CHEMYX
PRECISION SYRINGE PUMPS

Preliminary version

LabVIEW Driver

User guide
Version 0.0.4
2016

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Version History

Manual Version History

Manual version	Driver version	Date	Modifications
1.0.0	1.0.0	Aug 24, 2016	First release

Driver Version History

Driver version	Date	Modifications
1.0.0	Aug 24, 2016	First release

Copyright

<TODO>: Different copyright from Chemyx?

Operational Safety

<TODO>: Copied from Chemyx pump manual?

Please read the following safety precautions to ensure personal safety and operational longevity of the Chemyx syringe pump. Chemyx, Inc. is not responsible for the equipment if used in a manner not specified by the manufacturer; warranty coverage provided by the equipment may be dropped as a result.

CHEMYX PRODUCTS ARE NOT FOR USE ON HUMANS

USE PROPER POWER SUPPLY

Chemyx Inc is not responsible for the use of power supplies outside the stated electrical specifications or failure to switch the power converter from 240V to 120V while in the 240V environment or vice versa.

GROUND PRODUCT

Proper grounding is required.

DO NOT OPEN THE PUMP

Warranty coverage will be dropped if the pump is opened without authorization from Chemyx. Do not touch any electric connectors on the product.

DO NOT OPERATE WITH SUSPECTED FAILURES

Even though the pump can operate at extremely fast speeds, the user must determine the proper flow rate for any given application. For instance, pumping at 90ml/min using a 20 gauge needle will cause stalls and/or potential bursting of the syringe. Chemyx is not responsible for any damage that might result from examples similar to above.

PINCH HAZARD

Do not place fingers between the pusher block and end block while the pump is running.

OBSERVE ALL WARNING LABELS ON PRODUCT

Read all labels on product to ensure proper usage.

CHEMYX IS NOT RESPONSIBLE FOR SYRINGE DAMAGE

It is the user’s responsibility to wet ground glass syringes and set / tighten the safety nut appropriately for microsyringes.

Warranty and Support

<TODO>: Check with Chemyx

This software and driver is provided by Chemyx "as is" and any express or implied warranties, including, but not limit to, the implied warranty of mechantability and fitness for a particular purpose are disclaimed. In no event shall Chemyx or any contributor be liable for any direct, indirect, incidental, special exemplary, or consequential damage (including, but not limited to, procurement of substitute goods or services, loss of use, data, or profits; or business interruption). However caused and on any theory of liability, whether in contract, strict liability, or tort (including negligence or otherwise) arising in any way out of the use of the provided driver or software, even if advised of the possibility of such damage.

Chemyx does not warrant that the functions contained in the provided driver and software will meet any requirement or that the operation of the software will be error free.

Chemyx does not provide technical support for the driver and software described here.

The software and driver described here are freeware to control Chemyx syringe pumps.

Introduction

<TODO>: Add info from Chemyx?

This manual describes the LabVIEW driver to operate the Chemyx syringe pumps. The driver is divided into two categories: basic driver and advanced driver. The basic driver contains VIs for simple commands and to obtain the current status of the pump.

The advanced driver contains VIs to set the various parameters of the pump to configure one or multiple infusion or withdrawal.

An example VI is provided for each of the driver category: Basic example and Advanced example.

For more information about the Chemyx syringe pump, see Contact information.

Requirements

Computer running LabVIEW 2015 or later.

The computer must be equipped with a serial port or a USB port.

How to get started

Make sure that your computer meets the requirements.

Install the driver according to the installation instructions.

Connect the pump to the computer.

Run the Basic example and the Advanced example.

Start programming the syringe pump using LabVIEW.

Installation

Before installing the driver, make sure the computer meets the requirements.

Select the section below corresponding to the format of the file provided for the driver.

Driver format: VIPM package (*.vip)

If the code is provided as a VIPM package (.vip file), open the file by double-clicking it or opens VIPM. If VIPM is not installed on your computer (it is typically automatically installed with LabVIEW). Get more detail in the VIPM Installation page. You can download VIPM for free from: vipm.jki.net/download.

Once the package is open in VIPM, select the version of LabVIEW on which you want to install the driver. Click Install.

Driver format: Installer (*.exe)

If the code is provided as an installer file (*.exe), runs the executable and follow the instructions.

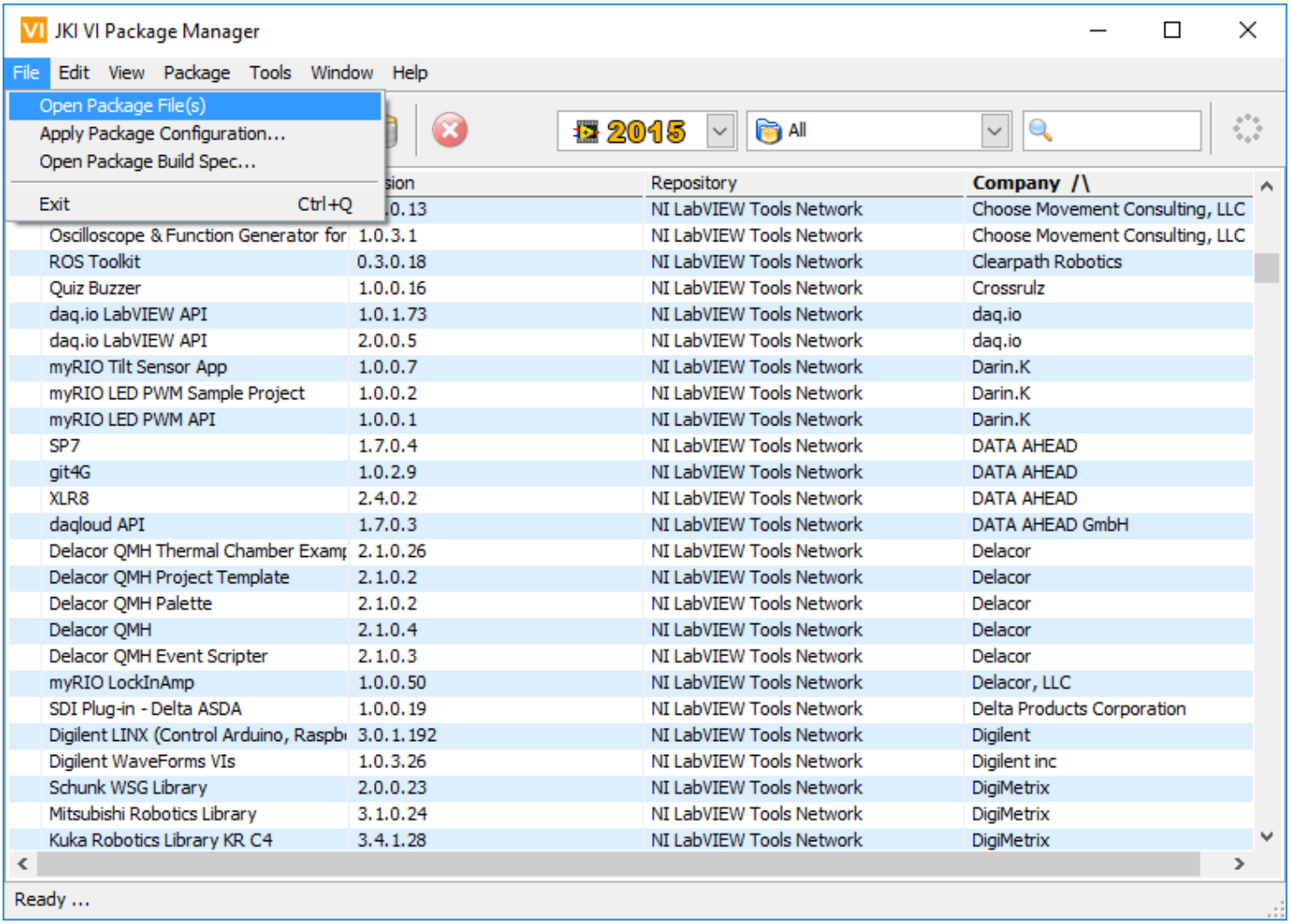
Driver format: Zip file (*.zip)

Unzip the file at the desired location of your hard drive.

VIPM Installation

VIPM from JKI is installed by default with LabVIEW. If VIPM was not installed on your system, you can download and install it from the vipm.jki.net/download.

