NOTOCORD®
Speeding up Research, Empowering Science™

User Manual

NOTOCORD-hem Evolution® 4.2.0.297

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Published on *My NOTOCORD* (http://my.notocord.com) on October 27, 2011

User Manual

Get started on NOTOCORD-hem main functionalities and modules with our user guides and tutorials.

Overview & Key Concepts

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NOTOCORD-hem is recognized as the most advanced software able to acquire, analyze & visualize life sciences signals, and report quickly and efficiently into Microsoft Excel®. Our validated solutions are fit for all Safety Pharmacology, Toxicology, R&D, Universities and Clinical research with proven analysis capabilities for cardiovascular, pulmonary, electrophysiology (in vivo & in vitro) signals. NOTOCORD-hem offers a powerful software platform hosting over 120 modules and applications ranging from acquisition to signal processing, analysis, and display.

Main Key Features

- Acquisition and analysis with modular data flows
- Over 1000 measurement channels
- Simultaneous acquisition from different sources and systems
- Interactive review while acquiring
- Online analysis, display and data review
- Interactive and advanced display capabilities
- Data storage in one single file up to terrabytes
- Unique streamlined reporting process into Microsoft Excel®
- Designed to meet GLP & 21 CFR Part 11 rules

NOTOCORD-hem detailed features

Acquisition

- Compatibility with main hardware on the market: Buxco, Corscience, Data Translation® PCI and USB A/D cards, DSI™, Hugo Sachs Electronics, Millar® Instruments, TMS International, WPI, devices
- Fast set up for data capture and analysis
- Flexible parameters adjustment
- Easy insertion of comments and markers while recording
- Generation of a single file including all data
- Highly compressed data (e.g. 400 Mo for a typical 24h telemetry study with 6 dogs)
- High capacity storage (100GB / file) with fast access to any period of the signal
- Possibility to schedule acquisition time periods
- Advanced time synchronization between different data acquisition systems (eg. DSI implants & video cameras without specific hardware links)

Data analysis & review

- Online and offline analysis
- Possible data review during acquisition without inducing interruptions
- Post-acquisition file reviewable instantly
- No time consuming replay needed for recorded signals review
- Opening of large data files in a few seconds
- Extensive library of analysis modules and signal processors
- Possible implementation of external modules onto NOTOCORD-hem software platform
- Processing and analysis of NOCOTORD-hem and Matlab® data streams in both environments using unique library of functions

Display

- Online display
- Raw data and calculated trends easily accessible for display
- Graphical superposition for data curves and tendencies comparison
- Advanced display capabilities with continuous waveforms, trends and numbers
- Channels overlay within same display for flexible visualization of waveforms
- No limitations in the number of displays and up to 20 individual graphs on each display

Report

- Exclusive reporting system based on Microsoft Excel®
- Direct data transfer from file to final report
- Excel template creation for time-saving reporting
- Traceability of extracted data

