DataApex

Clarity™

CHROMATOGRAPHY SOFTWARE

LC UNI - FLOM PUMPS

Clarity Control Module ENG

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Contents

To facilitate the orientation in the **LC UNI - Flom pumps** manual and **Clarity** chromatography station, different fonts are used throughout the manual. Meanings of these fonts are:

Instrument (blue text) marks the name of the window to which the text refers.

Open File (italics) describes the commands and names of fields in **Clarity**, parameters that can be entered into them or a window or dialog name (when you already are in the topic describing the window).

WORK1 (capitals) indicates the name of the file and/or directory.

ACTIVE (capital italics) marks the state of the station or its part.

The bold text is sometimes also used for important parts of the text and the name of the **Clarity** station. Moreover, some sections are written in format other than normal text. These sections are formatted as follows:

Note: Notifies the reader of relevant information.

Caution: Warns the user of possibly dangerous or very important information.

▌ **Marks the problem statement or trouble question.**

Description: Presents more detailed information on the problem, describes its causes, etc.

Solution: Marks the response to the question, presents a procedure how to remove it.

1 LC UNI Control Module

The **DataApex LC UNI Pump Control** is universal LC driver designed to function with **LC Pumps** controlled by text commands using the COM port (RS232).

The controlled pump must be able to change flow upon external command. It is not possible to use this module to control pumps that need to receive the whole gradient table at once.

Complete list of pumps supported at the time by existing **LC UNI** profiles is available in the **D004-Clarity-Controls-List-of-Controlled-instruments** datasheet, the particular profiles for these pumps can be found in the C:\CLARITY\BIN\UTILS\UNI_DRIVERS\ directory of the **Clarity** installation directory. It is also possible to create your own profile for controlling other pumps, as described in the chapter **"Customizing the LC UNI control module"** on pg **22**.

1.1 Profile specification

Flom LC UNI profile presents features for controlling the Flom **301M** pump. Four profiles are prepared, enabling to control one isocratic pump (A, B - depends on the ID set in the pump), two pumps with binary gradient (AB) or three pumps with ternary gradient (ABC).

2 Requirements

Clarity Installation CD ROM with LC Control (p/n A24).

Appropriate number of free serial COM ports in the PC, based on the pump models to be controlled.

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Note: Modern computers usually have only 1 (if any) serial (COM) port installed. To use more devices requiring the port, the **MultiCOM** adapter (p/n MC01) is available.

Serial cross DB9F-DB9F cable with pins nr. 7 and 8 interconnected (on both connectors).

- -

Note: Cables are not part of **Clarity** Control Module. It is strongly recommended to order required cables together with the Control Module.

3 Installation procedure

The pump installation should be performed in the following order:

Connect the pump to the computer with the appropriate communication cable.
Switch on the pump.

Set the pump itself, if necessary.

Start **Clarity**.

Enter the System Configuration dialog and configure the pump.

Customize the used profile if needed.

3.1 Hardware - wiring

Commands for the pumps are communicated with **Clarity** through the Serial cross DB9F-DB9F cable.
The cable needs to have 7 and 8 pins interconnected in both connectors.
It may be, however, necessary to use additional starting cable, when no other part of the instrument is directly controlled.
Typical serial cable wiring is described in the picture:
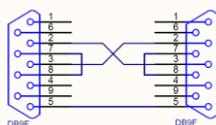
Fig 1: Serial cross DB9F-DB9F cable

3.2 UNI pump communication

The **Flom** pumps use these communication settings to connect to **Clarity**:

Tab 1: Communication parameters for Flom pumps

Parameter	Value
Baud Rate	9600
Parity	No parity
Data Bits	8
Stop Bits	2

Note: It is necessary to use the same communication parameters both in the pump and in **Clarity**. The communication settings for pumps controlled via **LC UNI** pump control are set in the UNI Pump Control Setup dialog described in the chapter **"UNI Pump Control Setup"** on pg **17**.

3.3 Setting the pump

Flom 301M pumps can be connected to create a gradient. Either it is possible to connect each pump to a different COM port, or all of the pumps in the gradient may be chain-connected to the same COM port. To do so, it is necessary to connect the first pump to the computer using port labeled RS1 on the pump. Connect next pump with a cable using RS2 port on the first pump and RS1 port on the second, and so on.

In such case, pump IDs should be set to *1*, *2* and *3* respectively for binary or ternary gradients. To set the pump ID, turn on a power switch on the rear panel while pressing a SET button (be patient and wait till you hear a beep sound). After entering the setup mode, a FLOW LED and pump display will go on and off. Push a PUMP button twice until the **U.LIM LED** is on and the digit 1 in the display is blinking.

Then, using the UP or a DOWN buttons, select a number between *1* and *9* and push a PUMP button to determine the selection. Do not set the same number to different pumps. See he pump manual for details.

Flom 301M pumps have the pressure limits set in the range *0 - 30* MPa, the flow rate limits are *1 - 999* μl/min.

