Clarity Hardware

INT5 A/D converter

ENG

Code/Rev.: M065/24B – 04 August 2006

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1 Brief Description

1.1 INT5 Acquisition Board

INT5 is an internal integrating 24-bit A/D board that converts the analogue data from detectors into digital form, which can be further processed by means of any of the DataApex's Chromatography Station: *CSW17*, *CSW32* or *Clarity*.

This manual describes the use of the **INT5** converter together with the **Clarity** software.

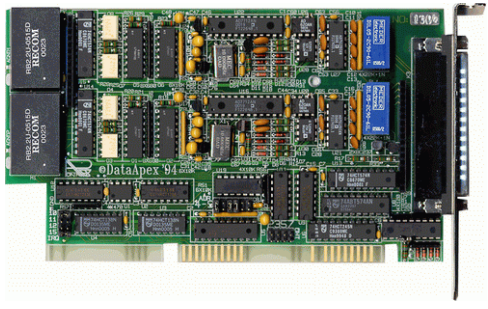


Fig. 1. INT5 Board

1.2 Hardware and software requirements

The **INT5 A/D Board** for **ISA** slot can be used with **Clarity** software under following operating systems: **MS Windows 98/Me/ NT/ 2000**.

The INT5 can also be used with **CSW17** and **CSW32** stations.

The PC must have:

- Free **ISA** slot for your INT5 converter.
- Available Interrupt.
  (see **4.3** - **Table of HW Interrupts** on pg. **18**)

Note: *If you cannot find any available interrupt try to reserve an available Interrupt in the **BIOS** as it is described in the Chapter **2.1**.*

1.3 A/D Converters types in general

Prior to collecting and processing the chromatographic signal by a computer the analog signal of the detector must be first converted to a digital form by an analog/digital (A/D) converter.

In principle there are three types of A/D converters – **sampling**, **integrating** and **Sigma-Delta** (with continuous integration.

Sampling converter

Periodically samples the input signal at discrete time intervals and transforms the resulting samples to digital form.

Owing to its speed this principle is suitable for converting rapidly changing signals, where the fundamental requirement involves accuracy (e.g. acoustic and visual signals).

Integrating converter

Integrates the input signal for a short time and transforms the resulting integral to a digital form.

It is thus apparent that the integrating converter is suited for processing analog signals for which the integral value is of paramount importance (e.g. measurement of electric power consumption, heat consumption and also chromatogram evaluation).

Its disadvantage is that it integrates discrete samples; the time between the samples is not addressed.

Sigma-Delta converter

The Sigma-Delta converter with continuous integration used in the DataApex's **INT5 A/D Board**, in contrast to the above-mentioned integration, integrates the input signal continuously.

Advantages of the INT5 A/D converter

- No loss of input signal during integration. There are no time delays during which the converter fails to integrate the input signal.
- There is no permanent servicing of the input analog switches, which would otherwise cause errors (offset, noise).
- The amount of data entering the computer is substantially smaller, since individual data items already represent partial integrals.

2 Installation

2.1 The INT5 Card

- The **Clarity** workstation communicates with the **INT5** card through a selected base address and one hardware interrupt.

  The implicit default values on the card are: base address **320H**, IRQ **10**.

  Because it is not possible to automatically configure the **INT5** card, it may be necessary to change the interrupt request and the base address. Both settings must be the same, both on the card and in the program. Meanwhile, these two settings must not be used by another device.

- If the available interrupt request is different from the default values, you will need to reconfigure the switch.

  The relevant values can be configured on the card using mechanical jumpers as described in the **4.2** - Jumper setting on pg. **18**.

Note: *Interrupts 2 and 9 are identical; they are indicated as number 2 on the **INT5** card.)*

- **Reservation of an available Interrupt in the BIOS:**

  On computers equipped with the **PnP (Plug and Play)** system, the **BIOS** often reserves some of the interrupts for this **PnP** system, and these switches cease to be available for **ISA** cards.

  - Turn on the **PC**; shortly after starting, try to invoke **BIOS SETUP** using the Delete key (or, depending on the type of **PC**, the Esc key, F2 etc.).
  - Once in **BIOS SETUP**, reserve an interrupt for the **INT5** card.

