Instruction Manual

FLOW-BUS LabVIEW™ Driver

Doc. no.: 9.17.078E Date: 22-01-2018

ATTENTION
Please read this Instruction Manual carefully before installing and operating the instrument.
Not following the guidelines could result in personal injury and/or damage to the equipment.

Bronkhorst®

Disclaimer

The information in this manual has been reviewed and is believed to be wholly reliable. No responsibility, however, is assumed for inaccuracies. The material in this manual is for information purposes only.

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Symbols

⚠	*Important information. Discarding this information could cause injuries to people or damage to instrumentation or installation.*
💡	*Helpful information.*
ℹ www	*Additional info, available on the internet or from your local sales representative.*

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1 Introduction

1.1 Product description

The Bronkhorst® FLOW-BUS driver is a set of LabVIEW™ VIs (Virtual Instruments) that implement the serial ASCII commands used on the FLOW-BUS. The VIs also handle the conversion of data that is sent to or received from an instrument.
For more information about the commands and the data exchanged, please refer to the RS232 interface with FLOW-BUS protocol manual (document no. 9.17.027) or to the operation instructions digital instruments manual (document no. 9.17.023).

Along with the driver some example VIs are included to demonstrate the structure of an application that utilizes the driver VIs. The examples can also be used to test communication with an instrument, as the examples are all tested and functional.

The driver documentation is aimed at individuals with a reasonable working understanding of LabVIEW™, and is not intended as a tutorial to developing applications written in the LabVIEW™ environment.

1.2 Other documents

Manuals and guides for Bronkhorst® instruments are modular. General instructions give information about the functionality and installation of instruments. Operational instructions explain the use of the digital instruments features and parameters. Fieldbus specific information explains the installation and use of the fieldbus installed on the instrument.

Type	Document name	Document no.
Manuals	Operation instructions digital instruments	9.17.023
	FLOW-BUS interface	9.17.024
	RS232 interface with FLOW-BUS protocol	9.17.027
Technical documentation	Hook-up diagram laboratory-style MBC RS232 + analog	9.16.062
	Hook-up diagram industrial style MBC RS232 + analog	9.16.051
	Hook-up diagram CORI-FLOW RS232 + analog	9.16.044
	Hook-up diagram LIQUI-FLOW L30 digital RS232 + analog	9.16.073

All documents and software tooling referred to in this section can be downloaded from ***http://www.bronkhorst.com/en/downloads****.*

1.3 Supported instruments

All FLOW-BUS instruments and instruments with RS232 communication are supported, with the following limitations:

- RS232/FLOW-BUS interface, firmware >= 4.09
- Digital mass flow meters/controllers without RS232 communication: firmware >= V5.xx
- Digital readout control modules (E-7000): firmware >= V3.xx

1.4 System requirements

LabVIEW™ Version	LabVIEW™ 8.5 or higher
NI-VISA Version	NI-VISA 5.4 or higher
Connections	RS232 port with FIFO buffers
Computer	The computer must meet the minimum requirements needed for LabVIEW™

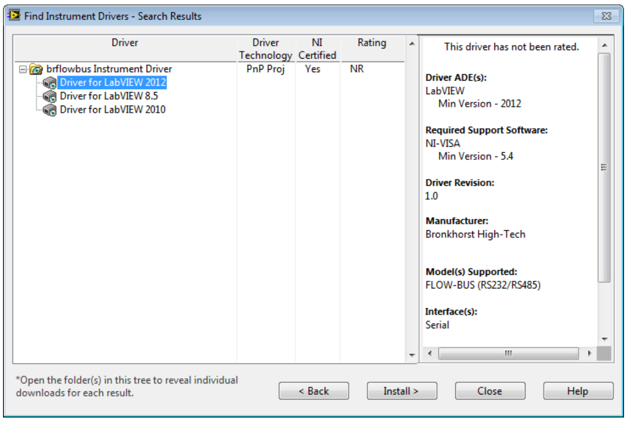
To avoid communication errors, it is advised to use a serial (RS232) port with hardware buffer overrun detection. Few USB-RS232 converters have this feature, but e.g. the Digitus part no. DA-70156 has.