3.4 Clarity Configuration
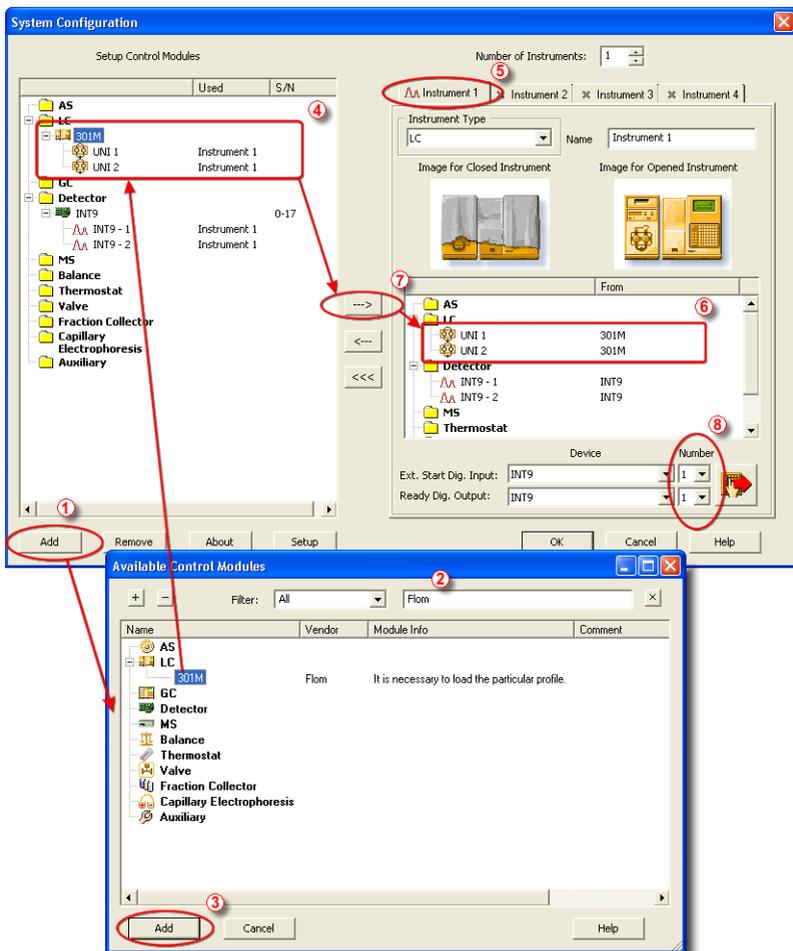
*Fig 2: How to add **Flom 301M pump***

Start the **Clarity** station by clicking on the 🖳 icon on the desktop.
Invoke the *System Configuration* dialog accessible from the *Clarity* window using the *System - Configuration…* command.
Press the *Add* button ① (see **Fig 2** on pg **6** .) to invoke the *Available Control Modules* dialog.
You can specify the searching filter ② to simplify the finding of the driver.
Select the **301M** item and press the *Add* ③ button.

The UNI Pump Control Setup dialog will appear.

Fig 3: UNI Pump Control Setup

Select the correct *Port* and *Communication Parameters* for your pump.

Set the correct number of solvents in the *No. of Solvents* field and name those solvents to suit your demands.
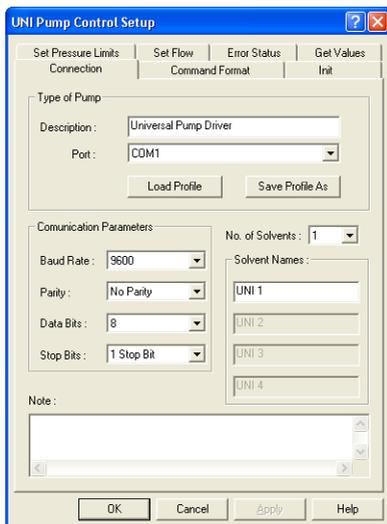Use the *Load Profile* button to load corresponding configuration for your LC pump.

- -

Note: The UNI Pump Control Setup dialog is more closely described in the chapter **"UNI Pump Control Setup"** on pg **17**. Loading of the correct profile is described in the chapter **"Profile Selection"** on pg **8**.

Press the *OK* button.

The **301M** item ④ will appear in the *Setup Control Modules* list of the System Configuration dialog, with the number of pump solvents matching the value set in the UNI Pump Control Setup dialog.

Drag the individual **301M** solvent icons 🔧 from the *Setup Control Modules* ④ list on the left side of the System Configuration dialog to the desired *Instrument* ⑤ tab on the right side ⑥ (or use the → button ⑦ to do so).

- -

Note: All defined solvents on single pump must be assigned on the same Instrument.

3.5 Profile Selection

Select and load the correct profile for the pump you have. The profile selection is performed in the System Configuration dialog during the adding of the LC UNI pump driver, but can also be changed later:

Open the UNI Pump Control Setup dialog from the System Configuration dialog, for example by double-clicking on the pump item on the left side of the System Configuration dialog or by using the *Setup* button while the pump item is selected.
Use the *Load Profile* button to open the Open dialog.

Browse to the UNI_DRIVERS directory and then to the directory of the Flom company.
Select the desired profile, as specified in the following table:

Tab 2: Pump models supported and available profiles

Pump	Head type	Profile used
301M		FLOM_301M_A
301M (two pieces)		FLOM_301M_AB
301M (three pieces)		FLOM_301M_ABC
301M		FLOM_301M_B

3.5.1 Profiles description

FLOM_301M_A.uni

This profile can be used with single Flom 301M pump. The pump ID should be 1.
Several pumps governed by the FLOM_301M_A.UNI profile may be configured on **Clarity** Instrument to form a gradient, however each such pump must be connected to a separate Com port in such case.

FLOM_301M_AB.uni

This profile can be used with two Flom 301M pumps to create binary gradient. The pump ID should be 1 for the pump A, 2 for the pump B. Both pumps will use the same COM port.
The pressure is read from first pump only to prevent fluctuating of the values. The pressure measured on different pumps may differ, the overpressure is detected by each pump individually and the *Stop Command* is progressed to all pumps connected on the Instrument.

FLOM_301M_ABC.uni

This profile can be used with three Flom 301M pumps to create ternary gradient. The pump ID should be 1 for the pump A, 2 for the pump B and 3 for the pump C. All three pumps will use the same COM port.
The pressure is read from first pump only to prevent fluctuating of the values. The pressure measured on different pumps may differ, the

overpressure is detected by each pump individually and the *Stop Command* is progressed to all pumps connected on the Instrument.

FLOM_301M_B.uni

This profile can be used with single Flom 301M pump. The pump ID should be 2.

Several pumps governed by the FLOM_301M_A.UNI and FLOM_301M_B.UNI profiles may be configured on **Clarity** Instrument to form a gradient, however each such pump must be connected to a separate Com port in such case.

4 Using the control module

A new LC Gradient tab appears in the Method Setup dialog, allowing to set the LC control method.

4.1 Method Setup - LC Gradient

The Method Setup - LC Gradient dialog serves for setting up the LC instrument method.