Depending on the type of BIOS, carry out one of the following:

BIOS type 1:	In section **PNP CONFIGURATION** (sometimes called **PNP/PCI CONFIGURATION** or **PCI CONFIGURATION SETUP**) reconfigure **Resources Controlled By** to **Manual**, and reserve the selected interrupt x by reconfiguring the corresponding IRQ-x assigned to : *Legacy ISA item.*
BIOS type 2:	In section **Advanced**, subsection **Plug and Play Configuration**, reconfigure **Configuration Mode: Use Setup Utility** and reserve the selected interrupt x by reconfiguring **IRQ-x : Used By ISA Card** item.

BIOS type 3: In the **PCI CONFIGURATION SETUP (PCI & ONBOARD I/O SETUP)** section, reconfigure **PnP (PCI PnP) BIOS Auto-Config** to **Disabled**. The displayed interrupts are available for PCI cards and, consequently, there must be no interrupt among them, which is configured for the card of the integrator. In the event that you should see one used, remove it.

- Turn off the computer.
- Insert the **INT5** card into the **ISA** slot.
- Start the computer up again.
- Start up the **Clarity** workstation, open the dialog **System Configuration** and double-click on the **INT5 A/D Card Driver** item (if this item is missing, add it using the **Add** button).
- In the fields **Base Address** and **IRQ** enter the values set using the jumpers on the card.
- Click on the **Apply** button.
- The **Status line** should read *OK*. In the event of a conflict, you will find there a description of its possible cause.

2.2 Device setup and wiring

The standard cable for **INT5** boards is composed of signal and starting cables for connecting the **CLARITY** station to the chromatograph.

2.2.1 Standard cable for Clarity station

- **Signal cables**
  Labelled "**DET1**" to "**DET4**" (according to the number of channels), the cables are supplied as standard without connectors with only stripped, tinned endings – red (+), white (-) and shielding (analogue ground).
- **Starting** (marker) **cables**
  Labelled "**IN1**" to "**IN4**" (according to the number of channels), ended with CINCH connector. One cable with free leads [red (+), shielding (digital ground)] for connection directly to the chromatograph or valve and one cable ended with a button for cases where starting contact is not available and it is necessary to perform start manually are supplied for each starting cable.
- **Cables of the digital outputs**
  Digital outputs **OUT 1** to **OUT 4** (according to the number of channels), are ended with CINCH M.

It is used for synchronizing autosamplers in the active sequence without an **AS Control** module or instrument control from the **Events Table**.

At the converter end the cable is always ended with a D-SUB 37 pole connector.

2.2.2 Chromatograph

Connect cables according to one of the following diagrams in **Fig. 2**. Use symmetrical connection only in the case that you are sure that the chromatograph/detector is equipped with symmetrical output –it is necessary to read through the instructions for the corresponding chromatograph.

The **INT5** (obsolete type) has a different wiring from the current types of DataApex A/D converters.

Note: *All current DataApex A/D Converters **INT7**, **U-PAD** and **Net-PAD** use the same standard **INT7 Connector**.*

It is possible to connect the chromatograph according to the wiring described in the chapter **4.1** - **Description of the INT5 Connector** on pg. **17**).

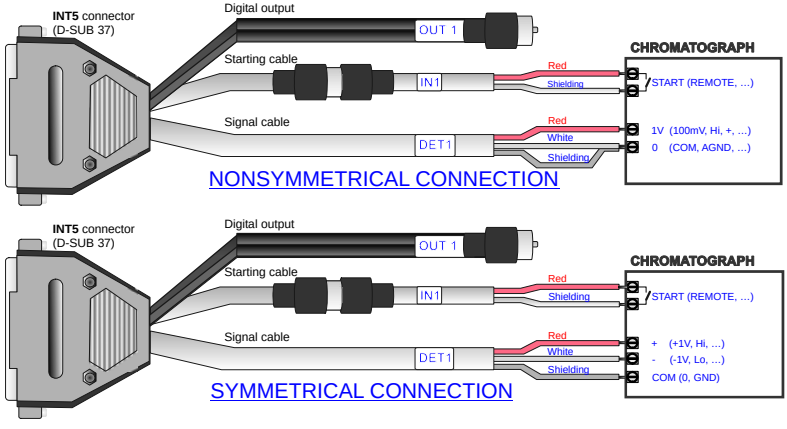


Fig. 2. Connection of Clarity with chromatograph

Principles of connection of signal cables:

Signal inputs of the A/D converters are symmetrical: + (red), - (white), analogue earth (copper braiding).

