DataApex
Clarity™
CHROMATOGRAPHY SOFTWARE

CB20 CONTROL BOARD

Clarity Hardware   ENG

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Contents

To facilitate the orientation in the **CB20 Control Board** manual and **Clarity** chromatography station, different fonts are used throughout the manual. Meanings of these fonts are:

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.

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

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

[Chromatogram](#) (blue underlined) marks clickable links referring to related chapters.

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 CB20 Control Board

The **CB20 Control Board** is designed for controlling **LC pumps** (that can be steered by frequency or voltage) by means of the **Clarity** chromatography software. It contains four 16-bit D/A converters and four 28-bit frequency (D/f) converters as well as eight auxiliary logical inputs and outputs. The board has been designed especially for control of analog-operated pumps by the **Clarity** chromatography stations.
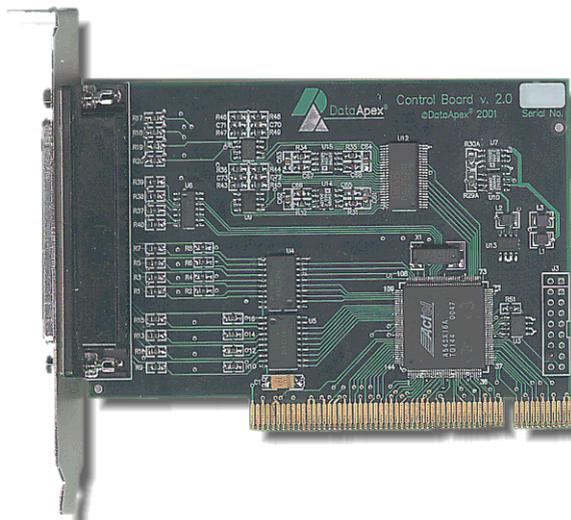

Fig. 1: CB20 D/A, D/f board

Thanks to the employed Plug-and-Play technology, one only has to install the corresponding driver and set up the control parameters corresponding to the relevant pumps.

Note: The **CB20** board is a direct successor to the ISA board **CB11**.

Instrument control has been incorporated directly in the **Clarity** program. Control is accessible from the *Method Setup – LC Control* and *Device Monitor* dialogs accessible from the *Instrument* window to which the controlled instrument is connected. Detailed description of the **Clarity** LC Control environment is provided later in this manual.

2 Requirements

The **CB20 Control Board** can be used with the **Clarity** software on a PC with a **PCI** slot and a **32-bit Windows OS**.

Caution: **CB20 Control Board** is supported up to Windows 10 OS.

Tab. 1: Hardware and Software Compatibility:

Software	Windows			
	11	**10** **(32-bit only)**	**8.1** **(32-bit only)**	**7**[SP1] **(32-bit only)**
Clarity	No	Yes (from 6.2)	Yes (from 4.0.3)	Yes
Clarity Lite	No	No	No	No
CSW32	No	No	No	Yes

Tab. 2: Hardware and Software Compatibility with obsolete Windows OS:

Software	Windows		
	XP[SP3] **(32-bit only)**	**Vista**[SP2] **(32-bit only)**	**2000**
Clarity	Yes (until 7.4.1)	Yes (until 7.2)	Yes (until 3.0)
Clarity Lite	No	No	No
CSW32	Yes	Yes	Yes

The PC must have one free **PCI** slot for your **CB20** card.

Note: Full size **PCI 2.0**, 32 bit PCI slot for 5V 32 bits half-length extension card is required. Low profile or PCI Express slots cannot be used.

Clarity must have the LC Control module (p/n A24).

3 Installation

3.1 CB20 installation

Caution: Ensure you have *Administrator* access rights in your system, before you proceed with the installation.

CB20 Control Board is not part of the **Clarity** *Typical* installation. To install it, select the *Full* installation or the *CB20* item in the *Choose Components* dialog during the installation of **Clarity**.