2 Installation

2.1 NI Instrument Driver Finder

The driver can be downloaded and installed from LabVIEW™ by using the NI Instrument Driver Finder. To install the driver with this tool please follow the next steps:

1. Open the NI Instrument Driver Finder (Tools » Instrumentation » Find Instrument Drivers or the Help » Find Instrument Drivers).
2. Select Bronkhorst High-Tech from the manufacturer drop-down list. If Bronkhorst High-Tech is not listed, enter 'FLOW-BUS' in the search field.
3. Click the Search button. If the search button is disabled hit the enter key.
4. Select the 'brflowbus Instrument Driver' entry from the search results list.
5. Select the driver for the installed (or compatible) version of LabVIEW™.
6. Click the Install button (log in with your NI account. If you do not have an NI account, create a new account and then log in).
7. The NI Instrument Driver Finder will now download and install the driver.
8. When the driver installation is finished you can close the NI Instrument Driver Finder, and start using the Bronkhorst® FLOW-BUS Driver.



Driver	Driver Technology	NI Certified	Rating
brflowbus Instrument Driver	PnP Proj	Yes	NR
Driver for LabVIEW 2012			
Driver for LabVIEW 8.5			
Driver for LabVIEW 2010			

This driver has not been rated.

Driver ADE(s):
LabVIEW
Min Version - 2012

Required Support Software:
NI-VISA
Min Version - 5.4

Driver Revision:
1.0

Manufacturer:
Bronkhorst High-Tech

Model(s) Supported:
FLOW-BUS (RS232/RS485)

Interface(s):
Serial

*Open the folder(s) in this tree to reveal individual downloads for each result.

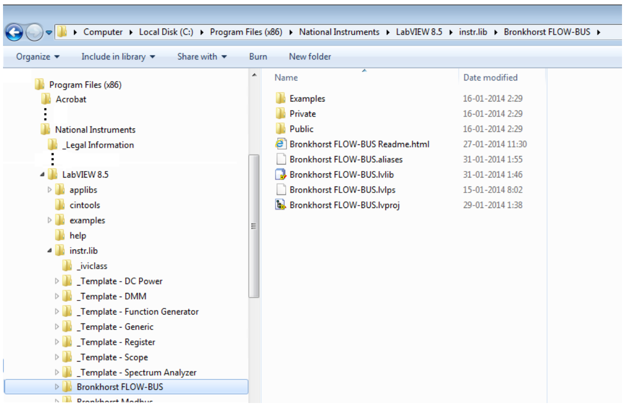
2.2 Manual installation

If installation with the Instrument Driver Finder fails, you can try a manual installation. For the manual installation you will also need to manually download the driver package.

The most recent version of the driver will always be available on NI's Instrument Driver Network (IDNet):
http://sine.ni.com/apps/utf8/niid_web_display.model_page?p_model_id=22575 *or*
http://www.ni.com/downloads/instrument-drivers/

Please make sure you download the driver that is compatible with your installed version of LabVIEW™. After downloading, follow these steps to install the driver:

1. Close LabVIEW™.
2. Extract the downloaded **bronkhorst_flow_bus.zip** file to the instrument library folder (typically located at C:\Program Files\National Instruments\LabVIEW xx\instr.lib*, where 'xx' indicates the installed LabVIEW™ version)
3. Start LabVIEW™, during the start-up process an entry will be created in the instrument driver menu to access the driver VIs.
4. Before you start using the driver it is advised to mass compile the driver VIs. The option Mass Compile can be found under **Tools » Advanced » Mass Compile**, click on this option and perform the following steps to mass compile the driver VIs:
   a. Navigate to the **instr.lib\Bronkhorst FLOW-BUS** folder.
   b. Click the **Current Folder** button.
   c. Click the **Mass Compile** button.
   d. Wait for the process to finish and click on the **Done** button.
5. The driver is now ready to be used.



Name	Date modified
Examples	16-01-2014 2:29
Private	16-01-2014 2:29
Public	16-01-2014 2:29
Bronkhorst FLOW-BUS Readme.html	27-01-2014 11:30
Bronkhorst FLOW-BUS.aliases	31-01-2014 1:55
Bronkhorst FLOW-BUS.lvlib	31-01-2014 1:46
Bronkhorst FLOW-BUS.lvlps	15-01-2014 8:02
Bronkhorst FLOW-BUS.lvproj	29-01-2014 1:38

**** C:\Program Files** is a system folder and is followed by (x86) on 64-bit Windows versions and may differ on non-English Windows versions.*

3 Interfaces

3.1 RS232 on multibus instrument

The RS232 interface on a multibus instrument can be connected to any RS232 V24 serial (computer) port. Make sure to respect the hook-up diagram. Bronkhorst offers special cables for communication, separating the RS232 lines from the power and analog in- and output. On the 9-pin male D-sub connector of the instrument RX and TX are available on pin 6 and pin 1.