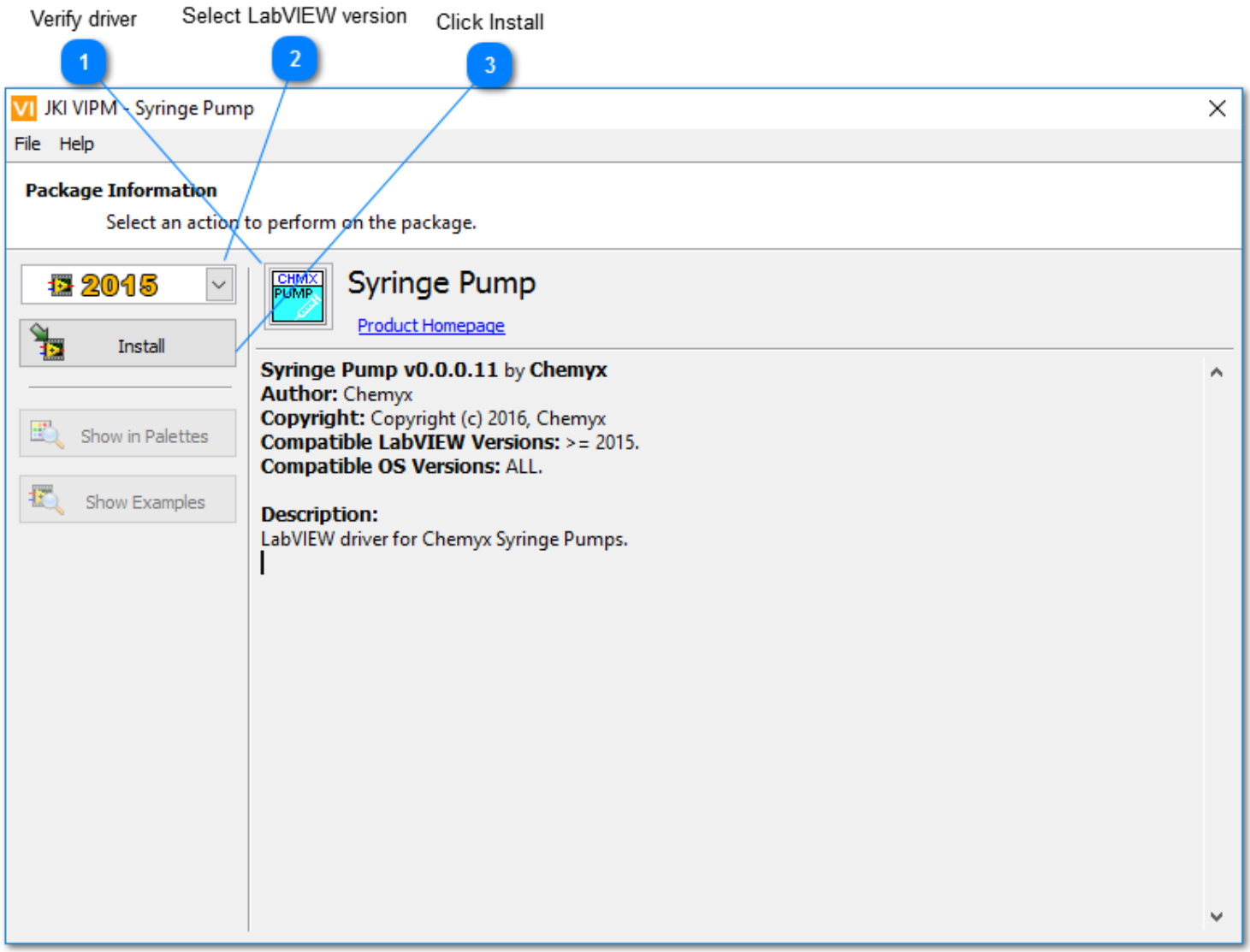
Double click the provided .vip file or open the file using VIPM (see image below).



A dialog giving information about the driver appears (see image below). Make sure that the information corresponds to the desired driver.

Select the LabVIEW version where you want the driver to be installed.

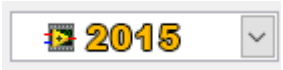
Click install.



1 Verify driver

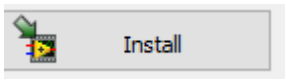
Verify that the provided information correspond to the desired driver.

2 Select LabVIEW version



Make sure that the LabVIEW version where you want the driver to be installed is selected in the roll-down menu shown here.

3 **Click Install**



Click install. Make sure to respond to any window dialog that could appear.

Connection

Connect the pump using the provided USB cable or the RS232 cable to your computer. If using the USB port, make sure to use the USB port on the pump marked with the word "USB".

Select the Serial port (COM1, 2, or other) value on the VI corresponding to the actual port of your computer.

Hint: if you are using a USB port, the COM value appears or disappears when connecting or disconnecting the pump when it's ON. (Select Refresh if necessary).

Select the baud rate (9600 or 38400) corresponding to the set value of the pump (Go see the setting menu).

RS232 Operations

Cable Requirements
In order to interface to a PC you need the following hardware cable pictured below:

DB9 Serial Cable Male to Female
Strait though configuration. Do not purchase a "Null Modem," "crossover," or "crossed over" cables.

USB to RS232 Dongle Converters
Due to the large numbers of computers made without RS232 ports, USB to RS232 dongles have been popular to "emulate" a RS232 port. Most but not all USB to RS232 dongles work with chemyx pumps due to driver conflict issues.

Communication settings

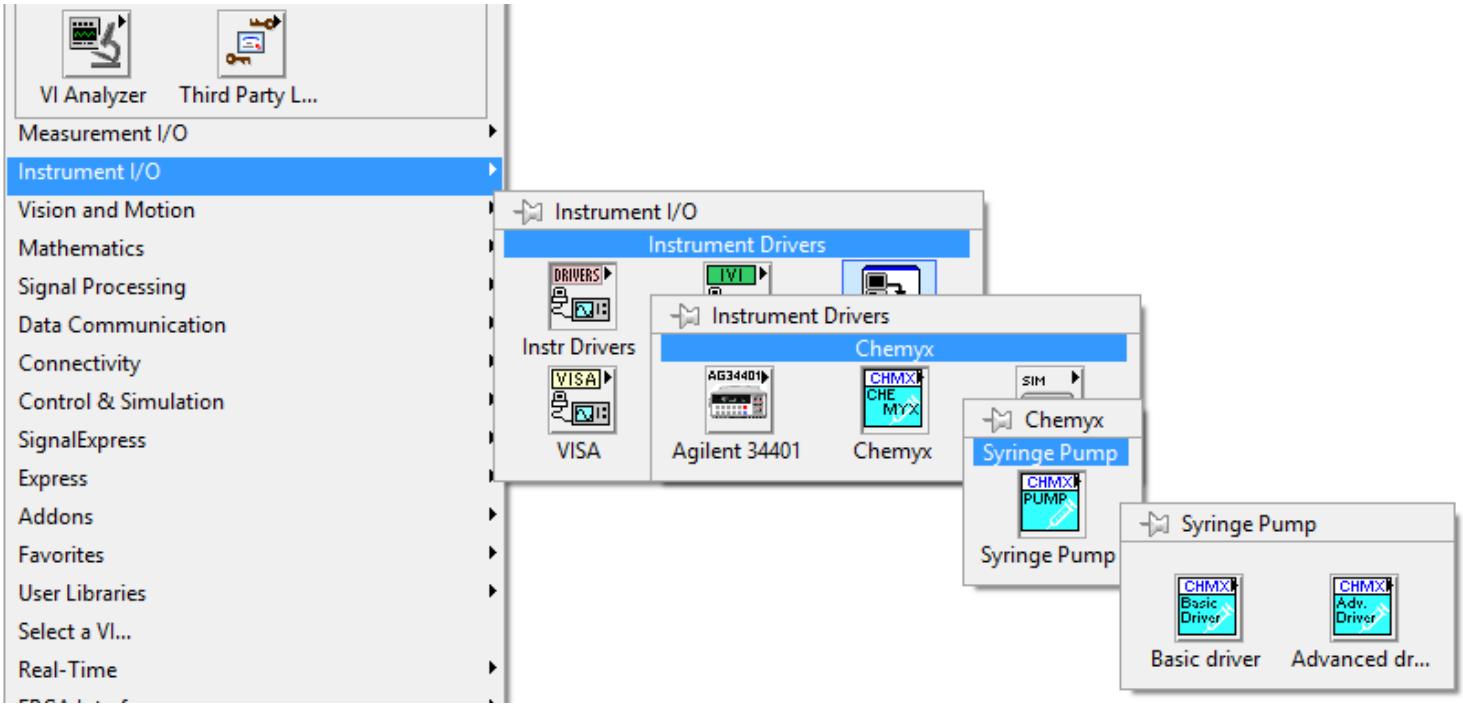
RS232 COMport Settings: All system from 11/1/2010

- Bits per Seconds: 9600 or 38400, set in the pump setting menu.
- Data Bits 8
- Parity None
- Stop Bit 1
- Flow Control None

Note: Settings are same for both DB9 and USB COM ports

Driver use

If the driver was installed using VIPM or an executable, the VIs of the driver can be accessed in the block diagram through the Functions >> Instrument I/O >> Chemyx >> Syringe Pump sub-palette (see image below).

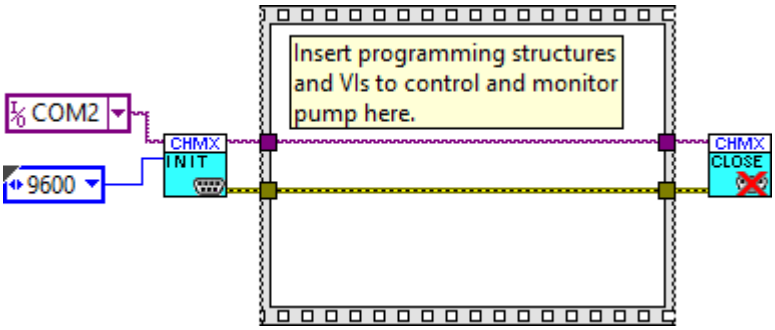


The VIs are divided in two drivers, Basic driver and Advanced driver.

The driver VIs can also be accessed using Quick Drop.

The Basic example and the Advanced example illustrate how to use the VIs to control and monitor the syringe pump.

At the minimum, the communication must be opened using the Initialize_comm.vi, and close at the end of the application using Close_comm.vi, both VIs are located in the Communication sub-palette (see image below).