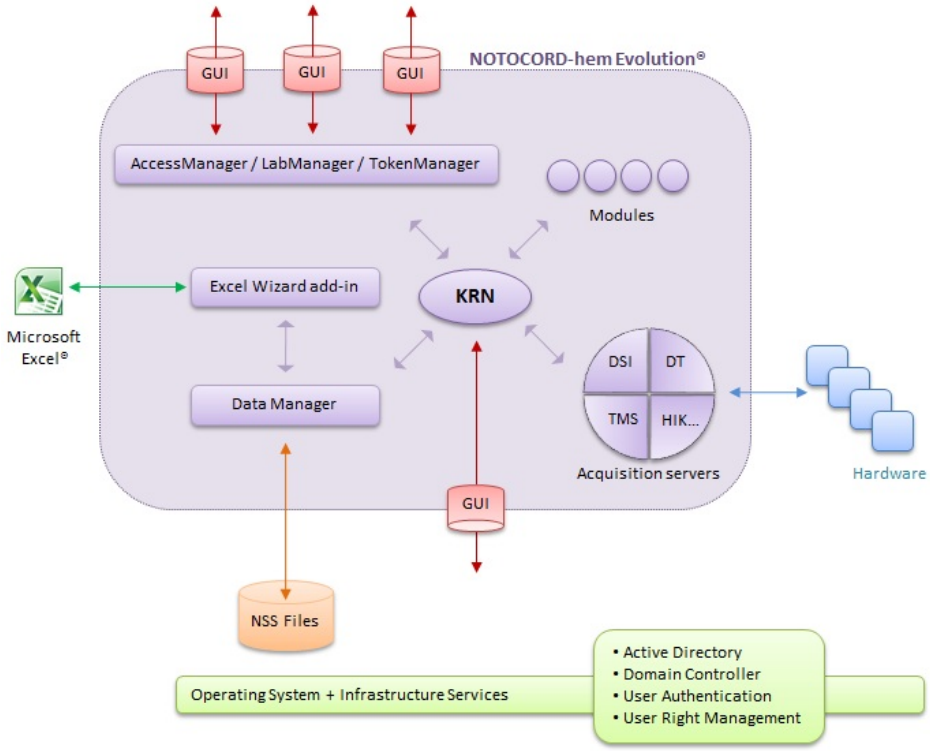
NOTOCORD-hem structure & Operating mode

Components

- The kernel (KRN) is the heart of the system. It contains all the functions used to control data acquisition, processing, analysis and display. It comes with 4 default modules:
  - NSR10a is an acquisition module that allows the simulation of a previously performed acquisition.
  - CTD60a is a continuous display module used to visualize signals.
  - CYC10a is a processing module provided to determine the cycle of a repetitive signal and calculate its characteristic points.
  - KBD30a is used to insert markers on key moments during a test.
- The acquisition servers ensure compatibility between NOTOCORD-hem and acquisition hardware.
- With more than 120 modules to choose from for acquisition, signal processing, analysis, display and other signal treatment, you can build your

personalized analysis.

- The Excel Wizard provides fast and efficient data extraction into Microsoft Excel®.
- The highly secure and compliant applications Access Manager / Lab Manager (audit trail, user access management, etc.) allow you to be compliant with Good Laboratory Practice requirements and 21 CFR Part 11.
- Data storage/access system is managed by an independent system named FOG. Data files are identified by the .nss file extension.



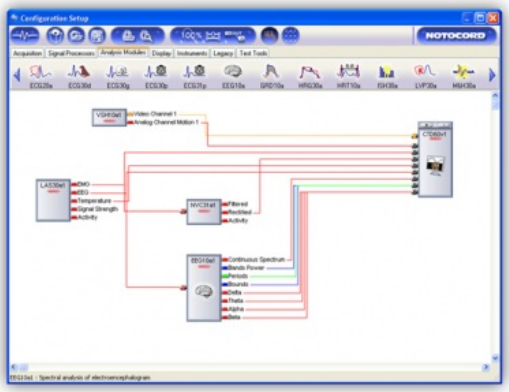
Environment

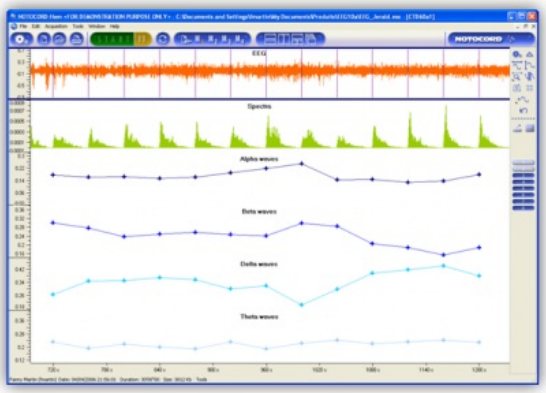
NOTOCORD-hem is compatible with various acquisition devices. It interacts with hardware and acquisition cards to retrieve the information to analyze. Each generated file contains data and the configuration. NOTOCORD-hem operates in the Microsoft environment, including Windows XP and Active Directory.