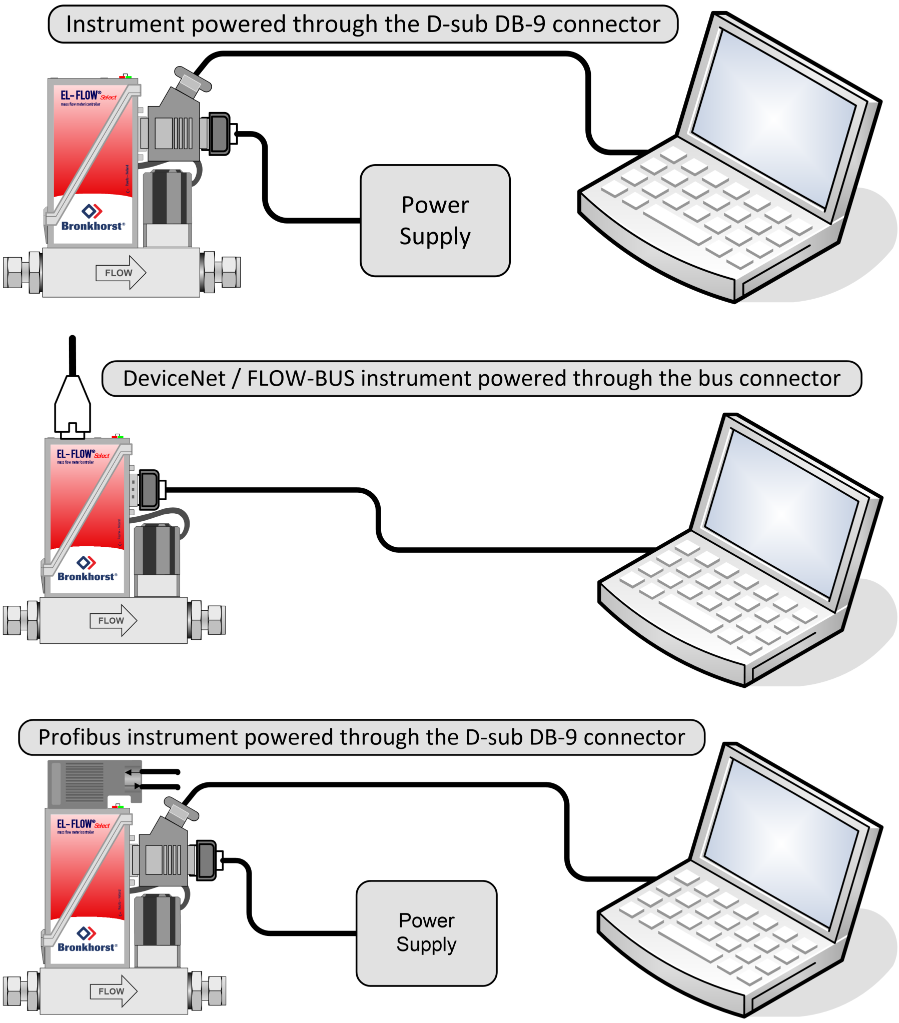
Serial RS232 communication on a multibus instrument with RS232 can be treated as a FLOW-BUS system with one instrument and a FLOW-BUS/RS232 interface. In case a FLOW-BUS fieldbus connection is present, other instruments connected to the FLOW-BUS can be communicated with as well.

RS232 communication is possible by:

- 9-pin Sub-D connector (non-IP65 instruments, e.g. EL-FLOW)
- 8-pin DIN connector (IP65 instruments, e.g. CORI-FLOW)

For the exact connections consult the applicable hook-up diagram for your instrument.

Applications


Instrument powered through the D-sub DB-9 connector
EL-FLOW Select
Bronkhorst
FLOW
Power Supply
DeviceNet / FLOW-BUS instrument powered through the bus connector
EL-FLOW Select
Bronkhorst
FLOW
Profibus instrument powered through the D-sub DB-9 connector
EL-FLOW Select
Bronkhorst
FLOW
Power Supply

By default, the interface offers communication at a baud rate of 38400 baud. On instruments that offer the possibility to change the RS232 baud rate, the baud rate may be configured differently. See the technical documentation of your instrument for supported baud rates.