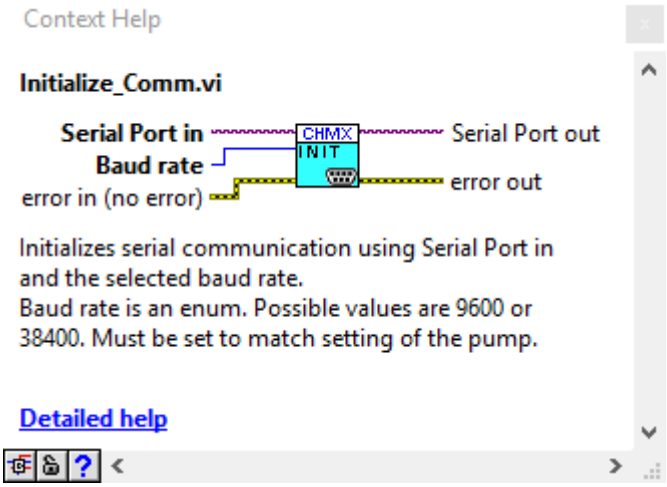


Help

You can find the pump manual using the following link: www.chemyx.com/support/downloads-and-manuals/syringe-pump-manuals/.

All provided VIs of this driver contain a description in the VI in the Documentation category of the VI properties. Additional details can be obtained in the manual that can be accessed through the "Detailed help" link or the blue question mark button of the LabVIEW Context Help window (see image below). Note that the additional help is accessible in the context help window only if the driver was installed using VIPM from JKI.

A PDF version of the manual can also be found in the directory where the driver was installed ("<LabVIEW>\instr.lib\Chemyx\Syringe Pump" when installed using VIPM from JKI).



LabVIEW code

The LabVIEW code provided for the Chemyx Syringe pumps consists of two parts: the syringe pump driver that contains the VIs to control and communicate with the pumps, and of two examples that demonstrate how to use the driver VIs.

The syringe pump driver is divided into two sub-drivers: basic driver and advanced driver.

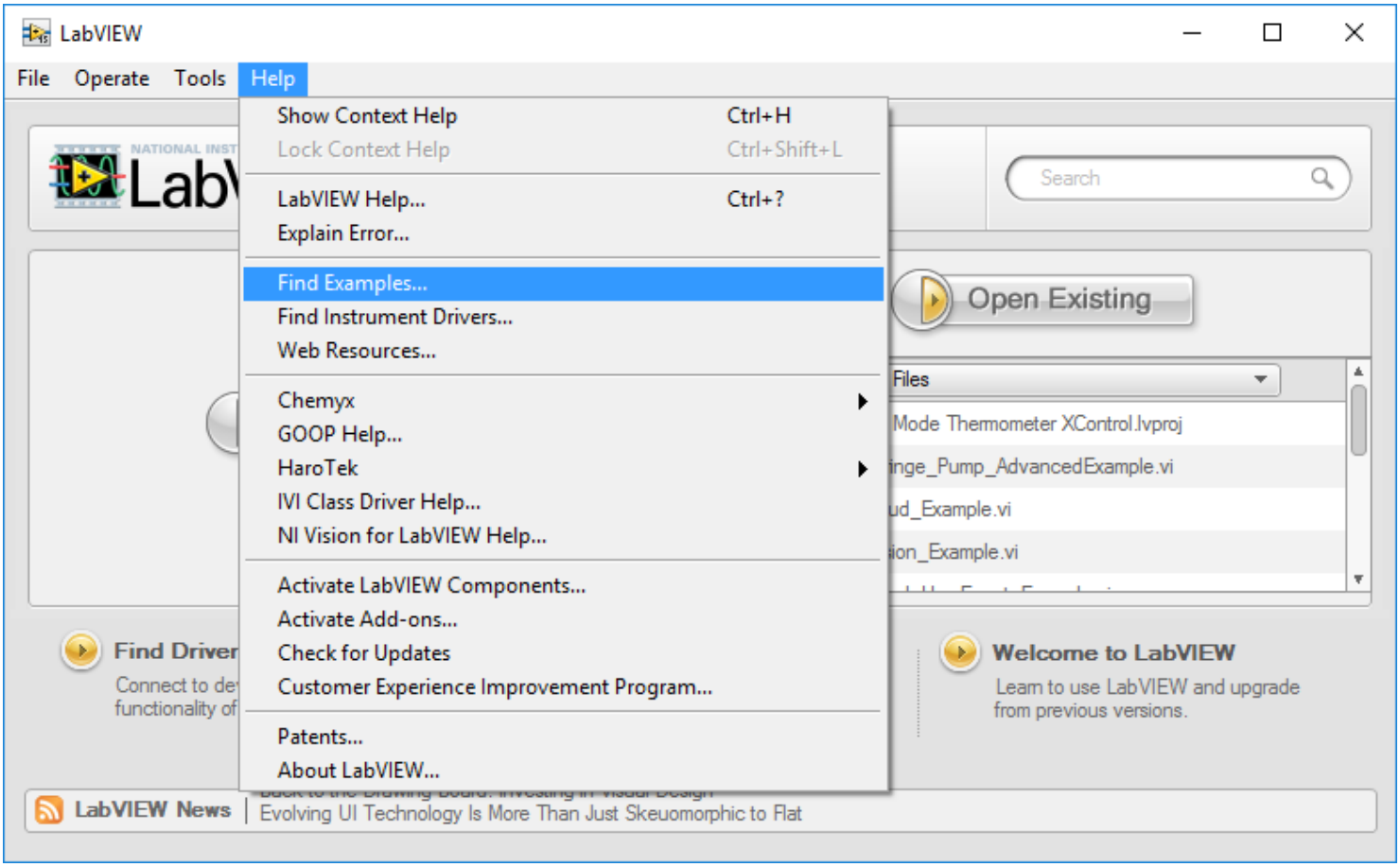
Examples

Two example VIs are provided with the LabVIEW Syringe Pump drivers to illustrate how to control the pump using a computer and LabVIEW.

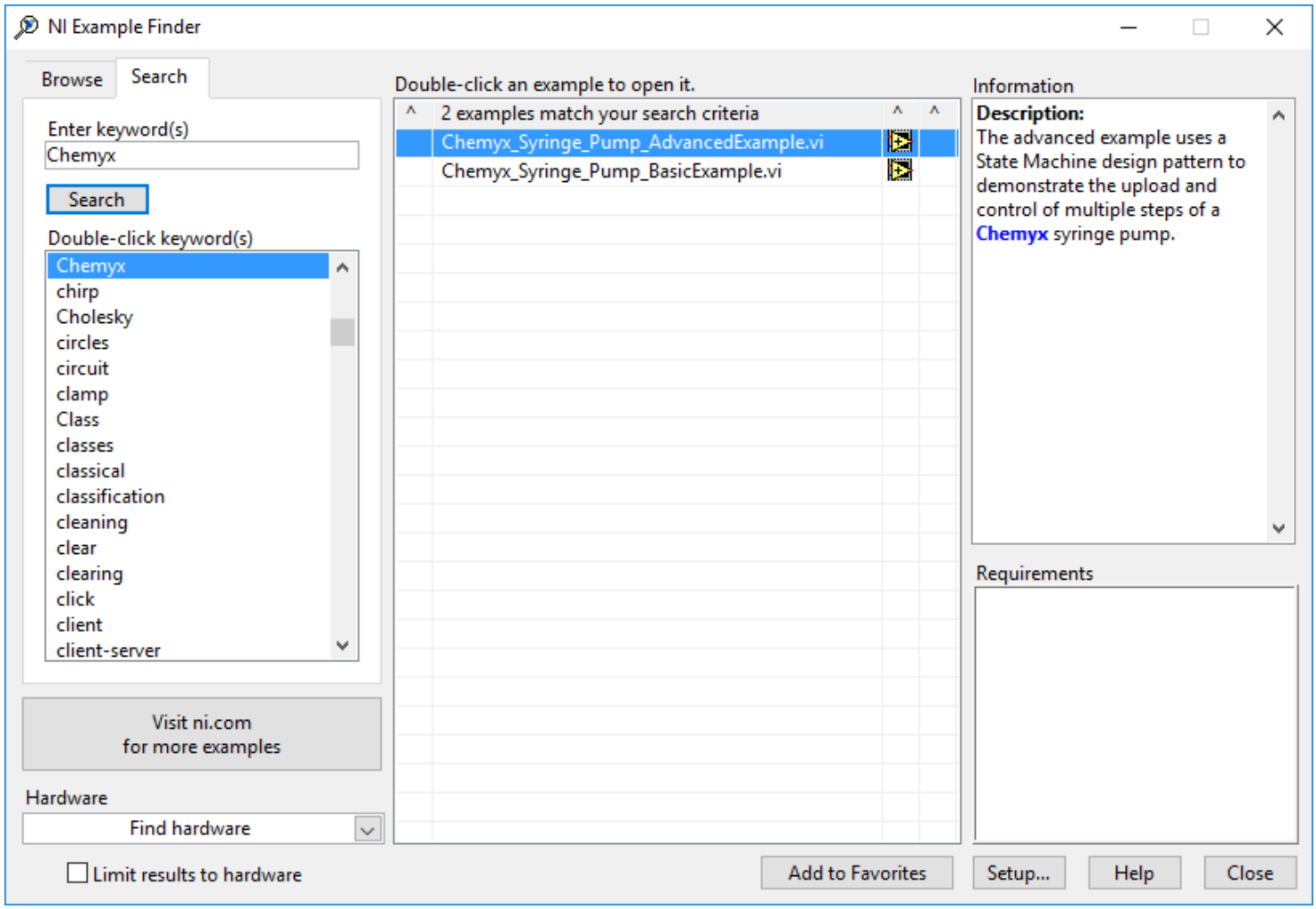
The Basic Example is a simple VI that demonstrates how to use the Basic driver VIs to operate the pump with the basic commands Start, Stop, Pause, and Reset, and how to obtain read the pump status.