Caution: The UNI pump driver does not check the values entered *Flow Rate*, *Min. Pressure* and *Max. Pressure* for validity on the connected pump. Values exceeding the pump's operational ranges will usually cause a Communication Error warning message.
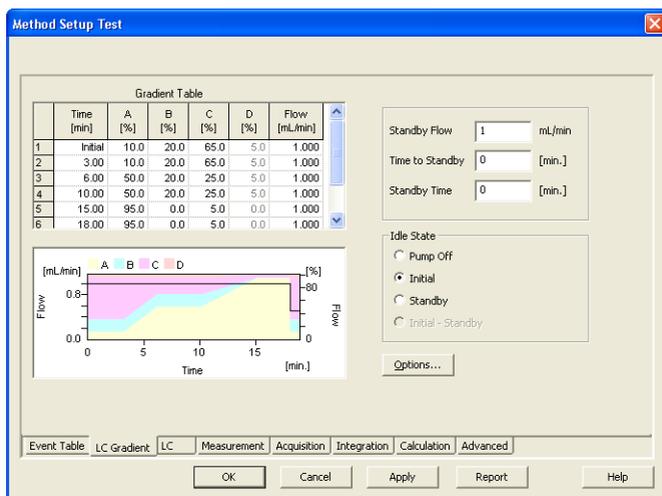

Fig 4: Method Setup - LC Gradient

Gradient Table

A table for setting the composition of the mobile phase and the overall flow rate as a function of time. Operation is analogous to that of spreadsheets (Excel, Quatro Pro, etc.). To prepare the cell to receive values, click it by the left mouse button; the cell will highlight by dots. A cell that fails to highlight is not available for editing.

Time [min.]

Sets the time at which the ratio of flow rates and the overall flow rate correspond to the values entered in the corresponding row. These values vary continuously from one time defined in the **Gradient Table** to the next in a manner ensuring that the conditions specified in the next row are satisfied.

XXX1 (..4) [%]

Represents the percentage of a component. The designation **XXX1-4** is in fact replaced by the name of the component (items *Solvent 1 - 4* in the Gradient Options dialog). Should you enter a component value such that the sum of all values exceeds 100 %, the percentage in the last column is automatically adjusted; if the percentage of the last compound is already zero, the value of the currently entered component is adjusted instead. The flow rate of a compound is calculated by multiplying the overall flow rate (indicated in the *Flow* column) by the corresponding percentage divided by 100.

Flow [ml/min]

Indicates the overall flow rate through the column. The entered value applies to the time specified in the corresponding row.

The possible ranges of the *Flow* for the given pump depend on the type of the Pump. For possible values please check the pump's manual.

Graph

The graph depicts the percentage of components as a function of time together with the overall flow rate. Data are taken over from the **Gradient Table**, changes effected in this table are immediately reflected in the graph. Legend in the header of the graph indicates the assignment of colors to individual components. The assignment is fixed and individual components are displayed in the graph from bottom to top. The flow rate is displayed as a black line.

The graph has two vertical axes: the axis on the left refers to the overall flow rate, the one on the right to the mixing ratio.

Parameters

Standby Flow

Sets the overall flow rate through the column in the *STANDBY* state reached after the last row of the table has been performed and the time period defined in the *Time to Standby* field has passed. The duration of this state is defined by the *Standby Time* item. The ratio of individual components in the respective *STANDBY* and *IDLE* states is given by the first row of the **Gradient Table** (the *Initial* row).

Time to Standby [min]

Indicates the time during which the flow rate and mobile phase composition changes continuously between the last values entered in the table and the values defined by *Standby Flow* field and the *Initial* row mobile phase composition.

This time is included in the analysis time (the Instrument is in the *CONTROL* state). In case when the *Time to Standby* is zero, there is a step change performed from the flow and components percentage

specified on the last row of gradient table to that specified for *STANDBY* state.

Standby Time [min]

The time during which the flow rate is maintained at *Standby Flow*. This time is included in the analysis time (the Instrument is in the *CONTROL* state).

Idle State

An item specifying the overall flow rate through the column outside the instrument method. The following options are possible:

Pump Off

The flow rates of all components are zero.

- -
Caution: Be careful as this setting may damage the column in some cases.

Initial

The flow rate is defined by the first row of the gradient table (the *Initial* row).

Standby

The flow rate is the same as in the *STANDBY* mode and, accordingly, corresponds to the value entered in *Standby Flow* field.

The *IDLE* state comes into effect each time an Instrument is opened, at the end or after abortion of an analysis by the *Abort* command, and is also maintained after the **Clarity** program is shut down.

The mixing ratio of individual components in both the *IDLE* and *STANDBY* states is given by the first row of the **Gradient Table** (the *Initial* row).
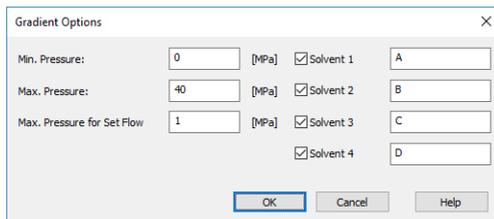
- -
Note: There is a step change in the flow and components percentage from the values specified for the *STANDBY* state to those specified for the *IDLE* state if the *Idle State* field is not set to *Standby*.

Initial - Standby

This option is disabled because the it is not supported by the **LC UNI** Control Module.

4.1.1 Gradient Options

Invoke the *Options…* button in the Method Setup - LC Gradient dialog to open the Gradient Options dialog. This dialog allows to set the custom name for particular solvents, to switch whether they are used or not in the gradient and to set the warning levels for pressure to prevent the damage to hardware.

Fig 5: Gradient Options

Min. Pressure

Sets the minimum pressure for the given pump. When pressure drops to the set value, the pump will shut down. This prevents the solvent leakage.

Max. Pressure

Sets the maximum pressure for the given pump. When pressure reaches the set value, the pump will shut down. This serves to prevent the damage to the pump when the column is blocked.

Min. Pressure and *Max. Pressure* for the given pump depend on the type of the Pump Head attached. For possible values please check the pump's manual.

Note: Pressure limits are checked in the pump hardware. Pressure checking doesn't start immediately after the pump is started, but with some delay. During this delay the pressure in chromatographic system can stabilize.

Max. Pressure for Set Flow

Sets the maximum pressure to be used in the Set Flow dialog in the Device Monitor. Initial value is *1* MPa.

Solvent 1 (..4)

It is possible to enable/disable particular solvent, as well as to set custom name to it.