3.2 RS232/FLOW-BUS interface

The RS232/FLOW-BUS interface is an interface between the FLOW-BUS and the RS232 V24 serial (computer) port. It will either be supplied as a separate enclosed unit with a FLOW-BUS connector and a RS232 connector or as an integral 14TE module of your E-7000 or E-8000 readout and control system. The converter offers communication with a baud rate up to 38400 baud. Communication software support is available. Communication settings are: 38400, n, 8, 1.

D-connector for RS232
The female RS232 (x) (sub miniature 9-pin) D-connector has the following pin configuration:

Pin number	Description
1	not connected
2	TXD
3	RXD
4	not connected
5	0 Vd
6	DTR
7	CTS
8	RTS
9	Shield

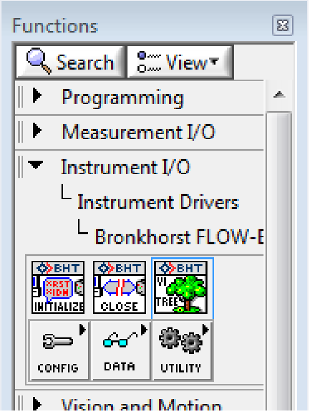
4 Operation

4.1 Accessing driver VIs

Driver VIs can be accessed via the functions palette on the block diagram of a VI.
To access the functions palette:

- open a (new) VI
- open the block diagram
- open the functions palette from the View » Functions Palette menu

The driver VIs are located in the functions palette under Instrument I/O » Instrument Drivers » Bronkhorst FLOW-BUS.



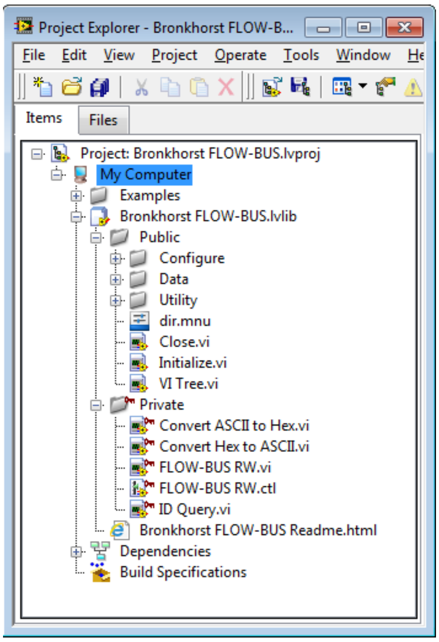
4.2 Driver structure

The driver project consists of a collection of folders with VIs that perform specific tasks.
The **Example** folder contains examples that will get you started with using the driver and building your own applications. They can also be used to test the communication with an instrument.
The **Public** folder contains almost all VIs needed to communicate with an instrument. The VIs are grouped in three sub-folders called **Configure**, **Data**, and **Utility**:

- The **Configure** folder contains VIs that can configure values in an instrument.
  An example of a Configure VI is the Configure Setpoint VI, which is used to write a value for the setpoint parameter to the instrument.
- The **Data** folder contains VIs that can be used to read data from an instrument.
  In order to read data a request command needs to be sent first. An example of a Data VI is the Read Measure VI, which can read the measure value from an instrument.
- The **Utility** folder contains VIs that can read and write to the instruments or do neither. The VIs mostly perform actions that don't affect the measuring and controlling in the instrument, like the Error Query VI that uses a response already received.

The VIs Close, Initialize, and VI Tree are located in the root of the Public folder. The VIs Initialize and Close are needed to initialize (open) and close the connection with the COM port on which the instrument or FLOW-BUS to RS232 Converter is connected. The VI Tree gives you an overview of all VIs in the driver project on its block diagram.

The **Private** folder contains VIs that are used in other driver VIs. These VIs are not meant to be used on their own, and can only be used inside driver VIs.