- Install **Clarity** software from the DVD-ROM.
- Turn off the **PC**
- Insert the **CB20** card into the **PCI** slot
- Start up the **PC**

a) MS Windows XP and later
In **Windows 8.1/7/Vista/XP** the drivers will be installed automatically during the installation of the **Clarity** software. Install the software before installing the card to the PC.

b) Previous versions of MS Windows
In other systems then Windows XP follow the procedure described in the chapter **"Troubleshooting"** on pg. **17**.

3.2 Device setup and wiring

Standard package is shipped with 3-metre cable for two frequency and two analog (voltage) outputs.

A different cable can be provided upon request.
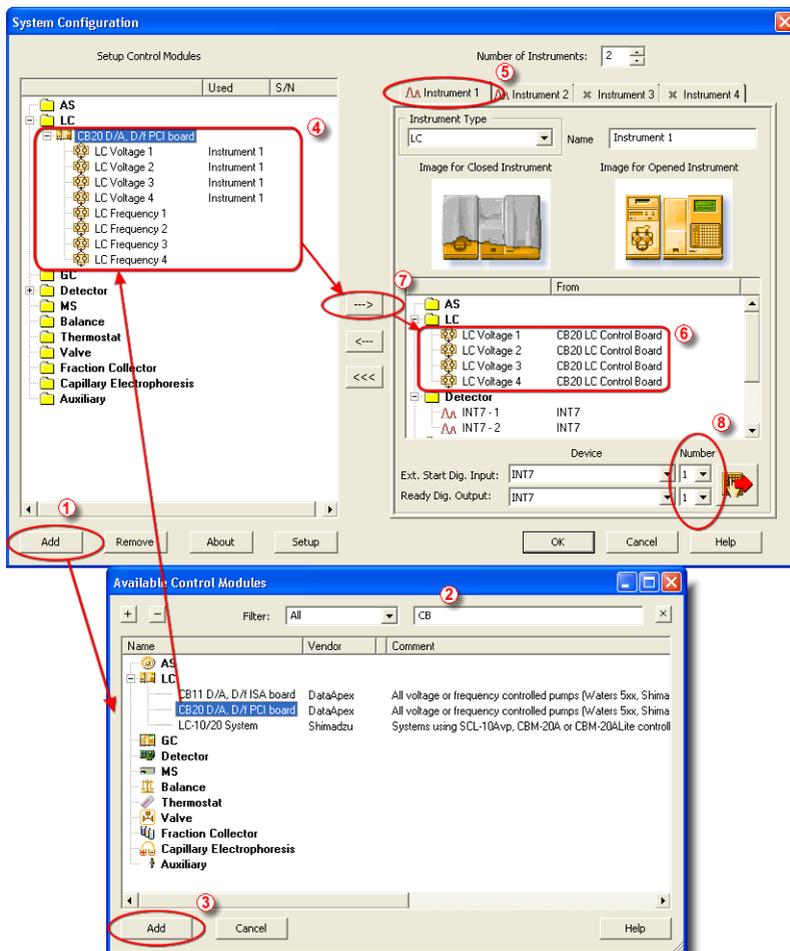
3.3 Clarity Configuration

Fig. 2: System Configuration

- Start the **Clarity** station with 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. **4**.) to invoke the *Available Control Modules* dialog.
- You can specify the searching filter ② to simplify the finding of the driver.

- Go to the **LC** section, select the **CB20 D/A, D/f PCI board** and press the *Add* button ③ .
- The DataApex CB-20 Setup dialog will appear.

Fig. 3: DataApex CB-20 Driver Setup

- Set the parameters of the **Voltage** or **Frequency** driven pumps (for more details see the chapter **CB-20 Setup** on pg. **6**). and click **OK**.
- The **CB20 D/A, D/f PCI board** will appear in the *Setup Control Modules* list of the *System Configuration* dialog ④ .
- Switch to the **Clarity** *Instrument* ⑤ tab where the LC control will be used*. The *Instrument Type* must be set to **LC**.
- Drag the corresponding *LC Voltage* or *LC Frequency* control channels from the *Setup Control Modules* list on the left side ④ to the desired *Instrument* tab on the right side ⑥ (or use the `-->` button ⑦ in the center).