Caution! *Shielding must be connected. It serves not only as the shielding but also as the analogue earth against which measurement takes place. In the case of asymmetrical output of a detector (only two clamps) shielding must be*

connected to the white lead! No lead of the signal cable may remain unconnected.

Try to connect to the output of the detector of the chromatograph with the largest possible level of signal, usually indicated as **INTEGRATOR** (signal approx. 1V). The level of the signal on the output marked **RECORDER** is usually only approx. 10mV.

Connection of starting cables:

Starting input reacts to a change of the TTL logical level (5V) or to a change of state of any contact (button, contact of relay).

Input implicitly reacts to a change of the logical one to zero (or closing of contact). The input function may be changed by switching the **Down** item of **Ext. Start/Stop** section from the **Method Setup - Acquisition** dialog accessible from the **Instrument** window using the - **Method - Acquisition** command.

Note: *For schemes and hints describing the typical wirings of autosamplers see the **Getting Started** Manual.*

2.3 Clarity configuration

- Start the **Clarity** station with the icon on the desktop.
- Invoke the **System Configuration** dialog using the **System – Configuration** command.
- Press the **Add** button to invoke the **Available Control Modules** dialog.

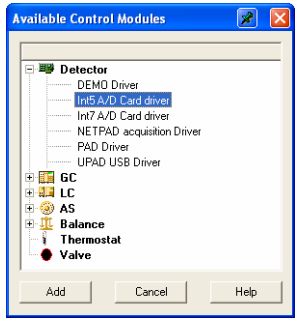


Fig. 3. Available Control Modules

- Select the **INT5 A/D Card driver** and press the **Add** button.
- The **INT5 Board Config.** dialog will appear.

Fig. 4. INT5 Board Config.

- Select the **Base Address** – it must correspond to the jumpers setting on the card.

Note: *For details on setting the correct **Base Address** and **IRQ** see chapter **3.2** - **INT5 Board** on pg. **12**)*

- Select the **IRQ** – it must correspond to the jumpers setting on the card.
- Set the names of detectors and press the **OK** button.

The *INT5 A/D Card* will appear in the **Setup Control Modules** list of the **System Configuration** dialog.

- Drag the INT5 detector icon from the **Setup Control Modules** list on the left side to the desired **Instrument** tab on the right side.

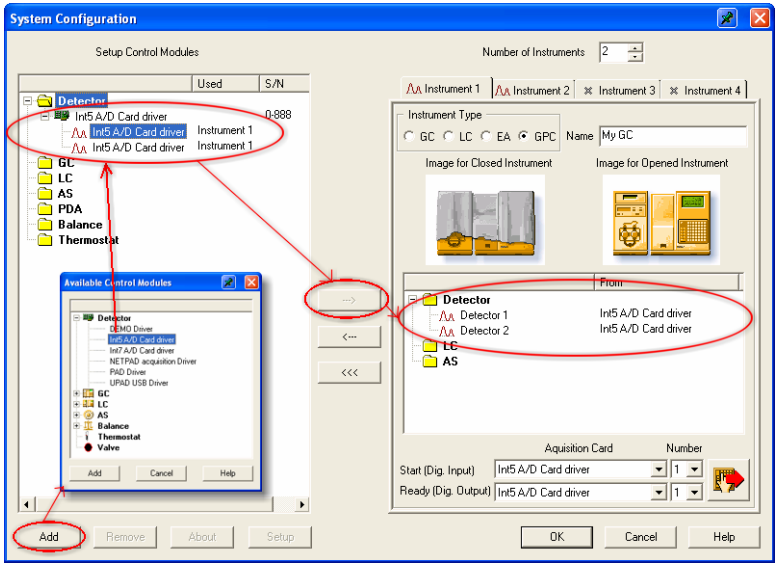


Fig. 5. System Configuration

- Set the **Start** input and **Ready** output numbers (in the lower-right part of the dialog) for your acquisition card according to the wires used for synchronization.