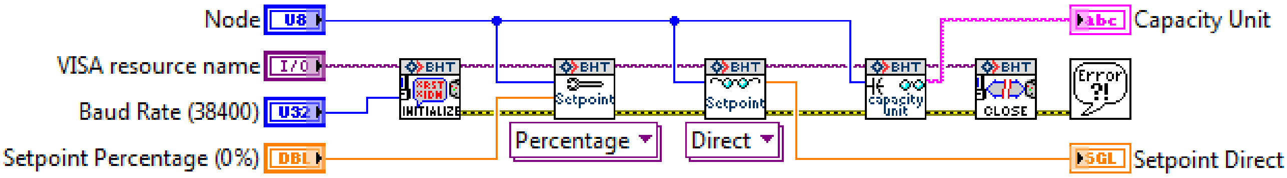


On all VIs that can communicate with an instrument, the VISA resource name in, the VISA resource name out, the Error in, the Error out, and the Node Address connections need to be connected. The Node Address connector is used to address the correct instrument when multiple instruments are connected on a bus. The VISA resource name-in and -out connections are used to pass the connection with the COM port, that gets initialized by the Initialize VI, between VIs. The Error in/out connections are used to pass errors between VIs and need to be connected in order for the driver VIs to report errors properly.

For more information about the various tasks the specific VIs perform, or for the process and parameter values of the parameter accessed in the VI, utilize the context help in LabVIEW™. To enable the context help, click on the **Help » Show Context Help** option in the menu or use the keyboard shortcut **CTRL+H**. Information about a VI or front panel control will show up when you hover over a VI or control for a few moments.

4.2.1 Basic application structure

The block diagram below shows an example from the example folder in the driver project. It concerns the **Setpoint Configure and Read VI**. This example initializes the connection, writes the setpoint (percentage) and reads back the setpoint (direct) and capacity unit from the selected instrument. After all values are read and written, the connection is closed and the program stops.



This is just an example of a very basic application using only a few of the VIs available. Bigger and more advanced applications can incorporate loops, case structures and events to create interactive front panels. These more advanced applications can be used to configure instrument settings and display the data read back from the instrument. An example of such an application is the Bronkhorst® FLOW-BUS Instrument Control Application VI in the Examples folder.

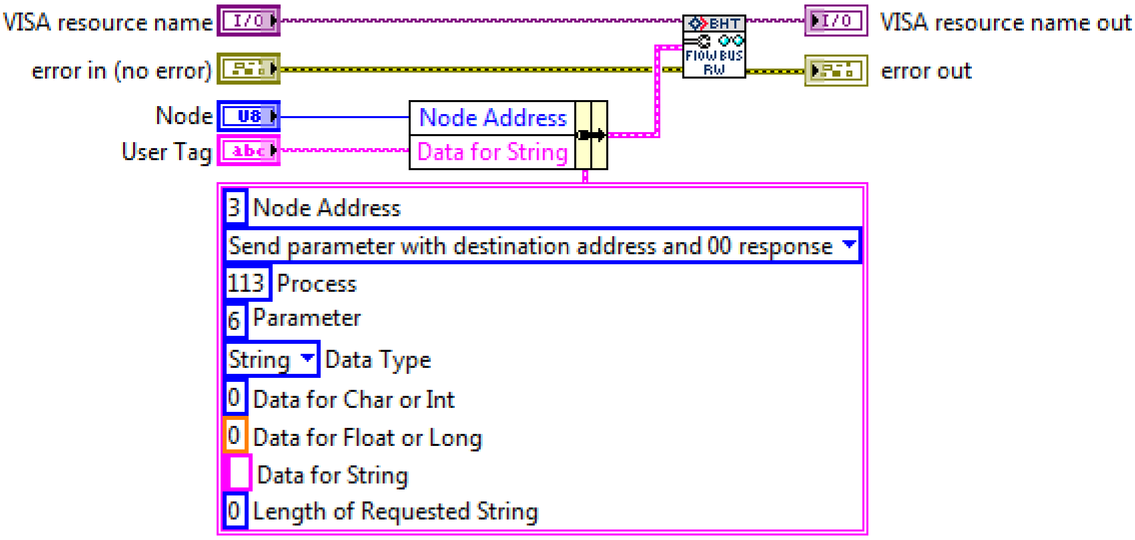
The **Initialize-** and **Close-VI** need to be present in every application. Those two VIs are used to open the connection to the COM port with the correct settings, and to close that connection when the application is finished. Without proper initialization communication to the instrument is not possible, and not closing the connection can result in errors when using the COM port in other applications.