The Advanced Example uses a State Machine Design Pattern to demonstrate the use of the Basic and the Advanced driver VIs to control the pump but also to set the parameters for single or multiple steps.

The examples can be opened, after installation using VIPM, through the "Find Examples..." item of the LabVIEW help menu.



Once the NI Example Finder is open, select the Search tab and type "Chemyx" in the "Enter keyword(s)" box. Click on search and the two examples will be listed in the center list of the window (see image below). Double click the example you desire to open.


NI Example Finder
Browse
Search
Enter keyword(s)
Chemyx
Search
Double-click keyword(s)
Chemyx
chirp
Cholesky
circles
circuit
clamp
Class
classes
classical
classification
cleaning
clear
clearing
click
client
client-server
Visit ni.com
for more examples
Hardware
Find hardware
Limit results to hardware
Double-click an example to open it.
2 examples match your search criteria
Chemyx_Syringe_Pump_AdvancedExample.vi
Chemyx_Syringe_Pump_BasicExample.vi
Information
Description:
The advanced example uses a State Machine design pattern to demonstrate the upload and control of multiple steps of a Chemyx syringe pump.
Requirements
Add to Favorites
Setup...
Help
Close

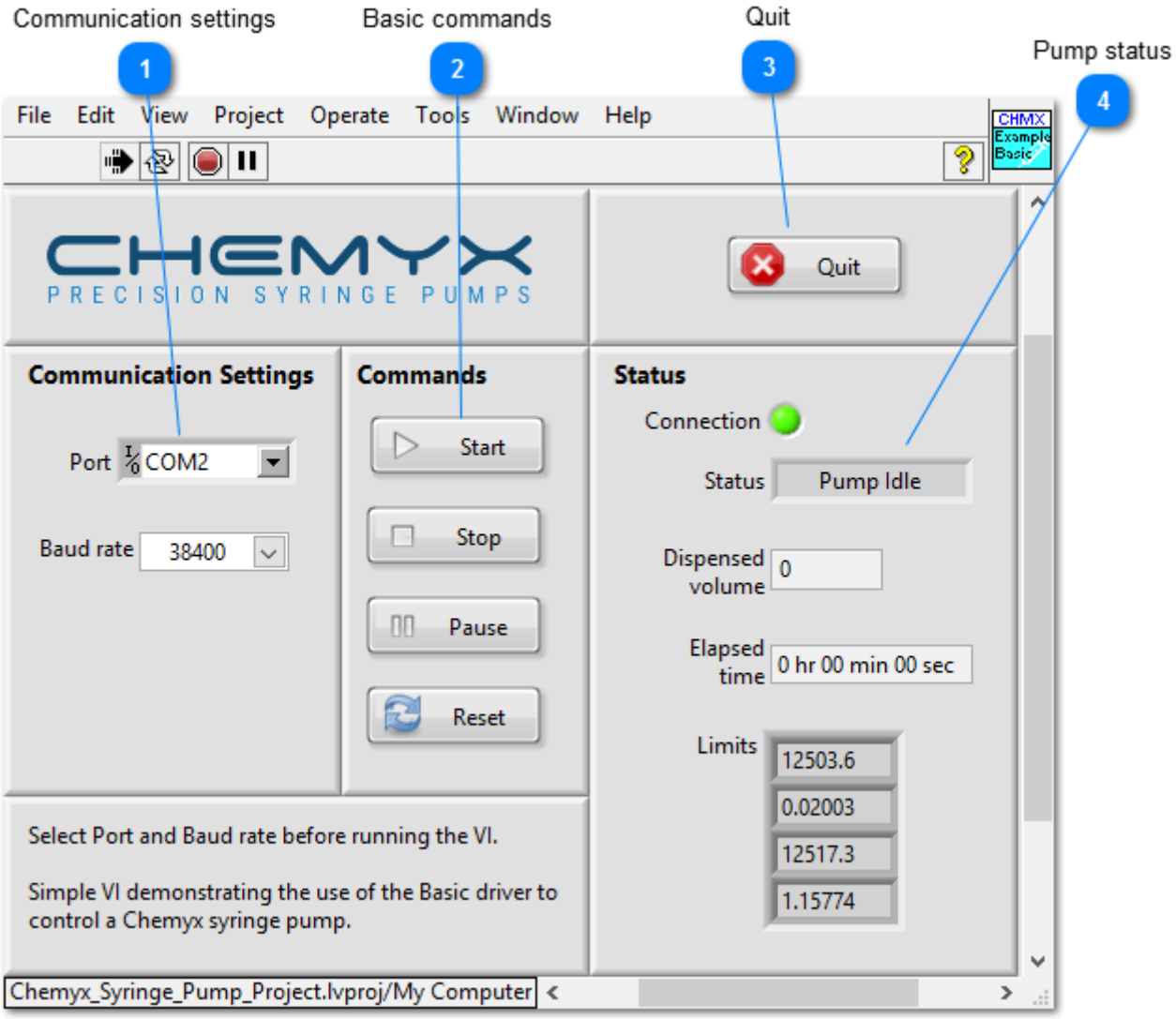
Basic Example

The basic example gives an illustration of how to use the basic driver. The basic example uses a general design pattern based on a while loop and an event structure to demonstrate basic operations of the LabVIEW driver for Chemyx syringe pumps.

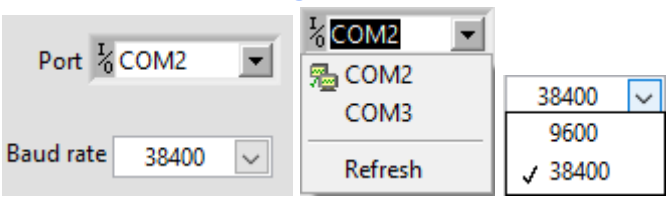
Communication settings (Port and Baud rate) must be set before running this VI.

The basic example can be used to start, stop, and pause operations of the syringe pumps. The pump must be manually configured directly on the pump.

The status of the pump is queried and displayed.



1 Communication settings

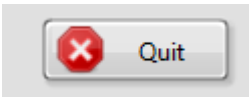


Selects the communication port and the baud rate of the pump from the available lists. Those two settings must be set before running the VI.

2 Basic commands

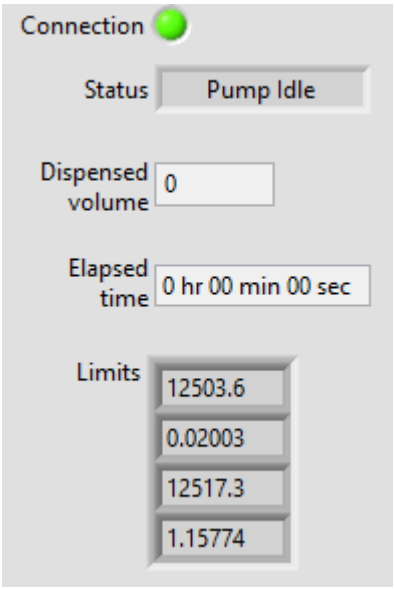
Starts the operation using the currently uploaded parameters, and Stops, and Pauses the pump operations. Reset restarts the pump.

3 Quit



Quits the application. Closing the window while the VI is running has the same effect than clicking the Quit button.

4 Pump status



Connection led is ON when the pump is successfully connected. Displays the status of the pump, the dispensed volume, the elapsed time and the limits.