Note: *The configuration dialog of the **INT5** card (**INT5 Board Config.**) can be displayed any time by double-click on its icon or using the **Setup** button.*

3 Using the INT5 board

3.1 Digital Inputs and Outputs

The board contains eight digital TTL outputs with maximum permitted current of 10 mA in HIGH state and 20 mA in LOW state.

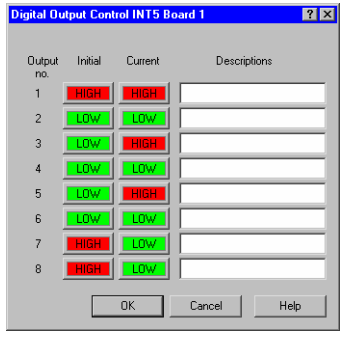


Fig. 6. Digital Output Control – INT5

The board also contains 4 digital inputs IN1 to IN4 permanently assigned to individual A/D channels. Each input contains a protective resistor and over voltage protection.

3.2 INT5 Board Config

The **CLARITY** station communicates with the integrating converters *via* a selected base address and one hardware interrupt.

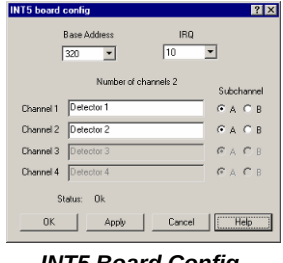


Fig. 7. INT5 Board Config.

Since automated setup of the **INT5** board is impossible, we submit a brief description to assist successful installation. Both the base address and

the interrupt are set on the board by means of jumpers as well as in the program (by the **System - Configuration** command from the **Clarity** window). The two settings must be identical.

Base Address

Sets the base address for communication between the station and the A/D converter. The address is shown as a hexadecimal number and must correspond to the setting of jumpers on the board.

Note: *See chapters **4.2** - **Jumper setting** on pg. **18** and **4.4** - **Table of Recommended Base Addresses** on pg. **19***

Possible values and the setting-up procedure are described in detail here. The occupied address space (8 addresses starting from the base address) must not overlap with the address space of any other equipment.

Note: *When the base address is changed the corresponding jumpers on the board must be reset accordingly.*

IRQ

Sets the number of the hardware interrupt for communi–cation with the A/D converter. The number must coincide with that set by the jumper on the board (see the chapter **4.2** - **Jumper setting** on pg. **18** and **4.3** - **Table of HW Interrupts** on pg. **18**) and must not coincide with an interrupt number used by any other equipment in the computer (mouse, hard disk, network card, etc.).

Note: *When the interrupt number is changed the jumper on the board must be reset accordingly.*

Number of Channels

Indicates the number of channels detected on the board.

Channel 1 (to 4)

Optional name of each channel on the board (e.g. the connected detector).

Status

The status of communication between **CLARITY** and the **INT5** board. The possible statuses are:

- **OK** - The board has been detected on the specified base address and interrupt number and is functioning properly
- **Invalid IRQ or malfunction board** - The hardware interrupt setting in the IRQ field does not match the setting of the jumpers on the board (see the chapter **4.2** - Jumper setting on

pg. **18**). The board may be also damaged, not properly installed in the slot, or there may be a HW conflict with another device.

- **Cannot find any INT5 board** - The most probably reason for this message is wrong base address setting. Again the figure in the Base Address field must match the jumper setting on the board (see the chapter **4.2** - Jumper setting on pg. **18**). The board may be also damaged, not properly installed in the slot, or there may be a HW conflict with another device.

Note: *You can check the tables specifying the recommended base addresses (see **4.4** - **Table of Recommended Base Addresses** on pg. **19**) and hardware interrupt numbers (see **4.3** - **Table of HW Interrupts** on pg. **18**) including their original assignment.*
In view of the ambiguous technical specification of PC computers it is next to impossible to recommend a specific address and/or interrupt number.
The tables do not contain possible assignments of addresses and interrupts to other boards potentially installed in the computer (network, modem, scanner, and similar boards).
If necessary, leave any re-configuration to your vendor. The default values are set off in the table.

Subchannel

The **INT5** board has two subchannels on each channel, between which it is possible to switch.

3.3 Method Setup - Acquisition

The **Method Setup – Acquisition** dialog is used to set the measuring conditions.