Using NOTOCORD-hem

The application consists of two main windows:

- The configuration window showing the links between selected modules and the various parameters specified.
- The main display window showing various data display and analysis tasks performed by display modules.





Main steps for configuration and data analysis with NOTOCORD-hem

Configuration

- Acquisition server: Selecting channels of interest and assigning an acquisition frequency to each one of them.
- Processing / analysis modules: Selecting processing / analysis module of interest, setting up parameters for each module and linking complementary modules to create a coherent system.
- Display windows: selecting information to be visualized, arranging displayed data (separate curves, overlapping curves, or numerical values), selecting display mode (lines, crosses, histograms) and color for all curves, setting size and position of each display window.

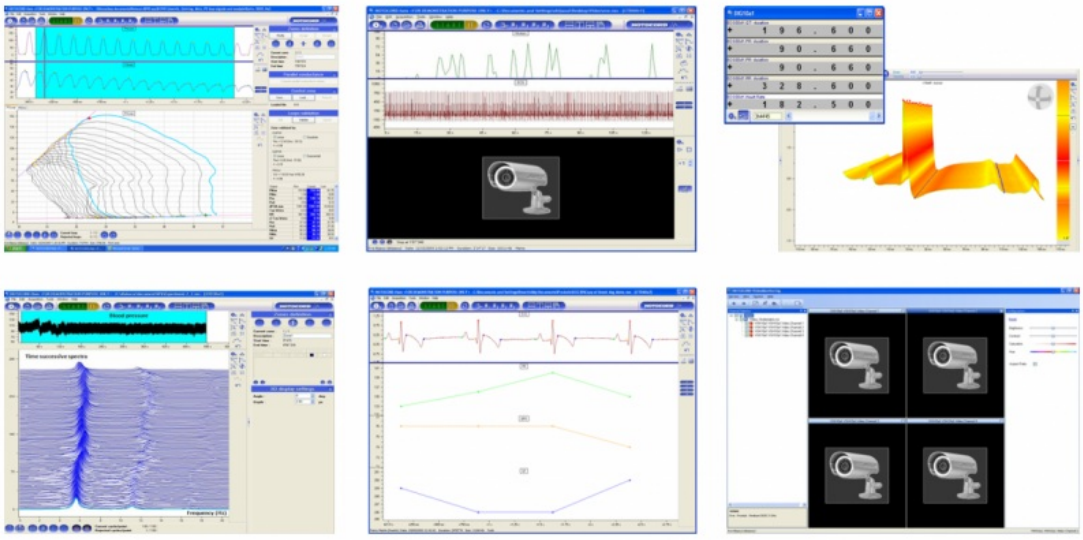
The configuration may be set up after acquisition.

Acquiring experimental data

Acquisition can last from a few seconds to a few days. A session may include several acquisition periods. Accessing data from a previous zone is possible at any time without interrupting data acquisition and processing. Storage of acquired and calculated data is performed during the acquisition process.

Analyzing graphical and/or digital data

Data can be visualized with various display modules or specific analysis modules: Continuous, digital, 2-D and 3-D displays.



Our Excel wizard allows fast and efficient data extraction into Microsoft Excel®. During NOTOCORD-hem installation, a specific toolbar is added to your Excel® application interface. This unique reporting system is designed to drastically reduce time needed to generate your report. Its flexibility and traceability characteristics make it an efficient, powerful and time-saving tool.

Setup

System requirements

Recommended PC configuration for using NOTOCORD-hem Evolution (version 4.x)

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This document aims to provide a NOTOCORD-hem user with a list of characteristics and recommendations for the configuration of the computer on which the software will be used. The user's requirements will then guide the choice for a standard or an advanced configuration.
Video data acquisition requires a dedicated computer configuration, including more advanced hard disk and graphic card features. Recommendations will be given in a dedicated paragraph.