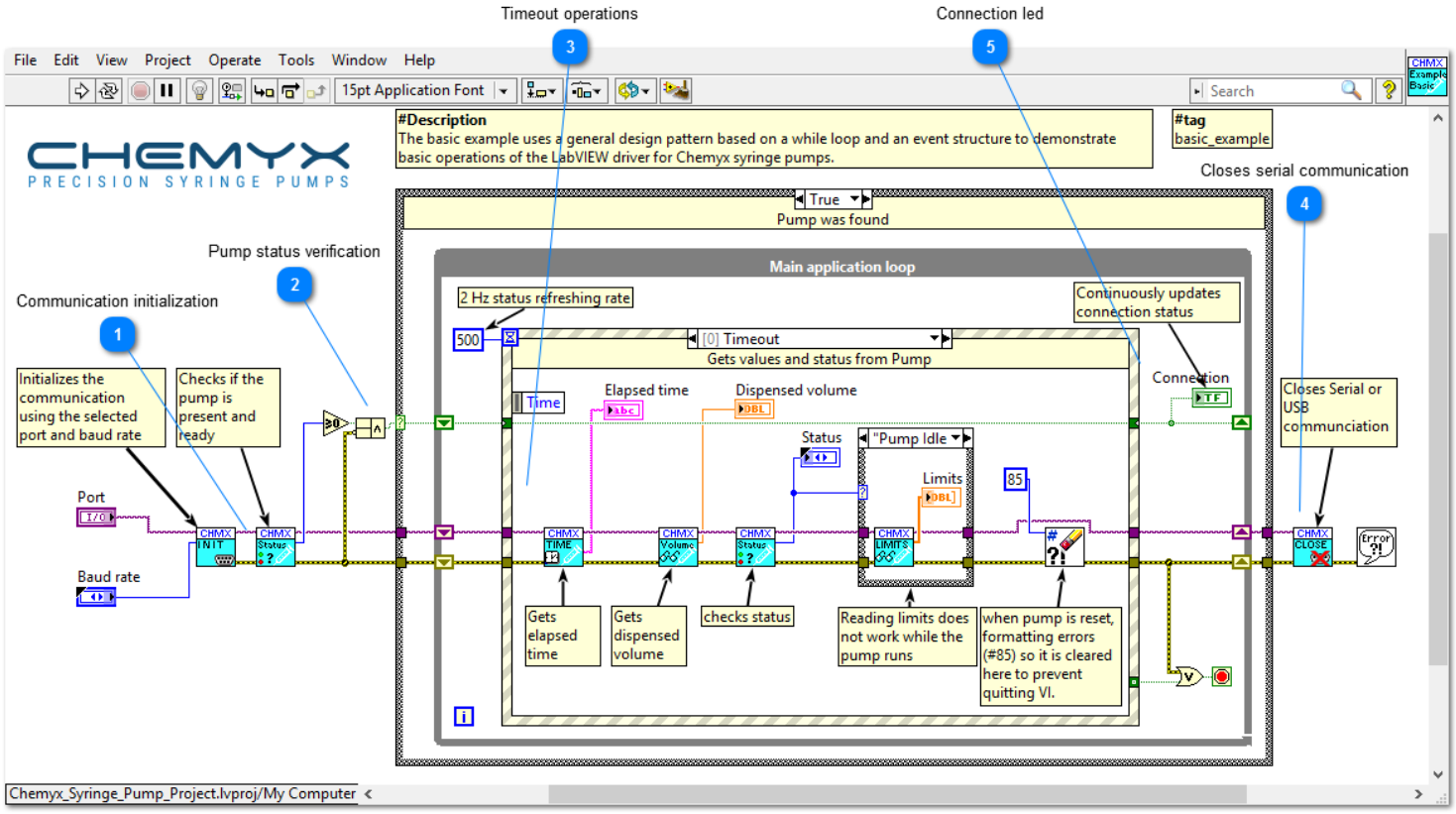
Basic block diagram

The block diagram of the basic example VI.

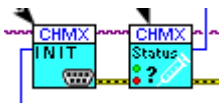
This basic example consists of a simple while loop with an event structure. The serial communication is initialized outside the loop and the while loop is executed only if the pump status is larger or equal to 0.

The timeout value of the event structure is set to 500 ms. When the timeout case of the event structure is executed, the elapsed time, the dispensed volume, the pump status, and the pump limits are obtained from the pump. Notice that a case structure prevents the limits to be queried from the pump while the pump is running because the pump returns only zeros in that case.

The event structure is configured for the Start, Pause, Stop, and Reset buttons. For each of those case, start, pause, stop, and reset VIs are executed.

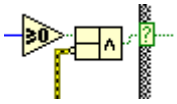


1 Communication initialization



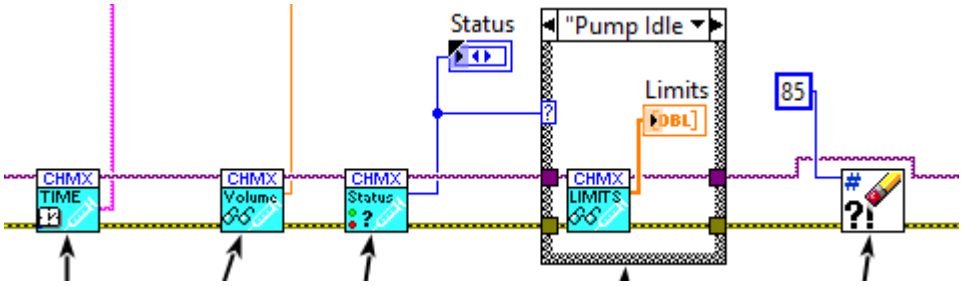
VIs used to initialize serial port communication and to check the status of the pump.

2 Pump status verification



If the status is smaller than 0, or if an error occurred, no pump was found. The user is then notified and the application is terminated.

3 Timeout operations

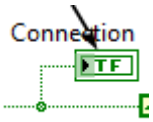


The timeout case of the event structure runs every 500 ms, as set by the timeout value, if no event is generated by the user. Elapsed time, dispensed volume, pump status, and limits are therefore obtained at a rate of 2 Hz. The limits cannot be obtained while the pump is running.

4 Closes serial communication

Serial communication is closed when the VI is terminated.

5 Connection led



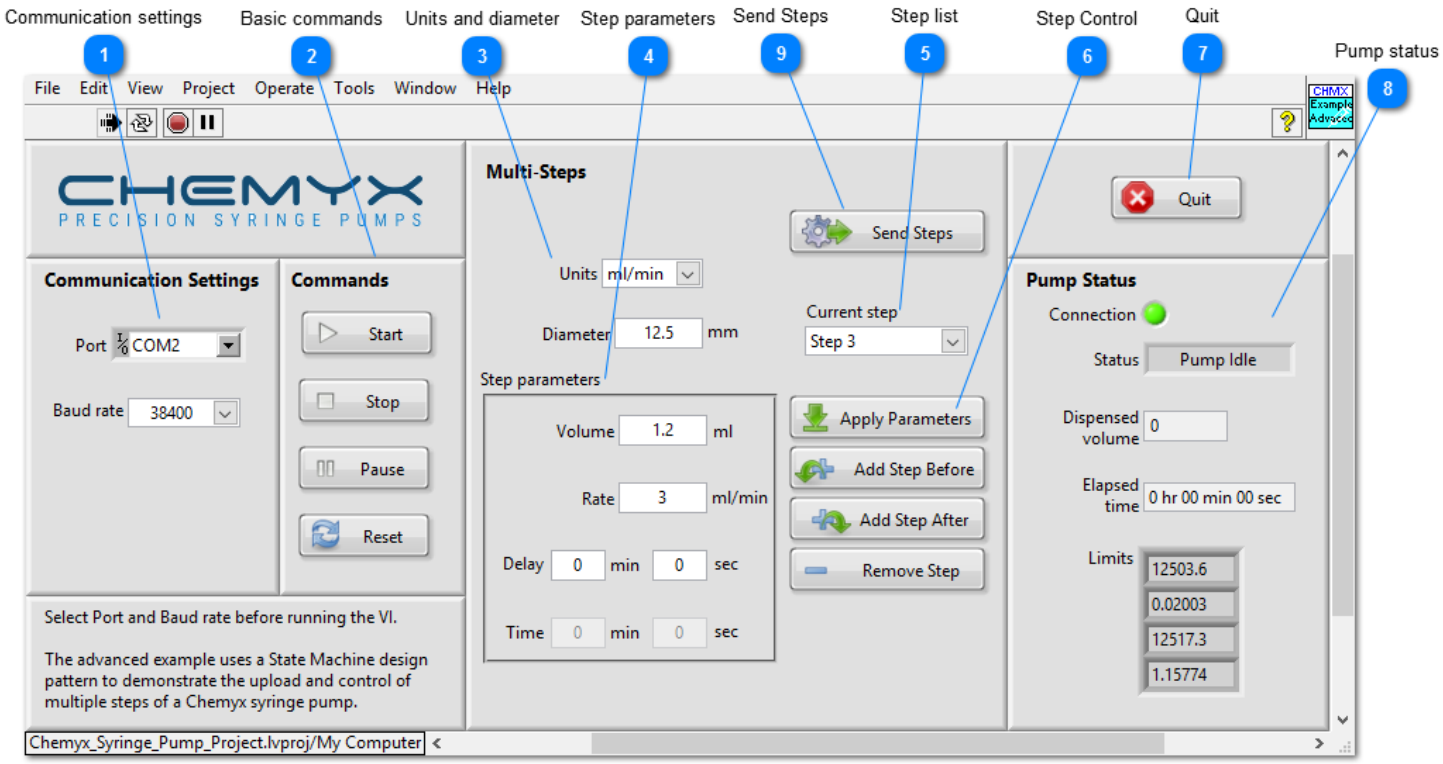
The connection led is updated after each iteration of the while using a shift register.

Advanced Example

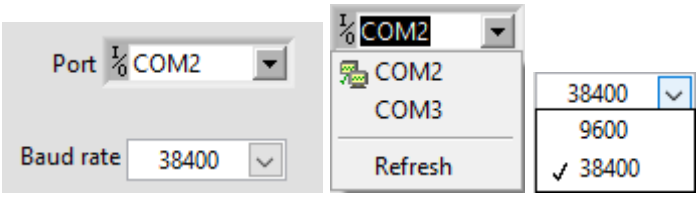
The advanced example gives an illustration on how to use the basic driver and advanced driver. The advanced example uses a State Machine design pattern to demonstrate the upload and control of multiple steps of a Chemyx syringe pump.

Communication settings (Port and Baud rate) must be set before running this VI.

The advanced example can be used to start, stop, and pause operations of the syringe pumps. The step parameters can be used to set single-step or multi-step operations of the syringe pump. To set single multi-step operations, the pump must be manually set in multi-step mode.



1 Communication settings

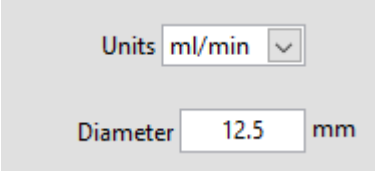


Selects the communication port and the baud rate of the pump from the available lists. Those two settings must be set before running the VI.