4.2 Device Monitor

The pump status dialog can be invoked by the *Monitor - Device Monitor* command from the Instrument window or using the *Device Monitor* 🔵 icon. It displays the actual flows of particular solvents, as well as the total flow, the total pressure and the analysis time.
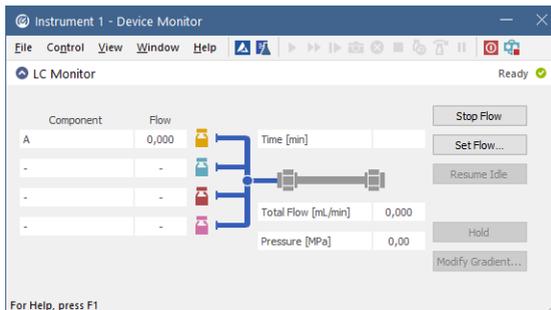

Fig 6: Device Monitor - LC Gradient

Device Monitor window displays actual conditions that were read from the pumps. If the necessary figures are not provided, the window will display the values sent to the device, that are expected to be applied in the pumps. The expected values will be highlighted in italics and a warning message will be displayed in the bottom part of the window.

The pump can be controlled from this window by using commands in the *Control - LC Control* pane of the menu or directly by the *Stop Flow*, *Purge* and *Resume Idle* buttons.

Stop Flow

The pumps can be stopped from this window using the *Stop Flow* button. This action will stop the pump only, the analysis run will continue and must be stopped or aborted from the Data Acquisition window or Single Analysis dialog. The flow can be resumed by sending the method to the instrument, using the *Send Method* and *OK* buttons in the Method Setup dialog.

Set Flow...

Sets the desired total flow and solvent ratios in the opened Set Flow dialog. *Max. Pressure* allows to set a different pressure than set in the "Gradient Options" on the previous page of a given method.

Fig 7: Set Flow

The number of solvents and their names displayed in the Set Flow dialog correspond to the solvent number and names set in the Gradient Options dialog. The last available solvent field is always grayed and is automatically counted as a rest of the percentage of the other solvents.

Resume Idle

Returns the pumps to *IDLE* state as defined in the appropriate field on the LC Gradient tab of the Method Setup dialog.

Hold/Resume

Clicking on the *Hold* button will keep the current gradient conditions until *Resume* is clicked.

Modify Gradient...

Opens the LC Control Manual Flow dialog allowing to set custom flow and mobile phase composition, disregarding the **Gradient Table** set in the method. The command is only available during the analysis run.

4.2.1 LC Control Manual Flow

The LC Control Manual Flow dialog accessible through using the *Modify Gradient …* button from Device Monitor window allows the user to set a custom mobile phase composition and flow while the analysis is running. It resembles the Method Setup - LC Gradient tab in functionality.

Fig 8: LC Control Manual Flow dialog

The LC Control Manual Flow dialog is only available during the analysis run. When it is invoked and the *OK* button is pressed, the original **Gradient Table** from the acquisition method is discarded and replaced by the **Gradient Table** from the LC Control Manual Flow dialog. Any such operation is recorded in the audit trail of the measured chromatogram.

- -

Caution: After the analysis run which used manual flow changes ends, the original method is automatically sent to all controlled devices to make sure **Clarity** station returns to the original method.

4.3 UNI Pump Control Setup

The UNI Pump Control Setup dialog consists of seven tabs which describe the behavior of the pump based on the loaded profile and allow to develop new profiles either from the scratch, or by changing the already existing profiles. This topic only describes the Connection tab needed for setting the communication with the pump, other tabs necessary for the development and functionality of the UNI pump profile are described in the chapter **"Customizing the LC UNI control module"** on pg **22**.
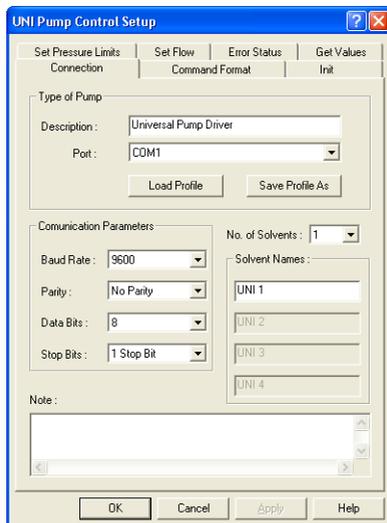
Fig 9: UNI Pump Control Setup - Connection tab

Type of Pump
The LC UNI pump control module enables to load the profile from a file or store the current profile as a new file. The *Type of Pump* section allows for better orientation in the currently opened profile.

Description
Holds the description of the profile, usually noting the type of the pump it is usable for.

Port
Sets the COM port to which the LC Pump is connected.

Load Profile
Loads the stored LC UNI profile (a file with the *.UNI suffix). Predefined profiles are stored in the UTILS subdirectory of the **Clarity** directory (C:\CLARITY\BIN\UTILS by default).

Save Profile As

Saves the currently opened LC UNI profile under a new name. Select the filename and folder where the profile should be saved in the Save As dialog.

Communication Parameters

The communication settings depend on the pump being connected. Check your LC Pump documentation for appropriate communication parameters.

Note: The communication parameters including the COM *Port*, with the exception of the *Baud Rate*, are not stored in the profile. When using the profile to control the pump, the communication parameters set in the UNI Pump Control Setup dialog must match those set in the pump.

Baud Rate

Sets the Baud Rate.

Parity

Sets the parity.

Data Bits

Sets the Data Bits.

Stop Bits

Sets the Stop Bits.

No. of Solvents

Sets the number of controlled solvents. Based on this selection, appropriate fields in *Solvent Names* section will be enabled.

Caution! If possible, add only the solvents that will be used in the gradient. The gradient table might otherwise not be able to calculate the missing information (e.g. percentages, total flow, etc.).

Solvent Names

Sets the names for individual solvents.

Note

Allows to add the user comments on the profile. The field is well suited for example for the information on which firmware version or **Clarity** version was the profile invented etc.

5 Troubleshooting

When the remedy for some problem cannot be discovered easily, the recording of communication between **Clarity** and the pump can significantly help the **DataApex** support to discover the cause of the problem.