Disclaimer

Due to constant technological progress, the information in this document cannot be considered as part of any agreement between NOTOCORD and users. Information hereafter may be modified by NOTOCORD without notice.
As software errors may exist in drivers/firmware, as hardware manufacturers may change without notice some specifications of their products, it is almost impossible for NOTOCORD to predict the final absolute performance for a complete system integrating a computer hardware and our software.

General considerations

The choice of a particular configuration is highly dependent on a user's specific requirements. The following factors should thus be considered carefully in order to choose the appropriate computer configuration:

- Data types (video or physiological signals)
- Signals properties (shape, amplitude ...) which can affect the calculation time of some modules, e.g. those requiring form identification such as ECG analyzers
- Total sampling rate of all outputs from modules present in the software configuration window
- Number of display modules, graphs, displayed curves, ...
- Number and complexity of analysis modules calculations and output connection status
- Number of signal processing modules connected to active outputs

A first step for choosing a configuration would be to add up sampling rates for each acquisition or calculated channel. Some examples are given in Table 1 below.

Description	PC configuration
Acquisition of 8 x 1 kHz channel + 8 digital filters = 8k + 8k = 16kHz	Entry
Acquisition of 2 x 50 kHz channels + 1 low pass filter on 1 channel = 100k + 50k = 150kHz	Standard
Acquisition of 8 x 1000Hz ECG channels + 8 ECG-related analysis modules	Standard
Acquisition of 32 x 1000 Hz channels	Standard
Acquisition of 8 video channels	Advanced
Reviewing of video data with any other signals	Standard

Table 1: Examples of experimental setups and corresponding recommended PC configurations

PC configurations

We recommend that the user carries out performance test under conditions similar to those of the experiments.

Characteristics	Entry	Standard	Advanced	Comments
Computer grade	Entry level workstation	Entry-level workstation or Workstation	Entry-level workstation or Workstation	
% CPU usage during acquisition	≤ 50%	≤ 50%	≤ 50%	Values when running the software extracted from "Task Manager" program
% Memory usage	≤ 50% max available	≤ 50% max available	≤ 50% max available	Values when running the software extracted from "Task Manager" program
Number of processors	1	1	1	
RAM	≥ 1024 Mb	≥ 2048 Mb	= 4096 Mb	When using external modules (EXT technology) 2GB is recommended
PCI/PCI-Express/USB	Yes	Yes	Yes	See Data Acquisition Hardware Supported below
Hard Disk controller	≥ SATA-II with RAID matrix 0	≥ SATA-II with RAID matrix 0	≥ SATA-II with RAID matrix 0 or SAS	
Disk capacity	≥ 200 GB, ≥ 7200 rpm	≥ 300 GB, ≥ 7200 rpm	≥ 200 GB, ≥ 10000 rpm with a secondary storage with ≥ 400 GB	Secondary local storage recommended for large files handling
Floppy disk	See comment	See comment	See comment	Only for legacy install/uninstall using floppy disk protection (before July 2008)

Network interface	Yes, ≥ 100Mbits/s	Yes, ≥ 1Gbits/s	Yes, ≥ 1Gbits/s	For GLP/21 CFR part 11 environment and ≥ 1Gbits/s for high volume transfer
Graphic interface	External to CPU Chipset. PCI Express	External to CPU Chipset. PCI Express	External to CPU Chipset. PCI Express	Multi monitors function is useful for great number of channels
Graphic dedicated RAM	PCI Express, ≥ 256 MB dedicated RAM, ≥ 1280x1024 resolution per screen, 32 bits color coding, 96 dpi font size display	PCI Express, ≥ 256 MB dedicated RAM, ≥ 1280x1024 resolution per screen, 32 bits color coding, 96 dpi font size display	PCI Express, ≥ 256 MB dedicated RAM, ≥ 1280x1024 resolution per screen, 32 bits color coding, 96 dpi font size display	DO NOT USE INTEGRATED GRAPHIC CONTROLER WITH CPU CHIPSET (see Appendix note)
Multi monitors	≥ 1	≥ 2	≥ 2	
CD-ROM reader	1	1	1	For software release installation, Networked drive is compatible
Uninterruptible power supply/Surge protection	Recommended	Yes	Yes	
Operating system	XP Professional SP3	XP Professional SP3	XP Professional SP3	
Microsoft .NET Framework	≥ v2.0	≥ v2.0	≥ v2.0	
Disk file system	NTFS	NTFS	NTFS	For access rights, file permissions, security
User privileges for installation	Administrator	Administrator	Administrator	
User privilege for running	Simple user	Simple user	Simple user	In a GLP environment, usage can be restricted to only an authorized user or group
Free space for temp storage	≥ 2 GB	≥ 2 GB	≥ 2 GB	
Spreadsheet	Microsoft EXCEL™ 2003, XP and 2007	Microsoft EXCEL™ 2003, XP and 2007	Microsoft EXCEL™ 2003, XP and 2007	
Antivirus and other background applications	No	No	No	Can trouble access to files during data processing (acquisition or recalculation)