. . . .

Note: The individual LC control channels can be configured to separate instruments.

. . . .

Note: The DataApex CB-20 Setup dialog can be displayed any time by double-clicking on the **CB20 D/A, D/f PCI board** icon or using the *Setup* button.

4 Using the card

New LC gradient tab appears in the *Method Setup* dialog, enabling the setting of the LC control method. By setting the pump to auxiliary mode (see the chapter **"CB-20 Setup"** on pg. **6**.), the LC Gradient tab is replaced by the LC tab.

4.1 CB-20 Setup

The *DataApex CB-20 Setup* dialog sets the parameters of the **CB20** LC control board. The dialog is accessible only from the *System Configuration* dialog, please see **Fig. 2** on pg. **4**.

Fig. 4: DataApex CB-20 Setup

Status

Describes the status of communication between the **Clarity** and the **CB20** board.

Tab. 3: Status of communication:

Status	Description
OK	The board has been detected and is functioning properly.
Cannot find board	The board may be damaged, not properly installed in the slot, or there may be a HW conflict with another device. Please check the "System - Device manager", whether there is not some conflict and/or the driver is installed properly.

Status	Description
DEMO Mode	If you have installed **Clarity Demo** or **Clarity Offline** version, the driver will simulate **CB20** board.
EVAL	If you have **CB20** board running in the computer with installed **Clarity Offline**.

Analog and Frequency outputs

The **CB20** board contains four converters for controlling HPLC pumps by means of voltage and another four capable of frequency control.

Name

You can set a custom name of the pump.

Aux Pump Mode

Sets the pump to auxiliary state, thus excluding it from the **Gradient Table**. This serves for the possibility to add more than four pumps to a single **Instrument**. Pumps with Aux Pump Mode enabled are controlled independently using separate LC tab in Method Setup (Idle Flow for each pump) and Event Table (flow change during analysis).

Enable Stop Pump

Check this option if you want to enable to stop the pump by means of digital input.

Stop Signal Polarity

By checking this checkbox you can make the pump stop when digital input is switched to *HIGH* (+5 V).

By default, the pump is stopped when the digital input is switched to *LOW* (0V).

Note: This feature is utilized by Waters pumps. If you control Waters pumps, select the option Waters to set the pump correctly.

Zero Flow Voltage

In this control you can set the voltage which stops the pump. After stopping the pump because of some problem, or after starting the computer the frequency output will be in calm state. This means that there will be 0 [Hz] on the frequency output. This option is available for *Frequency outputs* only.

Flow 0 ml/min

In this field you can set the frequency corresponding to the 0 ml/min flow.

Flow 10 ml/min

In this field you can set the frequency corresponding to the 10 ml/min flow.

Max change of Flow

Some pumps are not capable to handle commands for sudden change of flow rate (e.g. even switching the flow rate to zero at the end of the analysis could cause a problem). Here you can set the maximal change of flow rate that your pump would be able to process. All prospective sudden changes of flow in the gradient program will be automatically staggered into steps, thus protecting your pump. (e.g. the empirical values for Waters 501-510 HPLC pumps have to be less than 1 ml/sec.

4.2 Method Setup - LC Gradient

The *Method Setup - LC Gradient* dialog serves for setting up the LC related part of the template method opened in the *Instrument* window.
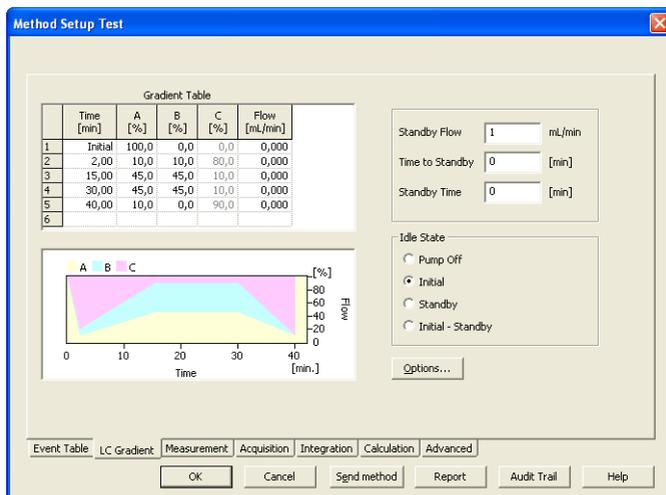