The recording can be enabled by adding or amending the COMMDRV.INI file in the **Clarity** installation directory (C:\CLARITY\CFG by default). The file can be edited in any text editor (e.g. Notepad). Following section should be edited or added:

```
[COM1]
echo=on
textmode=on
filename=LC_UNI_%D.txt

reset=off
```

Note: Instead of COM1 type the correct serial port used to communicate with the pump causing problems.

Note: *%D* (or *%d*) in the filename parameter means that the log will be created separately for each day. The *reset=off* parameter disables deleting the content of the log each time the station is started during the same day.

The created *.TXT files will greatly help in diagnosis of unrecognized errors and problems in communication.

5.1 LC UNI control specifics and limitations

The "Cannot establish communication with XXX pumps!" message appears while the Instrument window opens.

Description: The communication failed to initialize. The causes may be:

                   The communication parameters are incorrect

Solution: These parameters must be set the same in the pump and in the control module. Check your pump manual for corresponding settings.

                   Late or unexpected response from the pump

Solution: The communication is synchronous, i.e. the module waits for a reply for each command sent to the pump (unless specified otherwise). The response must be received within the specified *Timeout* time. Some pumps can respond quite slowly to some commands (for example *Reset* command or rapid flow rate changes).

Pump Communication Error is reported

Description: This message can appear after the initialization or anytime during a run. As a consequence of the Pump Communication Error the "Waiting, pump not ready" status in the Instrument window *Status Line* will be displayed. The reasons of the Pump Communication Error may be following:

                   Late or unexpected response from the pump - The communication is synchronous, i.e. the module waits for a reply for each command sent to the pump (unless specified otherwise). The response must be received within the specified *Timeout* time. Some pumps can respond quite slowly to some commands (for example *Reset* command or rapid flow rate changes). Also, when the response is not recognized (as a correct answer or global error response) the communication error will be generated.

                   Not accepted command - Unless the "not accepted" responses are used in the *Generic Error Response* field, such response will cause the communication error.

Solution: It is usually necessary to restart the **Clarity** Instrument window and/or the pump to recover from the error.

Pump Error is reported

Description: This message is generated, when a recognized error response has been detected. In some cases, the communication can be recovered by sending the method once more (using the *Send Method* and *OK* buttons from the Method Setup dialog) or using the *Resume Idle* command/button from the Device Monitor window.

                   Not accepted command - When the "not accepted" responses are used in the *Generic Error Response* field, such response will cause the Pump Error.

                   Pump Error Response - The pump *Error Response* will cause this message – usually it is due to the exceeding of pressure limits.

Solution: The running analysis must be stopped or aborted first. The reason for the error may need to be corrected on the pump.

5.2 Pump profile specifics

Exceeded pressure limit on **Flom** pumps will be reported in **Clarity** as "Pump Error", but, unlike for other pumps, the communication can be restored without closing the Instrument window.

The **Flom** pump has the pressure compensation function switched *ON*, but the pressure compensation data has to be recorded or downloaded to the pumps by the external utility.

The **Flom** pump error responses are ignored for the *Run Commands* and *Stop Commands* as long as the state is not checked before sending them and an error will be generated if the pump already is in the desired state.

6 Customizing the LC UNI control module

As an addition to predefined profiles, **LC UNI** module enables the user to operate any pump that is controlled by serial communication and has a command for controlling the flow. This means that if you know the communication protocol of your pump, you can make your own control module or modify some profile already existing.

Note: It is advisable to read the chapter **"Troubleshooting"** on pg **19**. in this manual before starting to make your new LC pump profile.

6.1 Strategy for profile development

As the communication protocol of a pump is usually considerably complex, it is advisable to use the following sequence of steps during the profile development:

1. Set the communication parameters to match those of the pump.
2. Start only with the *Init* command first. Commands well suited for *Init* command test are the version request or pump status.
3. Try to establish the communication.
4. Add the other functions stepwise.

Note: It is a good idea to save the profile often.

6.2 LC UNI Profile

6.2.1 Command Format

The communication with the pump is generally performed by text commands. In order for the pump to understand these commands it has to be sent in a proper format.

Caution: The format (shell) of the commands has to be set in hexadecimal mode. For more details on hexadecimal format please see the chapter **"ASCII code table"** on pg **38**.
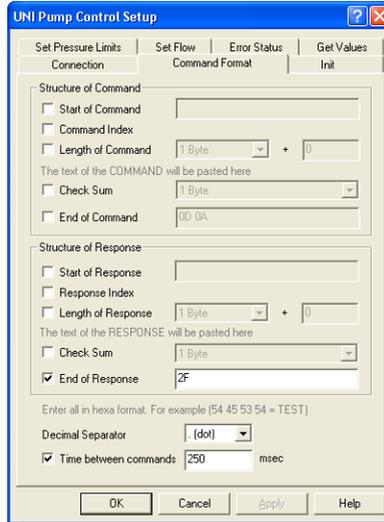
Fig 10: UNI Pump Control Setup - Command Format

The Command Format tab is divided in two sections:

The *Structure of Command* section sets the parameters of commands sent from **Clarity** to the LC Pump.
The *Structure of Response* section sets the format of the commands sent from the LC Pump to **Clarity**.

The universal communication module is designed to be able to format the following arbitrary formatting properties of the communication:

An example of the command structure
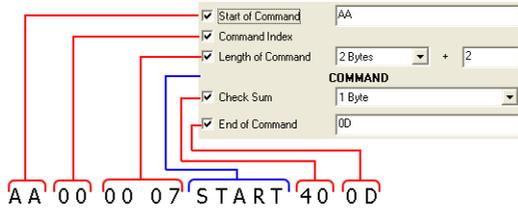
The shell of the command (red) is entered in hexamode and its format will be common to all commands.
The individual commands (blue) will be sent enclosed in the shell.

"**2 Bytes + 2**" = The length will be represented by 2 Bytes
and it will include the length of the COMMAND + CHECKSUM + END

Fig 11: The UNI Pump command structure

Start of Command/Response

Formatting characters introducing each command.

Command/Response Index

A byte containing the information about the ordinal number of the command.

- -
Note: This *Command Index* is used in certain types of pumps (e.g. Flux).

Length of Command/Response

One or two Bytes carrying the information about the length.