Table 2: Recommended PC configuration

Data Acquisition Hardware Supported

Manufacturer	Model	Description	Type of interface
DataTranslation	DT301 DT302	16 analog channels 12 bits 150 kHz max	PCI
DataTranslation	DT3010	32 analog channels 12 bits 1.25 MHz max.	PCI
DataTranslation	DT980x	16 channels, 12 to 16 bits, 100 kHz, 500V isolation between PC and device	USB 1.1
DataSciences International	Dataquest OpenART^{tm} 2.3 or 3.11	Digital Interface from DSI's telemetry hardware to NOTOCORD-hem software. Note : PCI-Express interface card designed since summer 2008 is highly recommended by DSI. Legacy PCI card may have some trouble with recent motherboard.	See DSI for recommended card
OHAUS	AR5120	OHAUS balance server	RS232
VSH10a/b	DS-40xx	4/8 video channels	PCI
Instrunet	I200	Instrunet acquisition server	PCI
TMS	PORTI 7 REFA8	Up to 40 channels, 22 bits, 2000 Hz sampling rate	USB
CorSciences	BT3/6	Up to 3 leads, 500 Hz per channel, 18 bits, 500 Hz sampling rate, DC coupling	Bluetooth®

Table 3: Supported hardware

Appendix

Graphic controller

Graphic Controllers integrated in the CPU Chipset **MUST NOT BE USED** (as 815E, 845GL, 865G, 915G, 915GV, 910GL, 945G, etc. http://download.intel.com/products/graphics/intel_graphics_guide.pdf).

Estimated data file size

Files size is mainly determined by the number of continuous signal channels (red outputs) and their sampling rate.

- Sum of sampling rate for each data flow. For example: 8 x 1000 Hz channels, 8 filter modules will produce about 8x1000 + 8x1000 = 16000 Samples/s.
- An approximate coefficient of 1.6 bytes can be applied. To know the number of bytes per second, the former value must be multiplied by 1.6. For example: 16.000 * 1.6 = 25.6 KB/s i.e.92 MB/hour. Value 1.6 depends on signals form (compression algorithm). 1.6 is an average value.
- With video recording enabled, file size is a function of number of video channels, number of images/s, image format, real-time compression quality, color or black and white images, sound simultaneously recorded and activity of subjects during recording. As a ruff estimate, size can be 33Mb/hour for 1 video channel, no sound, 25 frames/s, 320x200 frame size (CIF), low quality compression. Medium quality and High quality are respectively 80 Mb/hour and 180 Mb/hour. For more details, please refer to the specification document for video data acquisition server.

Local disk capacity

We advise you to have a local disk capacity that allows keeping all online experimentations included in the study. For maintenance reasons, the capacity must be multiplied by 2.

Data backup

Different strategies may be used depending on the volume of experimental data, GLP/21CFRPart 11 compliancy.
Media from magnetic-optic disk, writable DVD or recent online archiving system (SAN) may be used.
Contact NOTOCORD customer support for more information.