Fig. 5: Method Setup – LC Gradient

Gradient Table

A table for setting the composition of the mobile phase and the overall flowrate as a function of time. Operation is analogous to that of spreadsheets (Excel, Quatro Pro, ...). Upon left-clicking a cell, it is highlighted by dots and ready to receive values. A cell that fails to highlight is not available for editing.

Time [min.]

The entered value represents the time at which the ratio of flowrates and the overall flowrate correspond to the values entered in the corresponding row. (These values vary continuously from one time 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 box). 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 flowrate of a compound is calculated by multiplying the overall flowrate (indicated in the **Flow** column) by the corresponding percentage divided by 100.

Flow [ml/min]

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

Note: If the flowrate set for the given pump in a gradient table (calculated from a percentage and a total flow) exceeds the maximum flowrate for the set pump head, the change is ignored and last acceptable value is used instead.

Graph

The graph depicts the percentage of components as a function of time together with the overall flowrate. The data is taken over from the *Gradient Table*. Changes in this table are immediately reflected in the graph. An assignment of colours to individual components is shown in the header. The assignment is fixed and individual components are displayed from bottom up in the graph.

The flowrate is displayed in black.

The graph has two vertical axes: the axis on the left refers to the mixing ratio, that on the right to the overall flowrate.

Standby Flow

Indicates the overall flowrate through the column in the *STANDBY* state reached after the last row of the table has been performed and the *Time to Standby* has passed. The time period during which the flowrate is maintained so is defined by the item *Standby Time*. The ratio of individual components in the respective *STANDBY* and *IDLE* states is given by the first row of the Table (the *Initial* row).

Time to Standby [min]

Indicates the time during which the flowrate varies continuously between the last values entered in the table and the value defined by *Standby Flow*. This time is included in the analysis time (the *CONTROL* state).

Standby Time [min]

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

Idle State

An item specifying the overall flowrate through the column outside the instrument method. The following states are possible:

Pump Off

The flowrates of all components are zero.

Initial

The flowrate is defined by the first row of the *Gradient Table* (the *Initial* row).

Standby

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

Initial - Standby

When the Method is sent to pump or the analysis has started, the flowrate is defined by the first row of the *Gradient Table* (the *Initial* row). After the last row of the table has been performed and the *Time to Standby* has passed, the overall flowrate is set to the value entered in the *Stand By Flow*.

The *IDLE* state enters into effect each time an instrument is opened, at the end or after abortion of an analysis by the *Abort* command, and is maintained also when 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).

Options...

By invoking the *Options...* button in The *Method Setup - LC Gradient* dialog, the *Gradient Options* dialog will appear.
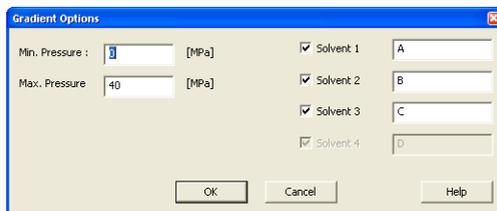

Fig. 6: Gradient Options

In this dialog, the *Min. Pressure* and *Max. Pressure* limits can be set and *Solvents* can be enabled and named. Available solvents depend on the number of pupms added to *Instrument* in the *System Configuration*. For more details see the chapter **Clarity Configuration** on pg. **4**.