LabVIEW™ applications can be made as complex as you need them to be. Just make sure that all VISA and Error connections are connected, initialized, and closed properly to insure correct operation.

To add functionality to the driver some knowledge of the driver VI structure is needed. This information is available in the next sections. Parameter properties can be found in the parameter properties table in the RS232 interface manual (document no. 9.17.027).

4.2.2 Standard driver VI structure

The image below shows the block diagram of the **Configure Counter Limit VI**, which can be found in the **Configure » Counter** folder. This VI configures the counter limit/batch in units selected with the **Configure Counter Unit VI**. The value is a float in IEEE-754 32-bits single precision notation of which the default setting is 0 ln.



3 Node Address
Send parameter with destination address and 00 response
113 Process
6 Parameter
String Data Type
0 Data for Char or Int
0 Data for Float or Long
Data for String
0 Length of Requested String

All driver VIs that communicate to an instrument use a **FLOW-BUS RW VI**. This VI is located in the Private folder that corresponds to the VIs function. The **FLOW-BUS RW VI** takes the values from the input cluster and uses these values to create a command string that complies with the FLOW-BUS protocol. The values needed to read from, or write to, a specific parameter can be found in the parameter properties table in the RS232 interface manual (document no. 9.17.027). In the cluster in the image above you can see all the settings to configure the counter limit. These inputs are:

Node Address	The address of the instrument (node) the message is meant for.
Communication Command	The type of command to send (Send parameter or Request parameter).
Process	The process number of the parameter.
Parameter	The parameter number of the parameter.
Data Type	The data type of the parameter.
Data for [data type]	The data that will be sent to the selected parameter in the selected instrument.

Constants that are not used will keep their default values.

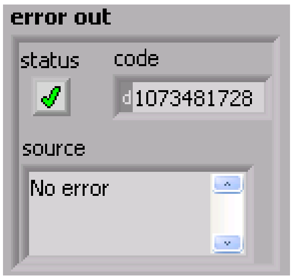
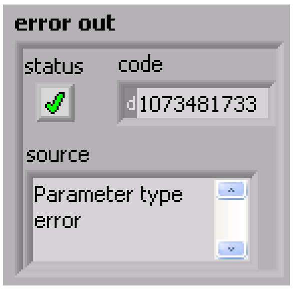
In the image above the controls for the **Node Address** and the **Data for Float or Long** are wired into the cluster. Wiring controls into the cluster makes the VI interactive, as the values can now be changed from the front panel. The controls are wired into the cluster by means of the **Bundle by Name** function that only changes the selected values. The other values are copied from the input cluster constants.

Most driver VIs closely resemble the pictured above. The output of the **Configure Counter Limit VI** does not need to be converted before passing it into the **FLOW-BUS RW VI**, but there are other Configure VIs outputs which need to be converted.

The block diagram of a Read VI looks similar to the block diagram of a Write VI. Because there is no data to be send, the parameters **Data for [data type]** are missing.

4.2.3 Instrument Driver Error Codes

In addition to VISA error codes, the following 'developer defined warnings' are implemented:

'error out' code		Developer defined warnings		
Dec	Hex	Error Code	Description	
1073481728	3FFC0800	00	No error	Example 1 'No error'  error out status ✓ code d1073481728 source No error Example 2 'Parameter type error'  error out status ✓ code d1073481733 source Parameter type error
1073481729	3FFC0801	01	Process claimed	
1073481730	3FFC0802	02	Command error	
1073481731	3FFC0803	03	Process error	
1073481732	3FFC0804	04	Parameter error	
1073481733	3FFC0805	05	Parameter type error	
1073481734	3FFC0806	06	Parameter value error	
1073481735	3FFC0807	07	Network not active	
1073481736	3FFC0808	08	Time-out start character	
1073481737	3FFC0809	09	Time-out serial line	
1073481738	3FFC080A	0A	Hardware memory error	
1073481739	3FFC080B	0B	Node number error	
1073481740	3FFC080C	0C	General communication error	
1073481741	3FFC080D	0D	Read only parameter.	
1073481742	3FFC080E	0E	Error PC-communication	
1073481743	3FFC080F	0F	No RS232 connection	
1073481744	3FFC0810	10	PC out of memory	
1073481745	3FFC0811	11	Write only parameter	
1073481746	3FFC0812	12	System configuration unknown	
1073481747	3FFC0813	13	No free node address	
1073481748	3FFC0814	14	Wrong interface type	
1073481749	3FFC0815	15	Error serial port connection	
1073481750	3FFC0816	16	Error opening communication	
1073481751	3FFC0817	17	Communication error	
1073481752	3FFC0818	18	Error interface bus master	
1073481753	3FFC0819	19	Timeout answer	
1073481754	3FFC081A	1A	No start character	
1073481755	3FFC081B	1B	Error first digit	
1073481756	3FFC081C	1C	Buffer overflow in host	
1073481757	3FFC081D	1D	Buffer overflow	
1073481758	3FFC081E	1E	No answer found	
1073481759	3FFC081F	1F	Error closing communication	
1073481760	3FFC0820	20	Synchronisation error	
1073481761	3FFC0821	21	Send error	
1073481762	3FFC0822	22	Protocol error	
1073481763	3FFC0823	23	Buffer overflow in module	