Power supply

Power supply failure during recording session could crash the PC and provoke loss of data. Uninterruptible power supply devices are strongly recommended.

Software Installation

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Requirements

The requirements for installing NOTOCORD-hem Evolution are:

- A computer corresponding to the recommended material requirements for the intended type of experimentation and use. Refer to the document "System Requirements".
- For an acquisition station, cards and drivers must be installed and functioning before NOTOCORD-hem installation, in accordance with the manufacturer's recommendations.
- The NOTOCORD-hem CD-ROM.
- The license used for the station: either electronic license supplied as a .lic file, or diskette license supplied as two yellow floppy disks.
- The user installing NOTOCORD-hem must have all the administrative rights for the machine.
- Microsoft .NET Framework 2.0 software should be installed on the computer. If it is not, the installation program will automatically offer you to do so.
- Microsoft Office Excel® 2003 or 2007 should be installed on the computer.
- For an update: any previous NOTOCORD-hem version installed on this computer must be uninstalled from: *Control panel > Add or Remove Programs* menu. If your license was previously installed, you don't need to uninstall it to perform NOTOCORD-hem software installation.

For an installation in a GLP environment, in order to limit access to files produced by NOTOCORD-hem:

- A specific Windows user account has to be assigned to secure NOTOCORD-hem data access. The associated password should be known by the person undertaking the installation.
- Specific NTFS rights have to be applied to the workfile directory to allow NOTOCORD-hem to work with this directory.

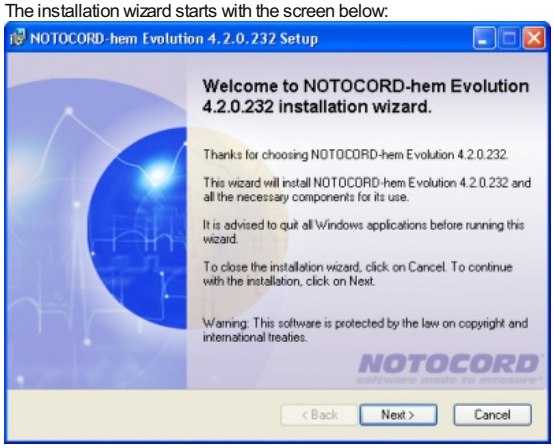
Start the installation

Open a Windows session using an account with all the **administrative rights** for the computer.

Insert the NOTOCORD-hem CD-ROM into the CD drive.

If the installation program does not start automatically, start the "Setup.exe" program from the root directory on the NOTOCORD-hem CD-ROM.

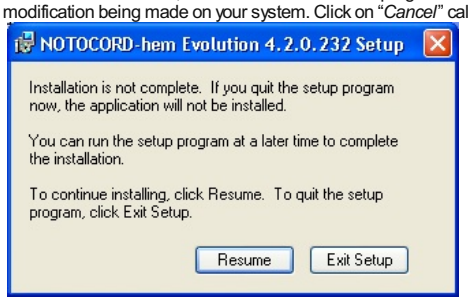
The installation wizard starts with the screen below:



Check that the displayed version number *4.x.x.xxx* is the right version and click on "*Next*".

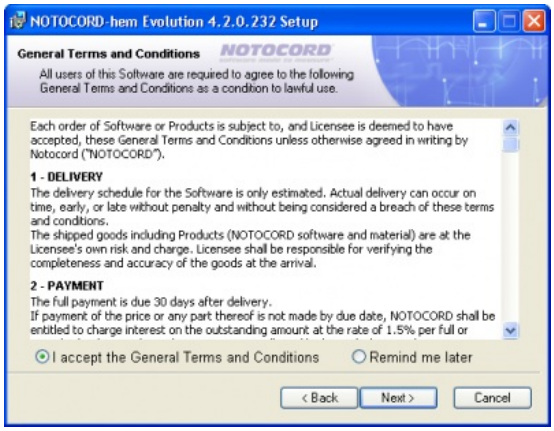
Exit installation

The cancellation button, found on each installation program screen, allows you to interrupt the installation process at any time during installation without any modification being made on your system. Click on "*Cancel*" calls up the confirmation request box shown on Figure below.