Caution! *The parameters can't be changed during analysis.*

Note: *The type of the displayed items in part depends on the type of the A/D converter installed.*

Bipolar

Positive and negative voltages will be measured.

Range

Selects the input voltage range (in mV). That means the maximum output voltage of the detector that the A/D converter can still process.

Sampling Rate

Specifies the sampling rate from among 10, 25, 50, or 100 samples a second.

Higher sampling rate allows to measure narrower peaks.

Higher sampling rate also means larger amount of data which will affect the size of the resulting chromatogram and the speed of its processing.

A sufficient number of samples for successful peak detection is about 20 samples per narrowest peak.

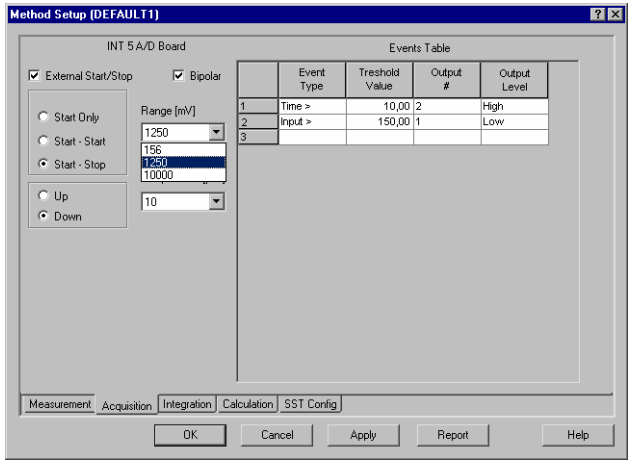


Fig. 8. Method Setup - Acquisition (INT5)

External Start/Stop

Enables control by an external signal.

Note: *The **Input** used for external **Start** from chromatograph can be set in the **System Configuration** dialog (see **Fig. 5** - System Configuration on pg. **11**).*

Start Only

The external signal only starts analysis.

Start - Start

The external signal terminates the analysis in progress and at the same time starts a new one. The first signal starts the analysis; the second signal terminates it and at the same time starts a new one - the so-called continuous measurement.

Start - Stop

The external signal starts and stops an analysis. The first signal start the analysis, the second signal stops it, etc.

Down

The station reacts to a voltage change in the relevant controlling input from high (> 3V) to low (< 0.7 V), or to closing a contact.

Up

The station reacts to a voltage change in the relevant controlling input from low (< 0.7 V) to high (> 3V), or to opening a contact.

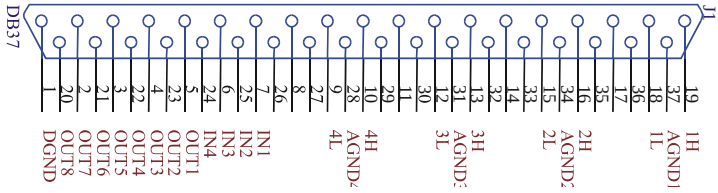
Event Table

Controls the eight digital outputs used to control external devices like valves, autosamplers, pumps, etc.

Note: *Consult the **Clarity Reference Guide** for further details on the **Event Table**.*

4 Tables and specifications

4.1 Description of the INT5 Connector



1H	+ Input of 1st channel
1L	- Input of 1st channel
AGND1	Ground of 1st channel
IN1, DGND	External start (marker) of 1 st channel
OUT1-8, DGND	Digital outputs controlled by **Event Table**, **Active Sequence** and **Digital Output** command