2 Basic commands

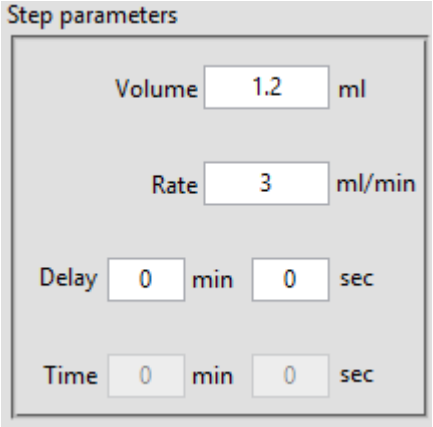
Starts the operation using the currently uploaded parameters, and Stops, and Pauses the pump operations. Reset restarts the pump.

3 Units and diameter



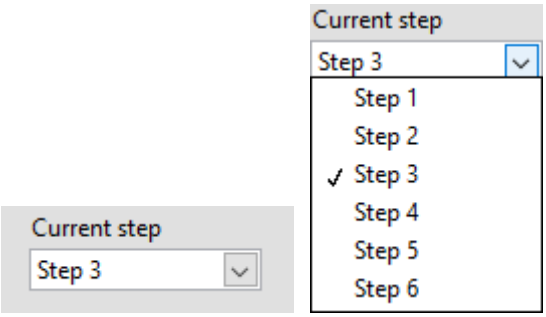
Control the units of volume and rates. The selection of units is given by the enum Units.

4 Step parameters



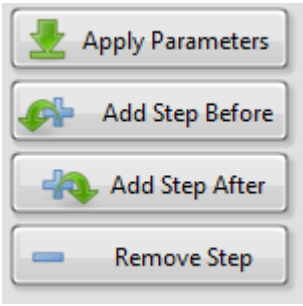
Parameters of the step currently selected or parameters to be applied to the current step or a new step. Notice that the Time parameter has been disabled.

5 Step list



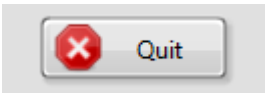
Select the current step from the list of available steps.

6 Step Control



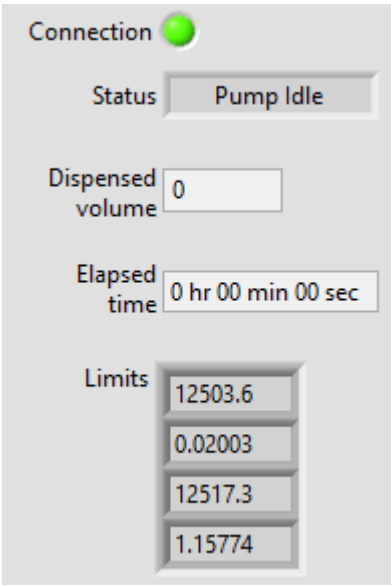
Applies the current step parameters to the current step. Add a step before the current step using the current parameters. Add a step after the current step using the current parameters. Deletes the current step (no step can be deleted if only one step remains).

7 Quit



Quits the application. Closing the window while the VI is running has the same effect than clicking the Quit button.

8 Pump status



Connection led is ON when the pump is successfully connected. Displays the status of the pump, the dispensed volume, the elapsed time and the limits.

9 Send Steps

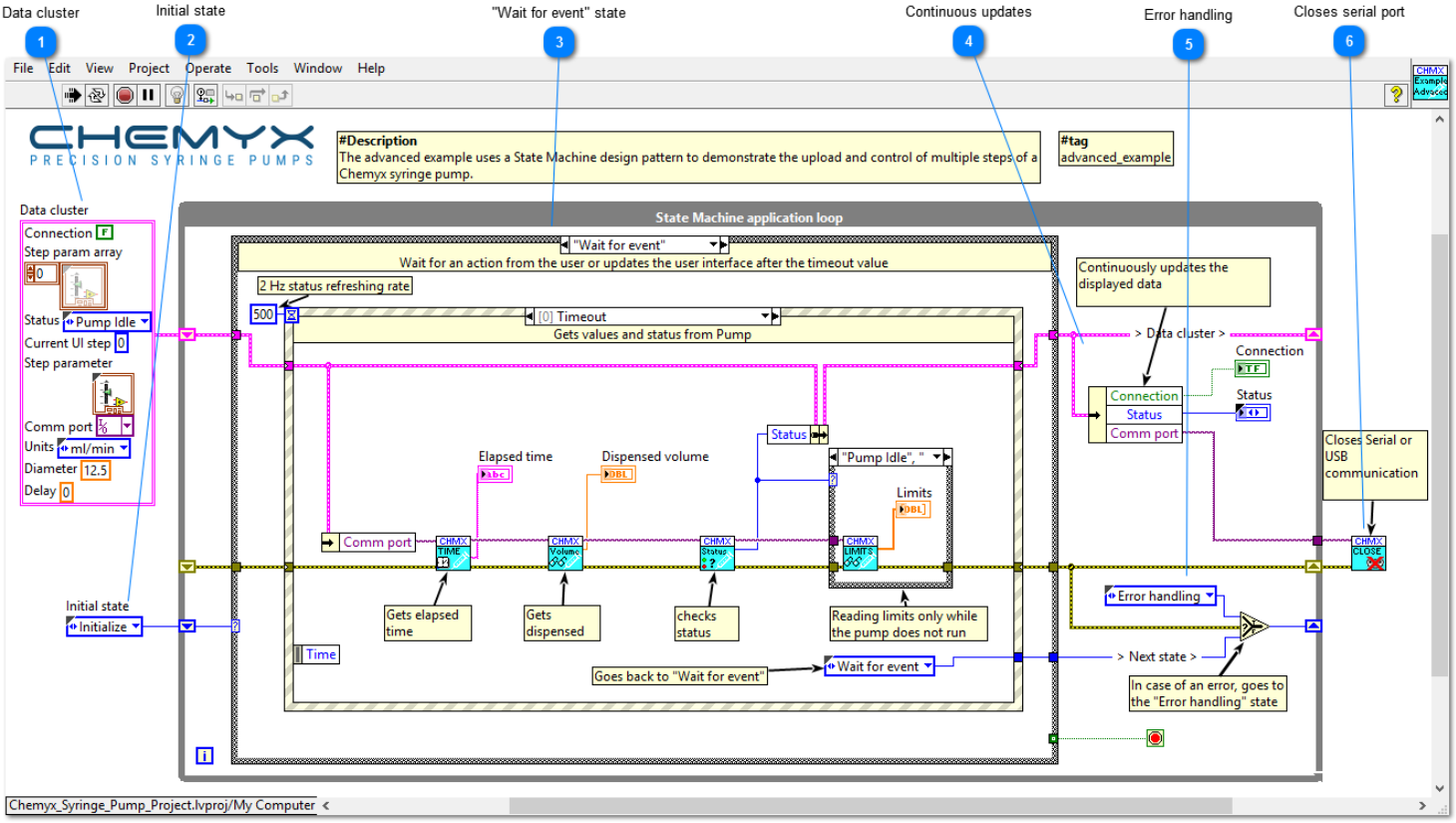
Send the parameters of all steps to the syringe pump. The pump must be in the multi-step mode to accept more the steps.

Advanced block diagram

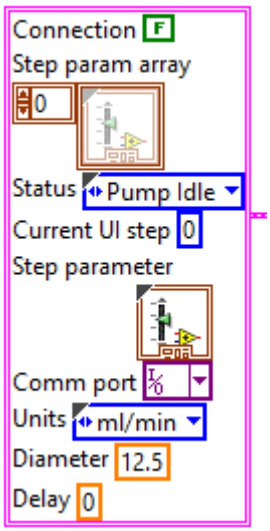
The block diagram of the advanced example VI.

The advanced example uses a state machine design pattern.

The initial state (or case) is set to Initialize. The initialization of the communication and the verification of the pump status is done in that state. If the pump is present, the next state is "Wait for event". If the pump is not present, the next state is "Quit".

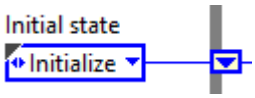


1 Data cluster



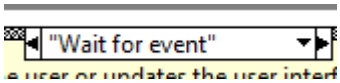
Data used to manage the application. When a control is changed by the user, the new control value is placed in the data cluster so that the data is available to all cases of the state machine.

2 Initial state



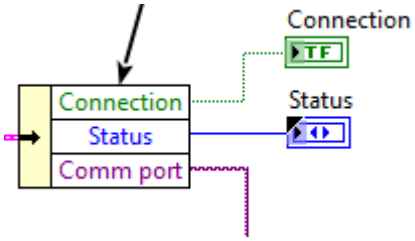
The initial state of the state machine is "Initialize". The shift register is used to pass the next state (or piece of code) to be executed from the previous state of the previous iteration of the while loop.

3 "Wait for event" state



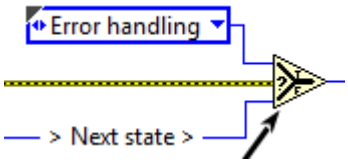
The "Wait for event" state contains the event structure. It is important that the state machine is always brought back to the "Wait for event" state after any series of states for the application to remain responsive to the user and for the pump status to be continuously updated.
The event structure is also configured for all the buttons.

4 Continuous updates



The connection LED and the pump status are updated at each iteration of the while loop. The comm port value is here only to make it available to the close come VI when the loop is terminated.