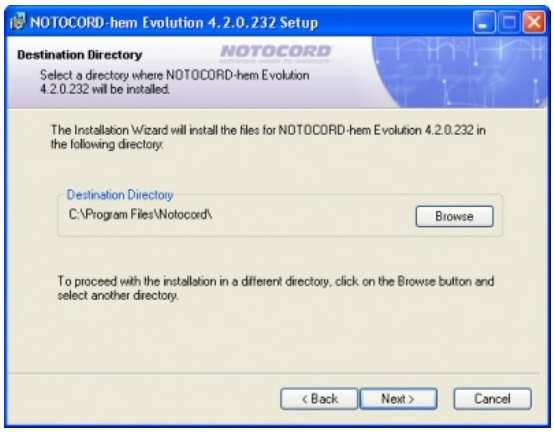
Click on "*Exit Setup*" to interrupt the installation process, or click on "*Resume*" to continue the installation.

Carry on with installation



Accept the general terms and conditions and click on "*Next*".
If you choose the "*Remind me later*" option, this window will appear again after 48 hours when opening NOTOCORD-hem. The user is required to agree to the General Terms and Conditions to be able to use the software.

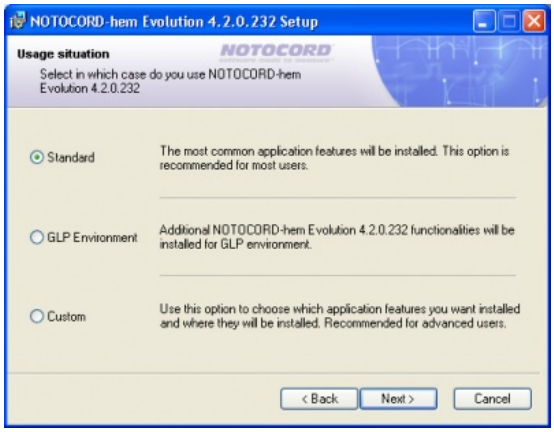
Choose the destination directory



The Installation wizard suggests an installation directory where all NOTOCORD-hem installation files will be stored. By default the recommended destination directory is C:\Program Files\Notocord\.

Click on "*Next*".

Select your type of installation



The above screen allows you to choose the type of installation: Standard, GLP Environment or Custom.

a) Standard installation

Context of use :
- You are not working following the Good Laboratory Practices rules and you don't have the AccessManager license (AMG50a token).
- You are using only one or several of the following acquisition devices: DataTranslation board, DSI board or Video board.

Go to the chapter "*Standard installation*".

b) GLP Environment installation

Context of use:
- You are working following the Good Laboratory Practices rules and you have the AccessManager license (AMG50a token).
- You are using only one or several of the following acquisition devices: DataTranslation board, DSI board or Video board.

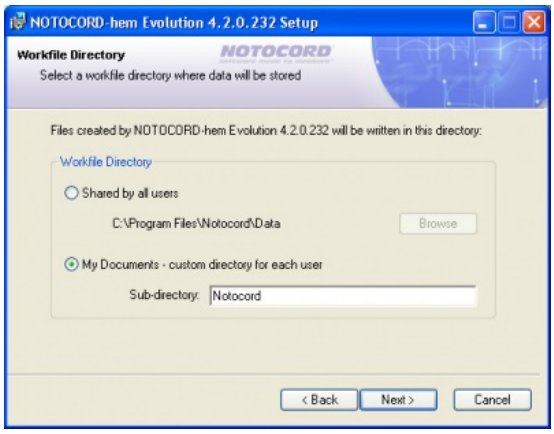
Go to the chapter "*GLP Environment installation*".

c) Custom installation

Context of use: other cases than the ones listed in a) and b)
Go to the chapter "*Custom installation*".