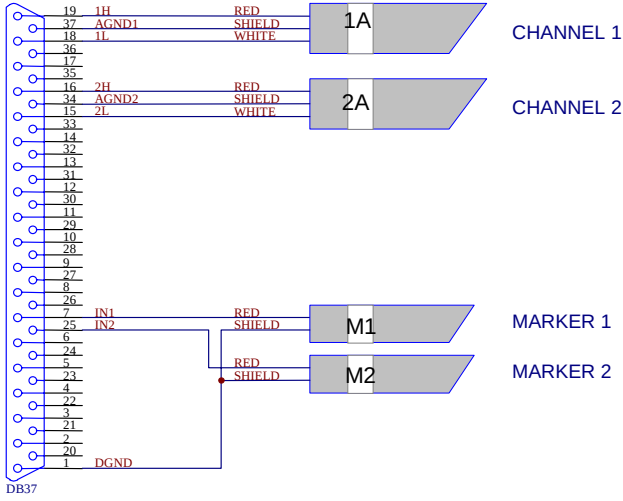


Fig. 9. A typical INT5 cable for two detectors

4.2 Jumper setting

The **CLARITY** station communicates with the integrating converters *via* a selected *base address* and one *hardware interrupt*. Since automated setup of the **INT5** board is impossible, we submit a brief description to assist successful installation. Both the base address and the interrupt are set on the board by means of jumpers as well as in **Clarity** sowtware (see **3.2** - **INT5 Board** on pg. **12**). The two settings must be identical.

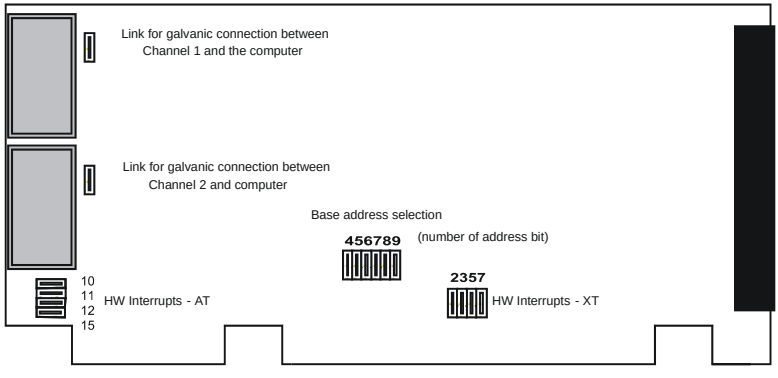


Fig. 10. Location of configuration jumpers on the INT5 board

4.3 Table of HW Interrupts

How to find an available IRQ:

Windows 98/Me	In the lower left corner of the screen, in the **Start** menu, select the command **Settings – Control Panel** and the **System** icon. Double-click on the item **Computer**. In the list that will appear as a result of this, find out which of the several possible Interrupts (3, 5, 7, 9, 10, 11, 12, 15) is not listed, i.e. is available.
Windows NT	In the lower left corner of the screen, in the **Start** menu, select the command **Programs – Administration Tools – Windows NT Diagnostics** – under the **Resources** tab click on the **IRQ** button.
Windows 2000	In the lower left corner of the screen, in the **Start** menu, select the command **Settings – Control Panel** and the **System** icon, under the **Hardware/Device Manager** tab select **View / View Resources by type / Interrupt Request**.

MS Windows system compatibility:

IRQ	Reserved for:
0	System timer
1	Keyboard
2	VGA, Ethernet
3	COM2
4	COM1
5	(often network, LPT2)
6	Diskette units
7	LPT1
8	Real time clock
9	= interrupt 2
10	**Free (often network)**
11	
12	Not recommended (PS/2 mouse)!
13	Coprocessor
14	First hard disk
15	Second hard disk, CD-ROM

4.4 Table of Recommended Base Addresses

Recommended Base Addresses:

Base address:	Jumpers:	Reserved for:
300H	4, 5, 6, 7	Prototype card
310H	5, 6, 7	Prototype card
320H	4, 6, 7	
200H	4, 5, 6, 7, 8	Game port
210H	5, 6, 7, 8	Expansion box
220 H	4, 6, 7, 8	

4.5 Technical Data

Converter type:	24-bit integrating, sigma – delta integration
Analog inputs:	mutually isolated with symmetrical inputs
Number of channels:	1, 2 or 4 fully independent
Input range:	unipolar and bipolar, each channel separately: 156 mV - 10 V
Conversion time:	10 - 100 ms
Non-linearity:	< 0.0015 %
Temperature dependence	< 20 ppm/°C
Auxiliary inputs:	4 TTL
Auxiliary outputs:	8 TTL

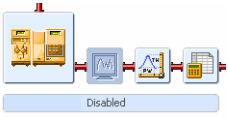
Effective resolution for various acquisition speeds and input ranges:

	10 V	**1 250 mV**	**156 mV**
10 Hz	20 bit	19 bit	16 bit
50 Hz	18 bit	17 bit	15 bit
100 Hz	17 bit	15 bit	14 bit

5 Troubleshooting

5.1 Data Acquisition – non-functional

Grey icon with heading "Disabled" and non-functional command Monitor – Data Acquisition



Other manifestations of this error are also: **Method Setup - Acquisition** tab missing, **Method – Acquisition** command non-functional, **Run, Stop, Abort** commands non-functional in the windows **Single Analysis** and **Sequence**). Possible causes are:

a) Detector not allocated to instrument:

- Open the **System Configuration** dialog from the main window **Clarity** using the command **System - Configuration** and check the tab of the corresponding instrument **Instrument x**.
- In the left-hand list **Setup Control Modules** select the correct detector connected to the A/D card you are using and link it to the corresponding instrument on the right.
- If your A/D card is not in the left-hand list **Setup Control Modules**, add this using the **Add** button and repeat the previous point.

Note: *More information on configuration of the INT5 card is provided in chapter 2.1 - The INT5 Card on pg. 6.*

b) You have a licence purchased for collection from a smaller number of instruments:

- Open the **System Configuration** dialog from the main window **Clarity** using the command **System - Configuration** and check the tab of the corresponding instrument – **Instrument x**. If the symbol of the curve in the tab header is blue, this concerns an instrument by which it is not possible to measure.
- Check your serial number S/N for example using the command **Help - About** from the main window **Clarity**.

c) You are using evaluation - EVAL or demonstration - DEMO version, which does not enable measurement of chromatograms.

- Check whether there is a blue line with the title **Eval** displayed in the main window **Clarity** under the

symbols of the instruments, or the title **Demo** in the window header.

5.1.1 INT5 ISA Card is not configured properly

Check in the **System Configuration** dialog for the **INT5 A/D Card driver** item.

Note: *You can invoke the dialog using the **System – Configuration** command from the main **Clarity** window.*

a) Item INT5 A/D Card driver appears in the System Configuration dialog:

Try to invoke the **INT5 Board Config.** dialog by double-clicking on the item. The **Status** line may give the following error messages:

- **"Invalid base address or IRQ value"**

  The interrupt configured in this program is probably used by another device.
- **"Cannot find any INT5 board"**

  The base address in this configuration does not match the address on the card, the base address is used by another device or the **INT5** card is damaged. Under **Windows NT/2000/XP**, the message also appears in the case of any problem with the interrupt. Check the **base address** and the **interrupt** both on the card and in the dialog **INT5 Board Config.**
- **Invalid IRQ or board malfunction**

  The interrupt configured here does not match the interrupt configured on the card, the interrupt is reserved in the **BIOS** for **PCI PnP** cards, or the **INT5** card is damaged.

b) Item INT5 A/D Card driver does not appear in the left list (Setup Control Modules) of the System Configuration dialog.

Click the **Add** button under the left list to open the **Available Control Modules** dialog and try to add the converter to the **Setup Control Modules** list:

- If an error message appears reading, "*Can't create detector*", the registered file CSWINT5.DLL is probably incompatible with the current version of **Clarity**. Repeat installation of the workstation.

Note: *You may find more details on installed and registered files in the SYSTEMINFO.TXT file, or using the **Help – About** command in **About - System Files** dialog.*

c) Item INT5 A/D Card driver does not appear in either one of the lists of the System Configuration dialog.

The CSWINT5.DLL File is probably missing from the CLARITY directory, or this file is not registered or is registered in a directory, which no longer exists. Repeat the installation of the workstation.

5.2 Data Acquisition - Simulated

The title Simulated is displayed in the Data Acquisition window

The corresponding instrument only displays the simulated curve (from the file CHANNX.DTA), or is allocated as what is known as a DEMO driver.

- Open the **System Configuration** dialog from the main **Clarity** window using the **System - Configuration** command and check the tab of the corresponding instrument - **Instrument x**.
- From the list of equipment allocated to the instrument take the **Detector x from DEMO driver** field and draw the correct detector of the A/D card you are using from the list on the left.
- If you only have Demo detectors in the left-hand **Setup Control Modules** list and your A/D card is missing, open the **Available Control Modules** dialog and using the **Add** button add it to the configuration of the station. Then repeat the previous step.