The first field decides whether the information about the length will be sent in 1 Byte or in 2 Bytes
The + X figure can contain following values:

    0 - when the length value reflects only the length of the command

    1 - when the length includes the command + one byte of checksum

    2 - when the length includes the command + one byte of Check Sum + one byte of End (or length of the command + 2 bytes of the Check Sum – it depends on the type of the Check Sum specified in the following field).

Check Sum

Selects the type of the checksum. The options determine the length of the Check Sum value (1 or 2 Bytes) and parts of the command/response and its format from which the checksum will be calculated (*COMMAND/RESPONSE* , *Length of Command/Response* , *Command/Response Index* , *Start of Command/Response*). Available options are:

1 Byte, *2 Bytes* - The one or two bytes of the check sum will be calculated from the *COMMAND/RESPONSE* only.

1 Byte with Length, *2 Bytes with Length* - The one or two bytes of the check sum will be determined from the *COMMAND/RESPONSE* and from the *Length of Command/Response*.
1 Byte with Index & Length, *2 Bytes with Index & Length* - The same as previous option + *Command/Response Index*
1 Byte with Start & Index & Length, *2 Bytes with Start & Index & Length* - The same as previous option + *Start of Command/Response*.

End of Command/Response
Selects the formatting characters ending each command.

Note:　　In most cases the ending characters are *<CR> <LF>*, which corresponds to 0D 0A in hexa mode.

Decimal Separator
Selects the sign used as decimal separator that will be used in the body of the COMMAND for formatting of the numbers. Available options are either *. (dot)* or *, (comma)*.

Time between commands
Sets a minimum time interval in milliseconds, after which the next command is sent to pump. The field is necessary for pumps that are not able to accept a new command before the previous one was performed.

6.2.2 Init

The Init tab provides parameters for testing the connection with the LC pump and for sending the initializing set of commands during the opening of the **Clarity** Instrument window and for sending the closing commands during closing of the **Clarity** Instrument window.
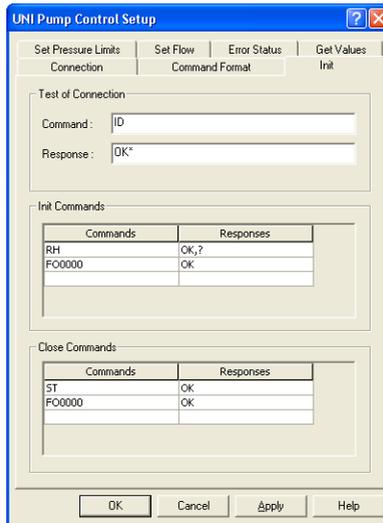
Fig 12: UNI Pump Control Setup - Init

Test of Connection

This section serves for the testing of the connection to the pump. This test is performed whenever the **Clarity** Instrument on which the pump is configured opens.

Note: The version or status requests are recommended for initial test of connection. Use wildcard (*, ?) characters in the response field if the response may vary.

Command

Sets the command to be sent during the testing of the connection.

Note: The **LC UNI** control module waits for a response for the time set in the *Timeout* field specified in the Error Status tab. If it will not receive the expected response, it will generate an error message and the communication will not be established.

Response

Sets the expected response from the device that will confirm that the connection is successfully established. If the *Response* field is left empty, the driver will expect no response and won't wait for one.

Init Commands

This table serves for specifying the initialization commands that will be sent to the pump after the above-mentioned test of connection finished successfully. The *Commands* column defines the commands that will be sent to the device, while the *Responses* column holds the expected responses. If the *Responses* field for the given command is left empty, the driver will expect no response and won't wait for one.

Note: Initialization commands can be typically used to start the communication, set the type of heads, reset the device, etc.

Close Commands

This table serves for specifying the closing commands that will be sent to the pump when closing the **Clarity** Instrument window. The *Commands* column defines the commands that will be sent to the device, while the *Responses* column holds the expected responses. If the *Responses* field for the given command is left empty, the driver will expect no response and won't wait for one.

Note: Closing commands are typically used to finish the communication, switch off the remote control mode, etc.

6.2.3 Set Pressure Limits

The Set Pressure Limits tab serves for setting the pressure limits in the pump.

Fig 13: UNI Pump Control Setup - Set Pressure Limits

Conversion of Clarity Figures to Device Communication Format

This section serves for setting the calculation equation for pressure between **Clarity** and the pump figures. The edit fields in the equations present the means for setting the scale (first field) and the offset (second field) for the conversion of figures sent to the device. The control module uses MPa as pressure units.

- - - - - - - - - - - - - - - - - - - -

Note: Let us assume that the pump receives the pressure in the form which tells that 0 is a pressure of 0 MPa, while getting the value of 350 would set the pressure to 35 MPa. The correct figures to enter would be *10* for the first field and *0* for the second field.

Set Pressure Commands

This table serves for specifying the commands for setting-up the minimum and maximum pressure allowed. The *Commands* column defines the commands that will be sent to the device, while the *Responses* column holds the expected responses. If the *Responses* field for the given command is left empty, the driver will expect no response and won't wait for one. The formatting and variables are described in the chapter **"Appendices"** on pg **36**.

The following variables can be used in the commands:

PU: Upper pressure limit

PL: Lower pressure limit

Note: Both *PU* and *PL* variables are substituted by values entered into the respective fields of the Gradient Options dialog when the command is sent to the pump.