5 Error handling



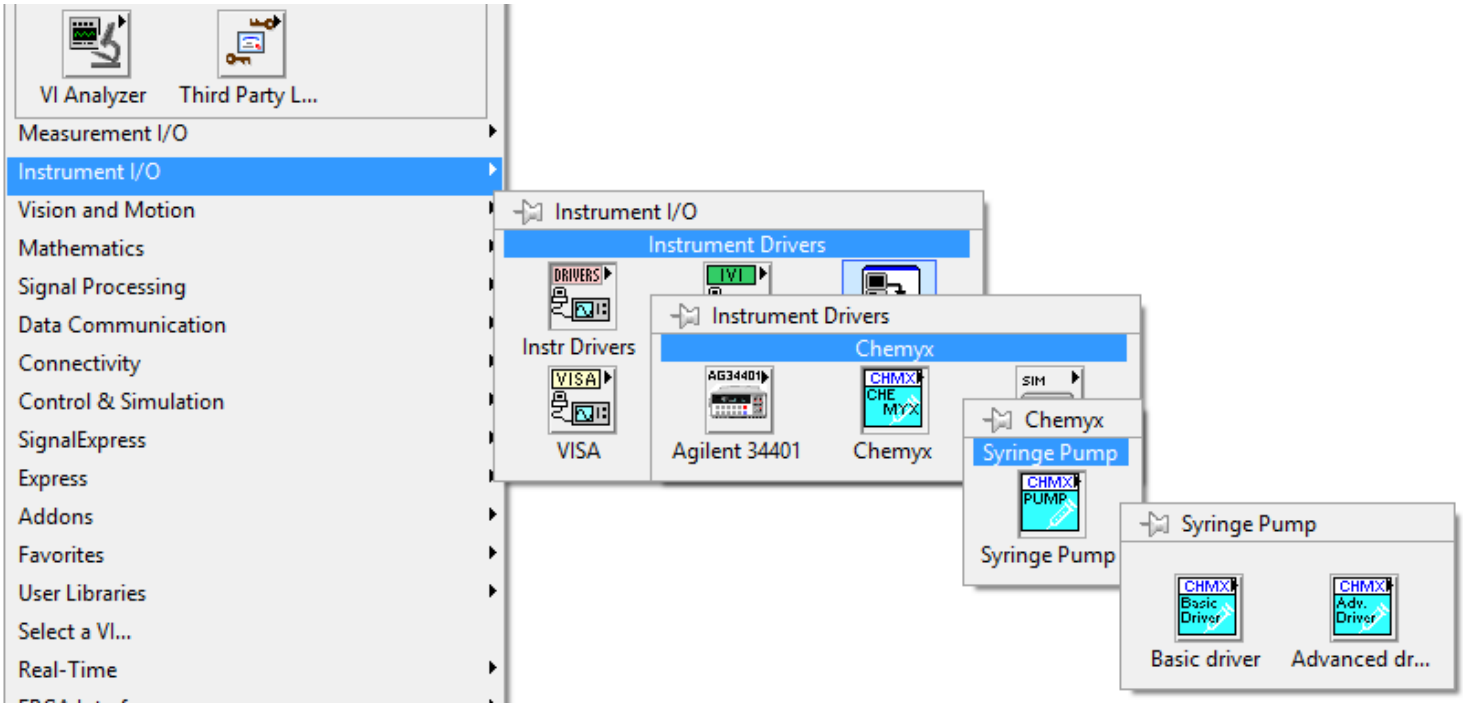
If an error occurs, the state machine goes to the "Error handling" case. If no error, the next state, as decided by the previous state is transmitted to the following loop iteration using the shift register.

6 Closes serial port

Serial communication is closed when the VI is terminated.

LabVIEW Driver

The VIs of the Chemyx syringe pump LabVIEW driver can be accessed through two sub-palettes, Basic driver and Advanced driver, located in the Functions>>Instrument I/O>>Chemyx>>Syringe Pump sub-palette.



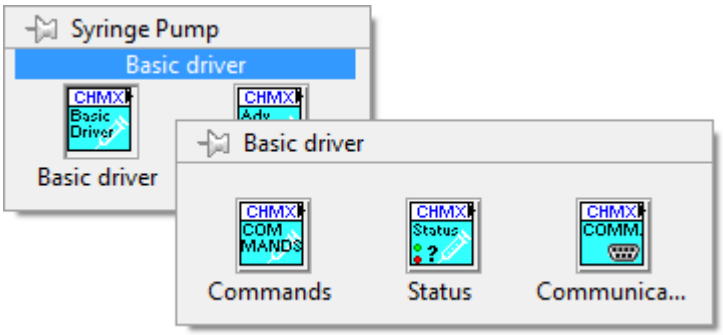
Basic Driver

The basic driver contains the VIs to send simple commands to the pump, to receive status information from it, and to control the serial communication.

The basic driver VIs can be used to start, stop, and pause operations that have been configured manually directly on the pump.

See the basic example for an illustration of how to use the basic driver.

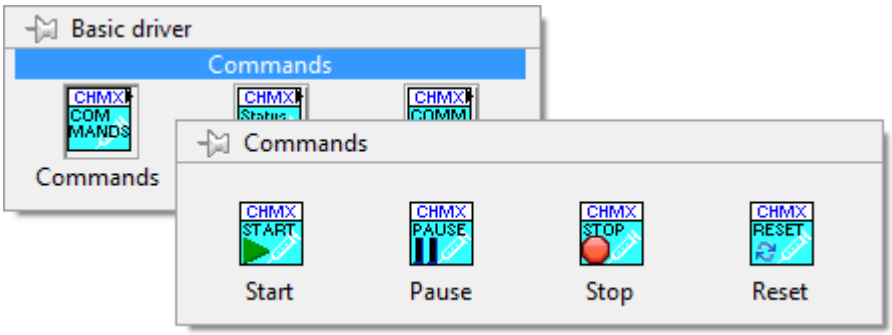
The VIs of the basic driver can be accessed through one of the three sub-palettes of the Basic driver sub-palette: Commands, Status, and Communication (see image below).



Commands

List of the VIs for simple commands to the syringe pump.

The Commands VIs can be accessed from the Commands sub-palette (see image below).



Pause

Pauses the current operation of the pump.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Reset

Restarts the pump.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Start

Starts the operation of the pump using the parameters currently loaded into the pump.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Stop

Stops the current operation of the pump.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

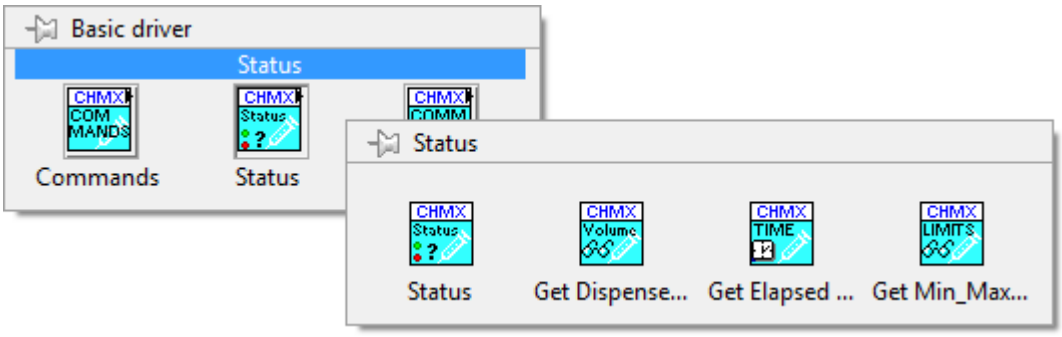
Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

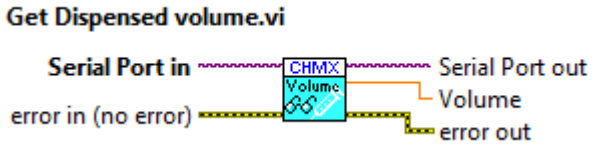
Status

VIs to obtain the different status information from the syringe pump.

The Status VIs can be accessed from the Status sub-palette (see image below).



Get dispensed volume



Returns the volume currently dispensed by the pump.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
Volume	Dispensed volume by the pump. In currently selected units.
error out	Standard LabVIEW error cluster.

Get elapsed time

Returns the elapsed time of the current operation of the pump as a number of seconds and as a string formatted as X hr YY min ZZ sec.

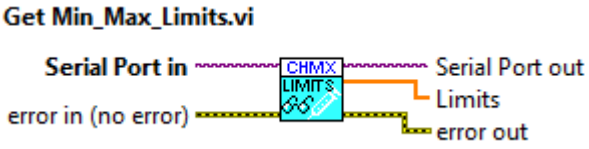
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
Time (sec)	Double float. Elapsed time in seconds.
Time string	String. Time formatted as a string in the format "X hr YY min ZZ sec" where X is the number of hours, YY is the number of minutes, and ZZ is the number of seconds.
error out	Standard LabVIEW error cluster.

Get min max limits



Returns the minimum and maximum of volumes and rates of the current pump.

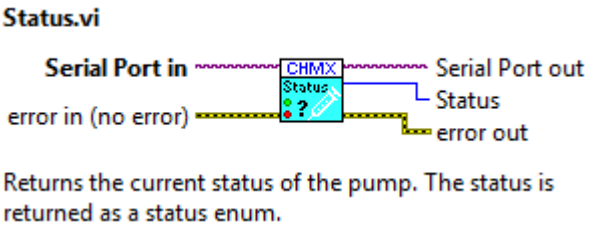
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
Limits	Array of double float. Volume Max, Volume Min, Rate Max, and Rate Min.
error out	Standard LabVIEW error cluster.

