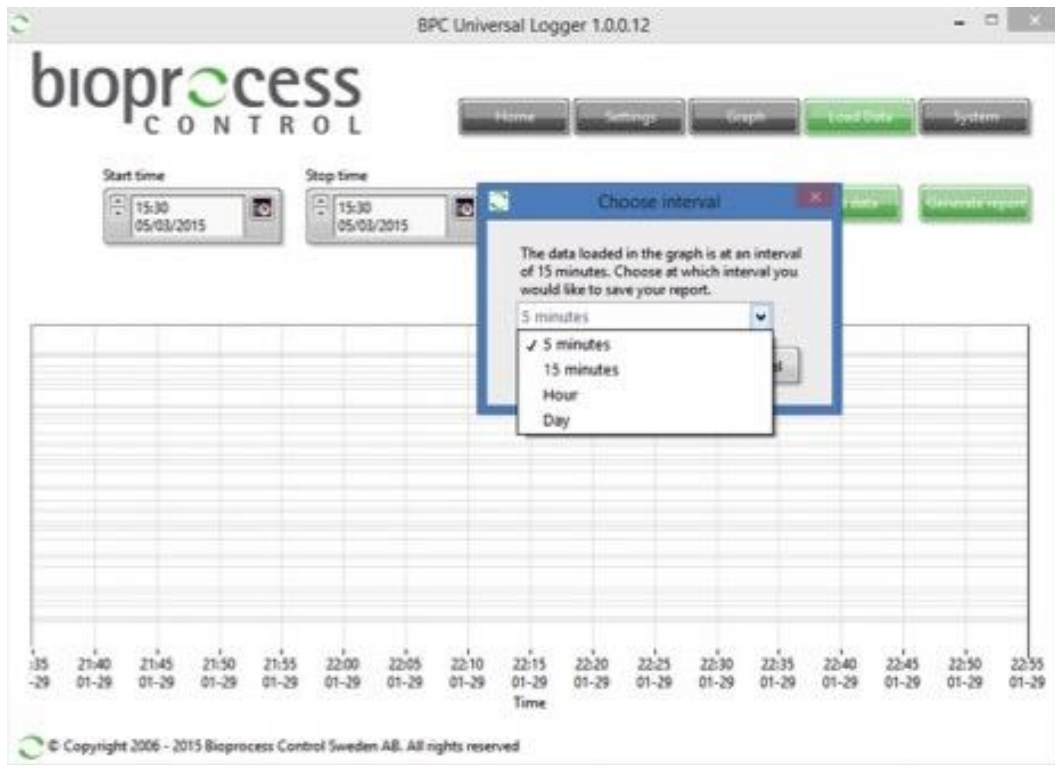


### Load Data

To start loading the data, choose the period of interest (i.e., start and stop times) and then to press the button “Load Data”. The data for the selected time period will show up in the graph.

### Generate Report

By pressing the button “Generate report”, a pop-up window will be displayed with the following message: *“The data load in the graph is at an interval of 15 minutes. Choose at which interval you would like to save your report: 15 minutes, hour, or daily”*.



After selecting the unit for the time (e.g., quarter of an hour, hour or day) and pressing “OK”, the data will be saved into a \*.csv (comma-separated values) file. The file can be opened and viewed through a spreadsheet program such as Microsoft Excel, Open Office Calc or Google Docs.

The flow rate for the selected flow cells is presented in Nml/h in the generated report.

### **Right clicking in the graph area (selected commands)**

*Clear Graph* will just clear the curves in the graph view, but all data that has been recorded will be kept. The graph can be reloaded by pressing the “Load Data” button in the “Load Data” window. It may take a little longer for the data to show up in the Graph window, than it does in the “Load Data” window.

### *AutoScale X*

Automatically scales the x-axis to contain all data.

### *AutoScale Y*

Automatically scales the y-axis to contain all data.

### *Export*

A picture of the current view of the graph can be exported as a picture, excel file, or added to the clipboard. (To export the experiment data, see the Load Data page guide.)

## SYSTEM

This section shows the System page. The page contains general information about the software, Universal Data Logger hardware (i.e., serial number, IP address) and contact details for troubleshooting and support.