6.2.4 Set Flow

The Set Flow tab sets the flow units conversion ratio between **Clarity** and the pump, the commands necessary to set the flow of the pump and, if necessary, the commands to run and stop the pump(s).
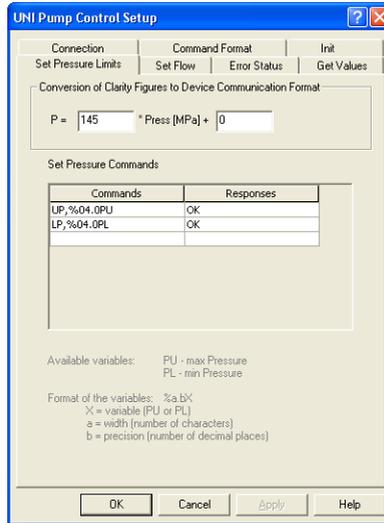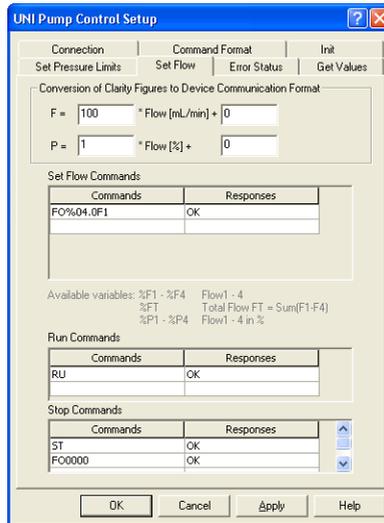

Fig 14: UNI Pump Control Setup - Set Flow

Conversion of Clarity Figures to Device Communication Format

This section serves for setting the calculation equations between **Clarity** and the pump figures. The edit fields in the equations present the means for setting the scale (first field) and the offset (second field) for the conversion of figures sent to the device.

- -

Note: Let us assume that the pump receives the flow in the form which tells that 0 is a flow of 0 ml/min, while getting the value of 1000 would set the flow to 10 ml/min. The correct figures to enter would be *100* for the first field and *0* for the second field.

F and *P* are the values that the pump uses, counted from values taken from **Clarity**. Some pumps use different format for receiving and sending the flow.

The formatting conventions described in the chapter **"Appendices"** on pg **36** . do not apply in the *Conversion of Clarity Figures to Device Communication Figures* section.

Set Flow Commands

This section sets the commands that will be used for setting the actual flow in the pump. The formatting and variables are described in the chapter **"Appendices"** on pg **36** . The following variables can be used in the commands:

%F1 - %F4: Flow of the solvent 1 - 4
%FT: Total Flow; FT = Sum(F1-F4)
%P1 - %P4: Flow of the solvent 1 - 4 in %

Note: On isocratic pumps that will be used in high pressure gradients, use *%F1* when getting the flow of the solvent. The *%FT* variable should only be used for stand alone pumps or in combination with *%Px* variables on low pressure gradient pumps.

Note:
On some pumps combined commands can be used to send more parameters, for example the Set Flow command can also eventually include the pressure limit parameters.

Run Commands
This table serves for specifying the commands that will be sent to the pump to start it - some pumps need not only to get the desired flow, but also to enter the running state. The *Commands* column defines the commands that will be sent to the device, while the *Responses* column holds the expected responses. If the *Responses* field for the given command is left empty, the driver will expect no response and won't wait for one.

Stop Commands
This table serves for specifying the commands for stopping of the pump - some pumps need not only to set the flow to zero, but also switching them from the running state to cease working. The *Commands* column defines the commands that will be sent to the device, while the *Responses* column holds the expected responses. If the *Responses* field for the given command is left empty, the driver will expect no response and won't wait for one.

6.2.5 Error Status

The Error Status tab sets the commands for testing potential error status of the device.

Fig 15: UNI Pump Control Setup - Error Status

Test Error

Generic Error Response
Sets the string for which all responses of the pump are checked. All responses from the device are checked for the specified string.

Command
Sets the command for checking the error status of the pump.

- -
Note: Once the *Command* field has been filled in it is necessary to fill both the *Error-free Response* and *Error Response* fields.

Error-free Response
Sets the expected response in case that the pump does not issue any error status.

Error Response
Sets the expected response in case that the pump has issued an error status.

- -
Note: The error response from the device is first checked against the *Error Response* field. Only if it does not match it would be checked against the *Error-free Response* field. Consequently the *Error-free Response* field can contain the wildcards (*, ?) that may be valid also for the *Error Response*.

On Error

Sets the commands to be sent to the pump after the error status has been detected. In the second column expected responses from the pump have to be stated.

- -

Caution!   When a response to an *On Error* command is recognized by *Error Response* or *Generic Error Response*, the communication may freeze in an endless cycle. To avoid this, use wildcard (*) in this field.

Stop Pump

Sets the behavior of the pump in case of the emerging error. When checked all running solvents will be stopped if error occurs.

Show Error Message

Enables the display of the error messages when error occurs.

Timeout

Sets a time (in seconds) for which the driver will wait for a response to a command. If the response has not been received within the specified time, a communication error will be generated.

6.2.6 Get Values

The Get Values tab is used to set the request format that will ask the pump for actual flow and pressure. These figures will be later displayed in the Device Monitor window and will be requested from the pump twice per second.

Note: If the pump or the LC UNI control module is busy performing other actions, the refresh rate will be slower.
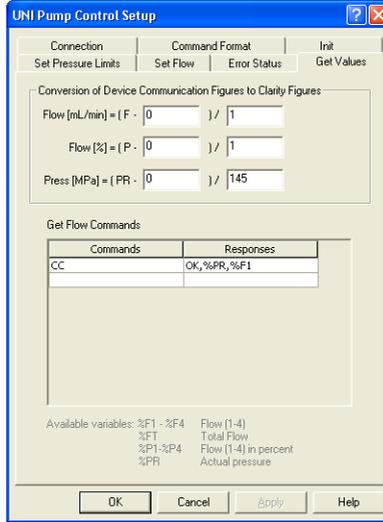
Fig 16: UNI Pump Control Setup - Get Values

Conversion of Device Communication Figures to Clarity Figures

This section serves for setting the calculation equations between the pump figures and **Clarity**. The edit fields in the equations present the means for setting the offset (first field) and the scale (second field) for the conversion of figures received from the device.

Note: Let us assume that the pump sends the flow in the form which means that 0 is a flow of 0 ml/min, while sending the value of 1000 would mean the flow of 10 ml/min. The correct figures to enter would be *0* for the first field and *100* for the second field.

The formatting conventions described in the chapter **"Appendices"** on pg **36**. do not apply in the *Conversion of Device Communication Figures to Clarity Figures* section. The LC UNI control module will calculate any missing figures providing that it has enough information to calculate them (e.g. will calculate *%FT* - Total Flow if it has *%F1 - %F4*).

Flow [ml/min]
Sets the conversion equation of the flow figures between the pump and **Clarity** formats.

Note: Flow has to be expressed in ml/min regardless to the setting of units used for display in the **Clarity** Device Monitor dialog.