4.3 Method Setup - LC - Auxiliary Pump

The *Method Setup - LC* dialog serves for setting up the LC related part of the template method opened in the *Instrument* window. This dialog is accessible when the pump is set to auxiliary state only (for more details see the chapter **CB-20 Setup** on pg. **6**).
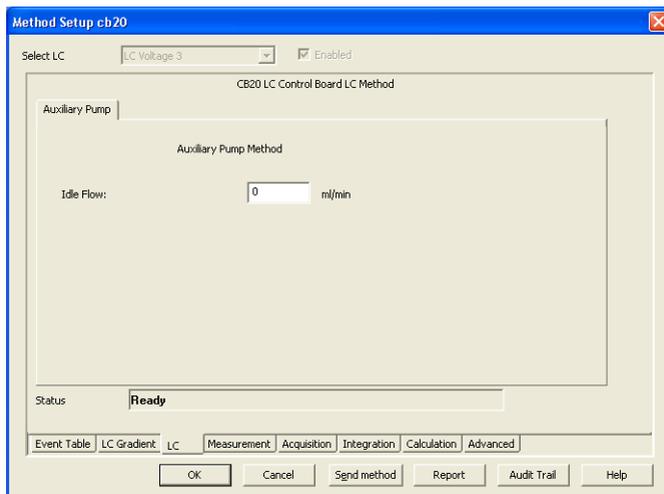
Fig. 7: Method Setup – LC

Idle Flow
Flow in ml/min in the idle state of the pump.

Description
Description of the pump.

Status
When the **CB20 Control Board** is correctly installed, the *READY* status is displayed.

4.4 Device Monitor

The *Device Monitor* window 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.

The individual solvent flow can be displayed either in flow units or as a percentage of total flow by checking the *View - Component flow in %* command.
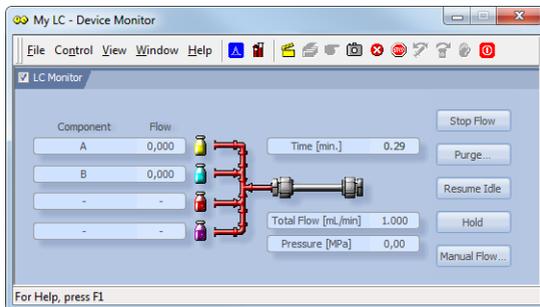
Fig. 8: Device Monitor - CB20

Caution: *Pressure [MPa]* doesn't indicate any value when the pump is controlled using the **CB20** Card.

Stop Flow

The pumps can be stopped from this window using the *Stop Flow* button. This action stops the pump only, the analysis continues to run and must be stopped or aborted from the *Data Acquisition* window or *Single Analysis* dialog.

Purge

The pumps may be purged by pressing this button. Set the desired total flow and solvent ratios in the opened *Set Flow* dialog.

Fig. 9: Set Flow

The number of solvents and their names displayed in the Set Flow dialog corresponds to the solvent number and names set in the Gradient Options dialog.

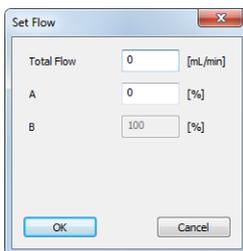The last available solvent field is always grayed out and is automatically counted as the rest of the percentage of the other solvents.

Resume Idle

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

Hold / Resume

Pauses / resumes the execution of the **Gradient Table** at the actual flow and mobile phase composition. The same flow and composition is maintained until the *Resume* button is pressed, which returns the method to the original **Gradient Table** again. The command is only available during the analysis run.

Manual Flow…

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.

4.4.1 Device Monitor - Auxiliary Pump

If the pump is set to *Aux Pump Mode* in the DataApex CB20 Setup dialog, the *Device Monitor* for Auxiliary Pump is provided.

Fig. 10: Device Monitor - Auxiliary Pump

Stop

Stops the Purge operation.

Purge

Displays the *Purge* window that allows to set the flow during the Purge operation.