Status



Returns the current status of the pump. The status is returned as a status enum.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

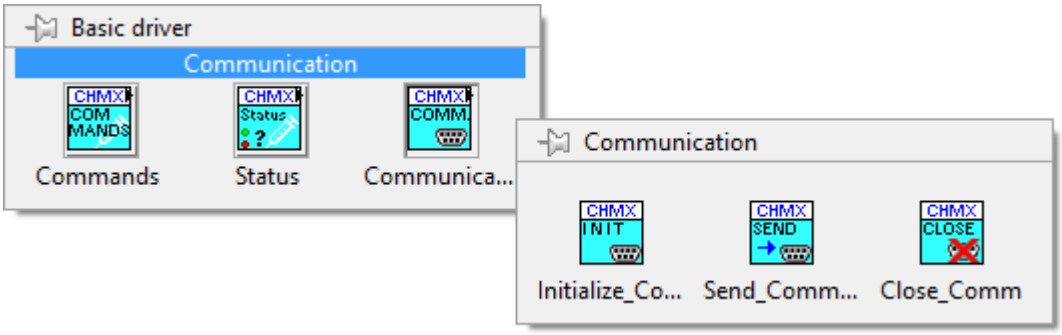
Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
Status	Enum. Status of the pump as defined in the enum pump status.
error out	Standard LabVIEW error cluster.

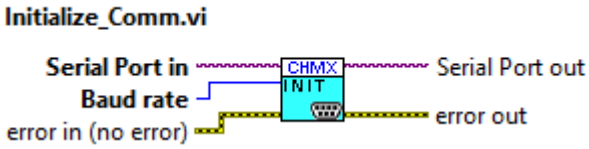
Communication

List of commands related to communication with the syringe pump. Information about the communication settings are given in the section Communication settings.

The Communication VIs can be accessed from the Communication sub-palette (see image below).



Init



Initializes serial communication using Serial Port in and the selected baud rate.

Baud rate is an enum. Possible values are 9600 or 38400. Must be set to match setting of the pump.

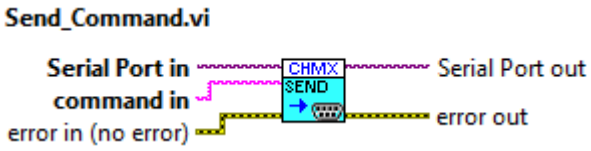
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Baud rate	Required. Enum.	Enum definition is given in Baud rate.
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial port out	LabVIEW VISA resource. Serial Port.
error out	Standard LabVIEW error cluster.

Send Command



Sends a string command to the syringe pump using the serial port in.

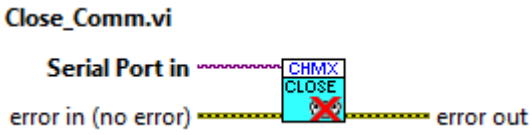
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
command in	Required. String.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial port out	LabVIEW VISA resource. Duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Close



Closes communication on the serial port.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

error out	Standard LabVIEW error cluster.

Controls

List of controls associated with the communication VIs of the syringe pump driver.

Baud rate

Baud rates are defined in an enum, named comm_rate_enum.ctl, with the following items:

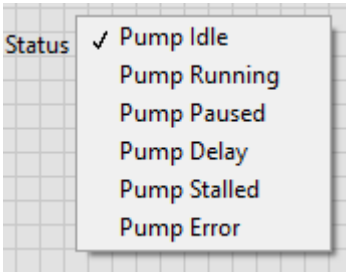
0: 9600
1: 38400

Controls

List of controls used in the basic driver.

Pump status

Enum. Giving all possible status of the pump.

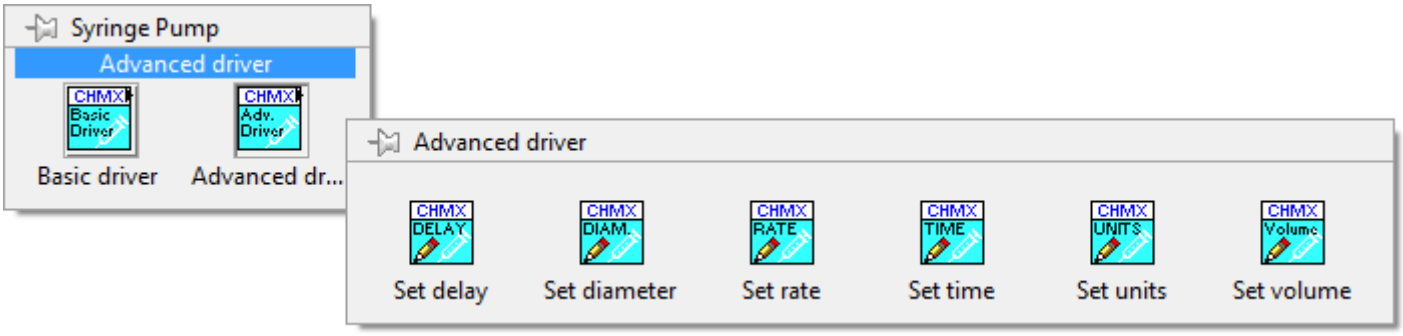


Advanced Driver

The advanced driver contains VIs to set the different parameters of the syringe pump operations.

See the advanced example for an illustration of how to use the basic driver and the advanced driver to control the syringe pump.

The Advanced driver VIs can be accessed from the Advanced driver sub-palette (see image below).



Set delay

Sets a delay before start of the syringe pump.

Delay is a double float. Units are minutes.

If you want the system to run at a certain point in your setup
(i.e. after, 10, 30 seconds, 1, 5, 10 minutes, etc.) you may set a time delay for appropriate time for pump to begin run.

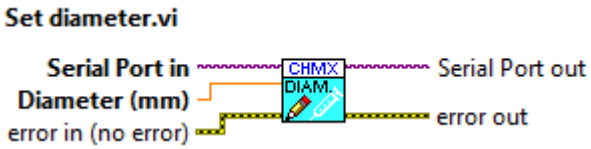
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Delay (min)	Required. Double float. Delay before start of the pump	Units are minutes.
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Set diameter



Sets the diameter of the syringe in mm.

Input diameter is a double.

Set syringe inner diameter measurement this tells the pump what syringe size you are using. Example: 10ml syringe ID is 14.5mm, so you would enter 14.5.

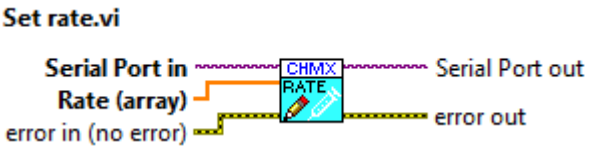
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Diameter in	Required. Double float. Syringe diameter in mm.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Set rate



Sets the rates of the syringe operations.

Rate is an array of double float. Units are those defined by the Set units operation.

Set 'flow rate' or flow speed at which you want to dispense/extract fluid.

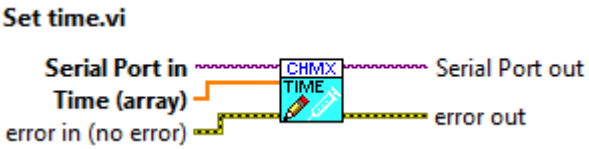
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Rate (array)	Required. Array of double float. Rates of pumping in multiple step operations.	Unit of volume is defined by the set units operation.
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Set time



Sets the times of the syringe multiple-step operations.

Time is an array of double floats. Units are hours.

Set volume as a function of time. Example: users wants to run the pump to run over 5 minutes (it will do so, but it will only administer as much volume as it can within that 'time' parameter.

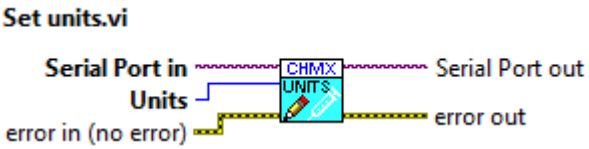
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Time (array)	Required. Array of double floats. Delays for the multiple step operations.	Units are hours.
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Set units



Set the rate and volume units of the pump.

Units are defined by an enum with the following items:
0: ml/min
1: ml/hr
2: ul/min
3: ul/hr.

Set unit increments for fluid delivery (i.e, ul/min, ul/hr, ml/min, ml/hr).

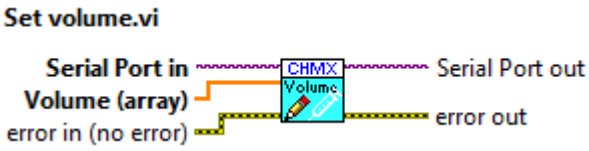
Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Units	Required. Typedef enum defined in Units.	
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Set volume



Sets the volumes of the syringe operations.

Volume is an array of double float. Units are those defined by the set units operation.

Infusions are accomplished using positive and withdraws are accomplished using negative volumes.

Set volume delivery this is how much volume you wish to dose to or extract from specified source.

Input parameters

Serial Port in	Required. LabVIEW VISA resource. Serial Port.	
Volume (array)	Required. Array of double float. Volumes to be pumped in multiple step operations.	Unit of volume is defined by the set units operation.
Error in (no error)	Input error. VI is not executed if an error is present.	Standard LabVIEW error.

Output parameters

Serial Port out	LabVIEW VISA resource. Serial Port, duplicate of Serial Port in.
error out	Standard LabVIEW error cluster.

Controls

List of controls used in the Advanced driver

Units

Units of volume and rates are defined in an enum named units_enum.ctl, with the following items:

0: ml/min
1: ml/hr
2: ul/min
3: ul/hr.

Contact information

<TODO>: Add info from Chemyx?

Contact Chemyx: www.chemyx.com/contact-us/.

Technical support for the pump: www.chemyx.com/support/.

Products: www.chemyx.com/syringe-pumps/.

Manual: www.chemyx.com/support/downloads-and-manuals/syringe-pump-manuals/.