The last byte from the 'error out' code (hexadecimal) in Labview corresponds to
the FLOWBUS-RS232 'STATUS MESSAGE' number, See also chapter "STATUS MESSAGE" in manual 9.17.027

4.3 Adding driver VI

The most important part of the driver is the building of command strings and the extraction of information from the instruments response. These functions are performed by the **FLOW-BUS RW VI** that can be found in the Private folder. This chapter offers a quick overview of the inputs required to start sending and receiving data with the **FLOW-BUS RW VI**. More information about the **FLOW-BUS RW VI** can be found in the block diagram and in the context help of the VI.

4.3.1 Sending parameter

The following values have to be present in the cluster that feeds the **FLOW-BUS RW VI** in order to send a parameter to an instrument.

Node Address	The address of the instrument (node) the message is meant for.
Communication Command	The type of command to send (send parameter with destination address and 00 response).
Process	The process number of the parameter.
Parameter	The parameter number of the parameter.
Data Type	The data type of the parameter.
Data for *[data type]*	The data that will be sent to the instrument, different data types require to be input in different inputs.

All of these values can be found in the parameter properties table in the 'Instruction manual RS232 interface' (document no. 9.17.027).

4.3.2 Requesting parameter

The following values have to be present in the cluster that feeds the **FLOW-BUS RW VI** in order to request a parameter from an instrument.

Node Address	The address of the instrument (node) the message is meant for.
Communication Command	The type of command to send (request parameter).
Process	The process number of the parameter.
Parameter	The parameter number of the parameter.
Data Type	The data type of the parameter.

The output data depends on the **Data Type**. There are three data outputs, one for **Character or Integer** values, one for **Float or Long** values, and one for **Strings**. If the requested Character or Integer value is a negative or signed value, the output value needs to be converted to a signed integer.

All of these values can be found in the parameter properties table in the 'Instruction manual RS232 interface' (document no. 9.17.027).

To make these functions interactive, wire a front panel control to one of the cluster values by using the **Bundle by Name** function (see Standard driver VI structure).

It is important to know that not all parameters are available on all FLOW-BUS instruments. Therefore not all VIs will work on all FLOW-BUS instruments. For more details about parameters and their use see the technical documentation of your instrument. The Bronkhorst® software application FlowDDE also gives an overview of which parameters are available on which devices.

4.3.3 Example

This example shows how to create a VI that can configure the user tag of an instrument.
First we need the values of the following parameters:

- Node Address
- Communication Command
- Process number
- Parameter number
- Data Type
- Data

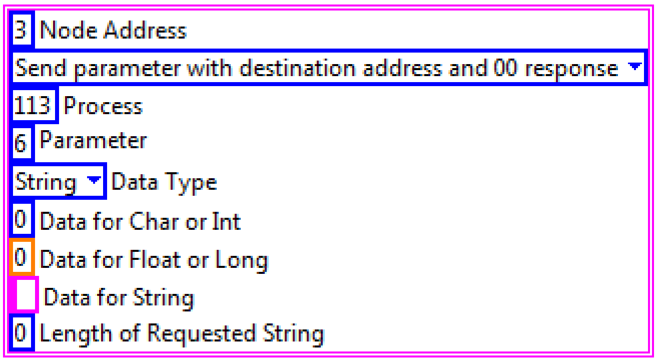
These parameters can be found in the the parameter properties table:

Parameter number (DDE)	Parameter name	Group 0	Group 1	Group 2	Process number	FB nr (par)	Var Type	Var Length	...
115	User tag	11			113	6	c	-2	...