Fig. 11: Purge

Resume Idle

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

4.4.2 LC Control Manual Flow

The *LC Control Manual Flow* dialog accessible through using the *Manual Flow…* 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.
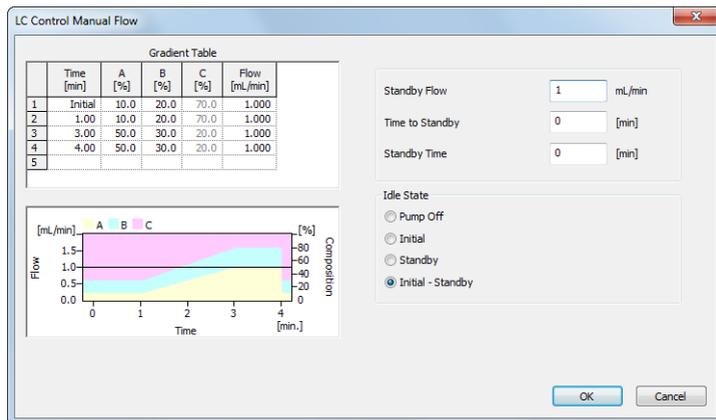
Fig. 12: LC Control Manual Flow dialog

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.

5 Tables and specifications

Tab. 4: Voltage channels (outputs):

CB20 contains 4 voltage channels with following parameters.

Parameter	Value
range	±10 V (only bipolar)
resolution	16 bits
monotonicity min.	14 bits
linearity error max.	±4 LSB
dif. linearity error max.	±3 LSB
temperature drift max.	100 ppm/°C
output impedance	100 Ω
max. time of short circuit on output	not limited

Tab. 5: Frequency channels (outputs):

CB20 contains 4 frequency channels with following parameters.

Parameter	Value
range	0.03 Hz - 100 kHz
used method of frequency creation	DDS (Direct Digital Synthesis – direct numeric synthesis)
resolution	28 bits
step	37.26 mHz (ca 27 steps/Hz)
phase instability	100 ns
temperature drift max.	50 ppm/°C
voltage level	TTL (0 V & +5 V)
max. output current	30 mA
output protecting serial resistor	33 Ω

Tab. 6: Numeric outputs:

CB20 contains 8 numeric outputs with following parameters.

Parameter	Value
voltage level	TTL
output protecting serial resistor	33 Ω

Tab. 7: Numeric inputs:

CB20 contains 8 numeric inputs with following parameters.

Parameter	Value
voltage level	TTL
pull-up resistor	10 kΩ (at +5 V)
input protecting serial resistor	100 Ω

All inputs and outputs are protected against ESD.
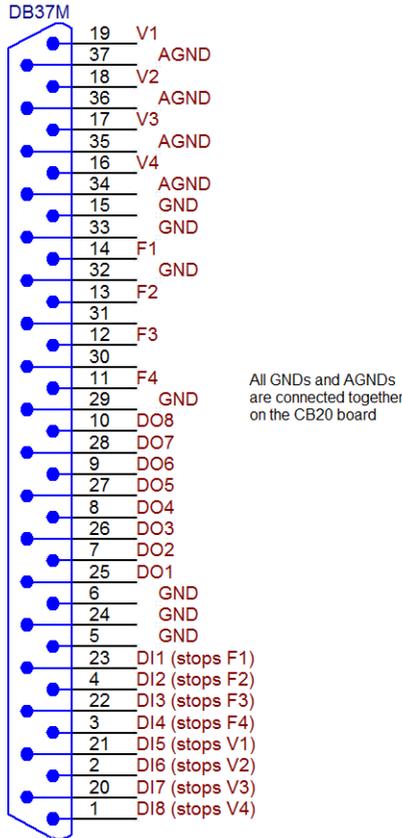
5.1 CB20 connector

Fig. 13: View of the back side of the connector

6 Troubleshooting

6.1 Problems with CB20 driver

Problems with **CB20** driver are generally indicated by following problems:

- **CB20** cannot be added to the *Setup Control Modules* in the *System Configuration* dialog.
- Doubleclicking on the device will not invoke the DataApex CB-20 Setup dialog.