Flow [%]
Sets the conversion equation of the relative flow figures between the pump and **Clarity** formats.

Press [MPa]
Sets the conversion equation of the pressure figures between the pump and **Clarity** formats.

Note: Pressure has to be expressed in MPa regardless to the setting of units used for display in the **Clarity** Device Monitor dialog.

Get Flow Commands
This section sets the commands that will be used for gaining the actual flow and pressure figures from the pump. The following variables can be used in the commands:
%F1 - %F4: Flow of the solvent 1 - 4
%FT: Total Flow; FT = Sum(F1-F4)
%P1 - %P4: Flow of the solvent 1 - 4 in %
%PR: Actual Pressure

Note: On isocratic pumps that will be used in high pressure gradients, use *%F1* when getting the flow of the solvent. The *%FT* variable should only be used for stand alone pumps or in combination with *%Px* variables on low pressure gradient pumps.

7 Appendices

7.1 List of variables

The following variables are used through the whole control module. It means that the value determined in one dialog can be used in other dialogs of the **UNI Pump Control** module.

Format specification fields

A format specification, which consists of optional and required fields, has the following form:

%[flags] [width] [.precision] [variable]

Each field of the format specification is a single character or a number signifying a particular format option

The optional fields, which appear before the Variable, control other aspects of the formatting, as follows:

Flags

A flag directive is a character that justifies output and prints signs, blanks, decimal points, and octal and hexadecimal prefixes. More than one flag directive may appear in a format specification.

Tab 3: Flag Characters

Flag	Meaning	Default
0	If width is prefixed with 0, zeros are added until the minimum width is reached. If 0 and - appear, the 0 is ignored. If 0 is specified with an integer format (i, u, x, X, o, d) the 0 is ignored.	No padding.

Width

The width argument is a nonnegative decimal integer controlling the minimum number of characters printed. If the number of characters in the output value is less than the specified width, blanks are added to the left until the minimum width is reached.

If width is prefixed with **0**, zeros are added until the minimum width is reached.

The width specification never causes a value to be truncated. If the number of characters in the output value is greater than the specified width, or if width is not given, all characters of the value are printed.

Precision

The precision specification specifies a nonnegative decimal integer, preceded by a period (.), which specifies the number of decimal places.

Unlike the width specification, the precision specification can cause rounding of a floating-point value.

Variables

Variables are strings that will be automatically identified in the commands or responses and replaced by the current values.

Tab 4: Variables in commands sent

Command	Meaning
%PU	Upper (max) pressure limits
%PL	Lower (min) pressure limits
%F1 - %F4	Flows of individual solvents
%P1 - %P4	Flows of individual solvents in percent
%FT	Total Flow

The formatting conventions are applied to the sent commands.

Tab 5: Variables in responses received

Command	Meaning
%FT	Total Flow
%F1 - %F4	Flows of individual solvents
%P1 - %P4	Flows of individual solvents in percent
%PR	Current pressure
?	Arbitrary character (wildcard)
*	Arbitrary string (wildcard)

The formatting conventions are not applied to the received responses.

7.2 ASCII code table

Tab 6: List of available ASCII codes

HEXA	Char	Note
00	NUL	(Null char.)
01	SOH	(Start of Header)
02	STX	(Start of Text)
03	ETX	(End of Text)
04	EOT	(End of Transmission)
05	ENQ	(Enquiry)
06	ACK	(Acknowledgment)
07	BEL	(Bell)
08	BS	(Backspace)
09	HT	(Horizontal Tab)
0A	LF	(Line Feed)
0B	VT	(Vertical Tab)
0C	FF	(Form Feed)
0D	CR	(Carriage Return)
0E	SO	(Shift Out)
0F	SI	(Shift In)
10	DLE	(Data Link Escape)
11	DC1	(XON) (Device Control 1)
12	DC2	(Device Control 2)
13	DC3	(XOFF)(Device Control 3)
14	DC4	(Device Control 4)
15	NAK	(Negative Acknowledgement)
16	SYN	(Synchronous Idle)
17	ETB	(End of Trans. Block)
18	CAN	(Cancel)
19	EM	(End of Medium)
1A	SUB	(Substitute)
1B	ESC	(Escape)
1C	FS	(File Separator)
1D	GS	(Group Separator)
1E	RS	(Request to Send)(Record Separator)
1F	US	(Unit Separator)
20	SP	(Space)

HEXA	Char	Note
21	!	(exclamation mark)
22	"	(double quote)
23	#	(number sign)
24	$	(dollar sign)
25	%	(percent)
26	&	(ampersand)
27	'	(single quote)
28	(	(left/opening parenthesis)
29	)	(right/closing parenthesis)
2A	*	(asterisk)
2B	+	(plus)
2C	,	(comma)
2D	-	(minus or dash)
2E	.	(dot)
2F	/	(forward slash)
30	0	
31	1	
32	2	
33	3	
34	4	
35	5	
36	6	
37	7	
38	8	
39	9	
3A	:	(colon)
3B	;	(semi-colon)
3C	<	(less than)
3D	=	(equal sign)
3E	>	(greater than)
3F	?	(question mark)
40	@	(AT symbol)
41	A	
42	B	
43	C	
44	D	
45	E	
46	F	

HEXA	Char	Note
47	G	
48	H	
49	I	
4A	J	
4B	K	
4C	L	
4D	M	
4E	N	
4F	O	
50	P	
51	Q	
52	R	
53	S	
54	T	
55	U	
56	V	
57	W	
58	X	
59	Y	
5A	Y	
5B	[	(left/opening bracket)
5C	\	(back slash)
5D	]	(right/closing bracket)
5E	^	(caret/circumflex)
5F	_	
60	`	
61	a	
62	b	
63	c	
64	d	
65	e	
66	f	
67	g	
68	h	
69	i	
6A	j	
6B	k	
6C	l	

HEXA	Char	Note
6D	m	
6R	n	
6F	o	
70	p	
71	q	
72	r	
73	s	
74	t	
75	u	
76	v	
77	w	
78	x	
79	y	
7A	z	
7B	{	(left/opening brace)
7C	|	(vertical bar)
7D	}	(right/closing brace)
7E	~	(tilde)
7F	DEL	(delete)