The next step is to enter the values in the corresponding fields of the **FLOW-BUS Command Cluster**. Note:

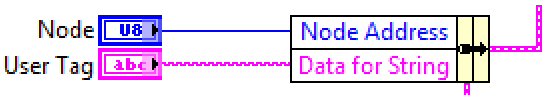
- The **Communication Command** will be set to “send parameter with destination address and 00 response” which corresponds to a write command with a status reply.
- The combination of Var Type c and Var Length -2 indicates the data type is a string, so the **Data Type** will be set to String.

When all settings are entered the cluster should look like this:

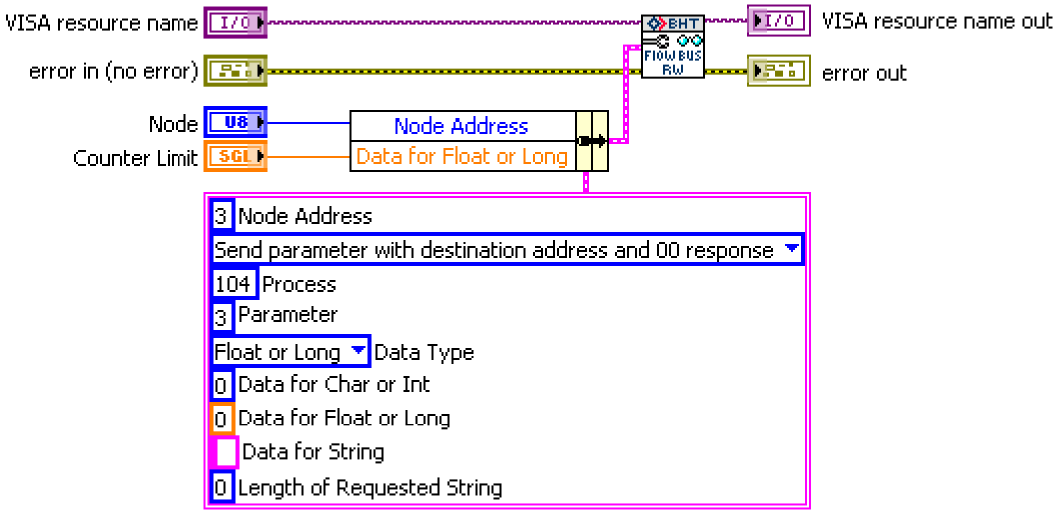


3 Node Address
Send parameter with destination address and 00 response
113 Process
6 Parameter
String Data Type
0 Data for Char or Int
0 Data for Float or Long
Data for String
0 Length of Requested String

If this cluster is wired to the **FLOW-BUS RW VI**, every time the VI is executed, the same values will be sent. To make the VI interactive, the controls of the node address and the string data can be wired into the cluster. To do this, wire the cluster to the **Bundle by Name** function and select the **Node Address** and the **Data for String** as the inputs. Then create controls for these two values and connect the output cluster to the **FLOW BUS RW VI**.



When everything is connected the VI can be used just like any other driver VI. The block diagram of the completed VI is shown below.



3 Node Address
Send parameter with destination address and 00 response
104 Process
3 Parameter
Float or Long Data Type
0 Data for Char or Int
0 Data for Float or Long
Data for String
0 Length of Requested String

If you compare the image above to the image in Standard driver VI structure or any other driver VI, you will see a lot of similarities. The only differences are the entered values, and possibly the conversion of the data to write to the instrument. Therefore the easiest way to make a new driver VI is to copy an existing one and change the necessary controls, indicators and values.

5 Service

For current information on Bronkhorst® and service addresses, please visit our website:

🌐 **http://www.bronkhorst.com**

Do you have any questions about our products? Our Sales Department will gladly assist you selecting the right product for your application. Contact sales by e-mail:

✉ **sales@bronkhorst.com**

For after-sales questions, our Customer Service Department is available with help and guidance.
To contact CSD by e-mail:

✉ **support@bronkhorst.com**

No matter the time zone, our experts within the Support Group are available to answer your request immediately or ensure appropriate further action. Our experts can be reached at:

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