6.1.1 How to check the CB20 driver

Windows XP/2000
In the lower left corner of the screen, in the *Start* menu, select *Settings - Control Panel* and the *System* icon, and under the *Hardware* tab click on the *Device Manager* button.

Windows 7/Vista
In the lower left corner of the screen, in the *Start* menu, type "Device Manager" in the search field and click on the found item.

Windows 8.1
Press the *Start* button on your keyboard and start typing *Device Manager* on your keyboard. Click on the listed item.

In the desired *Device Manager* window for the item "**Chromatography Devices - DataApex D/A Control Board, Model CB2.0**".
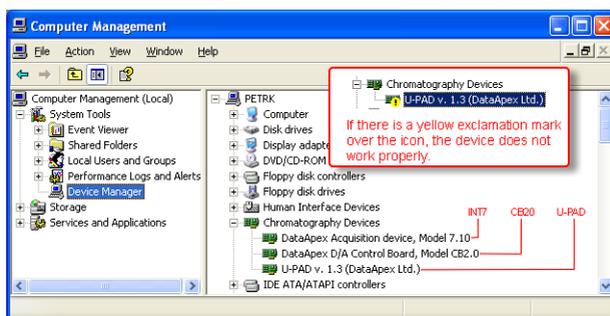Correctly installed driver can be seen in the following image:

Fig. 14: Device Manager in Windows XP

If the DataApex D/A Control Board, Model CB 2.0 is missing then the driver has not been installed.

Solution: Reinstall the driver manually as described in the chapter **"Troubleshooting"** on pg. **18**.

▌ **If the driver is installed but there is a yellow exclamation symbol over its icon, or it does not behave as expected the driver is probably incorrectly installed.**

Solution: Uninstall the incorrect drivers and install the correct ones as described in the chapter **"Troubleshooting"** on pg. **18**.

6.1.2 Manual Installation of the CB20 drivers

- During start-up, Windows should automatically recognize the new **Plug and Play** device and start the hardware installation wizard.

Note: If it does not use the *Start - Control Panel – Add Hardware* to invoke it.

- Select: *Search for the best driver for your device*
- Select: *Specify a location*; here click the *Browse* button and select the path to the main folder of the **Clarity** station and corresponding subfolder (C:\CLARITY\HW_DRIVERS\CB20 by default).

Note: The driver is also located on the **Clarity** installation DVD‑ROM in the HW_DRIVERS\CB20 subfolder. Here, it is necessary to select the version corresponding to the version of your MS Windows.

- The rest of the installation is carried out automatically.

 Reinstallation of incorrectly installed drivers

In certain situations (e.g. when you inserted the **CB20** board before installing the **Clarity** software) Windows OS can accidentally use incorrect drivers.

Then there is a yellow exclamation mark next to the Chromatography device item in the *Device manager*. Updating the driver will not solve the situation. It is necessary to get rid of the incorrect drivers and then install the correct ones.

6.2 LC pumps

▌ **The pump does not react to external control.**

Solution: Some pumps need to be switched to external control mode in order to be able to control it using the **CB20** board. This is usually done by closing dedicated contacts. Consult the pump manual.

6.3 General troubleshooting

▌ **The CB20 board is not listed in the *Setup Control Modules* list of the** System Configuration **dialog.**

Solution: Follow the bullets ① and ② in the **Fig. 2** on pg. **4**. to add the **CB20** board to the **Clarity**.

▌**There is not any LC Control tab in the *Method Setup* dialog.**

Solution: Verify that the relevant Voltage (Frequency) channels were configured to the proper *Instrument* tab in the System Configuration dialog, see the bullets ④ and ⑥ in the **Fig. 2** on pg. **4**.

Verify that the station has unlocked LC Control module. Ask on DataApex help line. You will be asked to provide the **Serial Number** of your station. This can be found in the *About* dialog, tab *System Files*, item **Serial number of application**.

7 Controlled devices

This section lists information related to selected controlled LC pumps.

Waters

The maximum speed of change of flowrate for Waters pumps is approximately 1 ml/s.