Choose your type of installation, click on "*Next*" and go to the corresponding chapter.

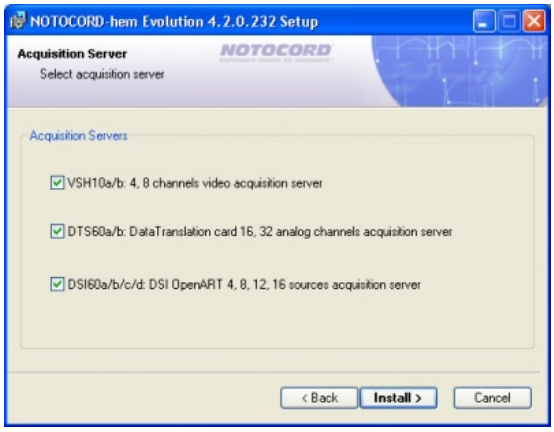
Standard installation



The standard installation starts with selection of the default directory where the data file produced by NOTOCORD-hem will be written.

- Choose one shared directory for all users to allow the files produced by NOTOCORD-hem to be easily shared regardless of which user opens the Windows session. The workfile directory proposed by default is C:\Program Files\Notocord\Data.
- Choose individual user directories so that each user can save his/her data in his/her personal directory. The default directory used by NOTOCORD-hem corresponds to a sub-directory called "*Notocord*" in the "*My documents*" directory of the user who opens the Windows session. You can type the name of the sub-directory of your choice in the "*Sub-directory*" box.

Once the workfile directory has been selected, click on "*Next*".

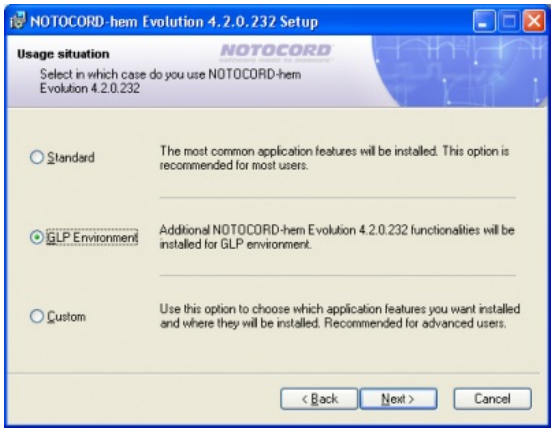


Select the acquisition server(s) you have in your license, by ticking the relevant box, and then click on "*Install*".

Installation is automatically undertaken and a progress bar informs you on how operations are progressing.
Click on "*Finish*" to close the window.

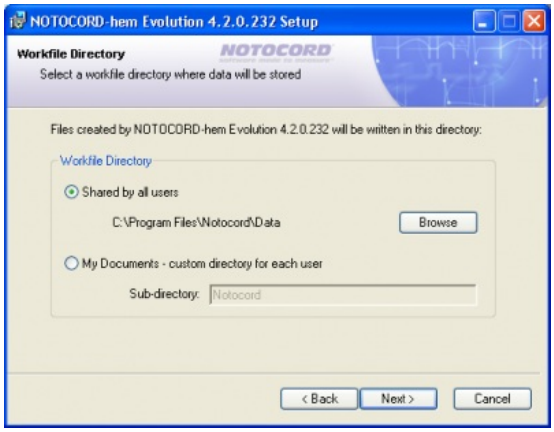
To complete the final stage by installing the license, go straight to the next part "*License installation*".

GLP Environment installation



In order to limit access to files produced by NOTOCORD-hem held in the workfile directory, the two following steps must be taken:

- A specific Windows user account will be assigned to secure NOTOCORD-hem data access. You will be asked to enter this account when filling up the "Data Manager Account" window (Figure 10).
- Specific NTFS rights will be applied to the workfile directory to allow the NOTOCORD-hem to work with this directory. The installation program will do it automatically.



The *GLP Environment* installation starts by selecting the default workfile directory where data files produced by NOTOCORD-hem will be written.

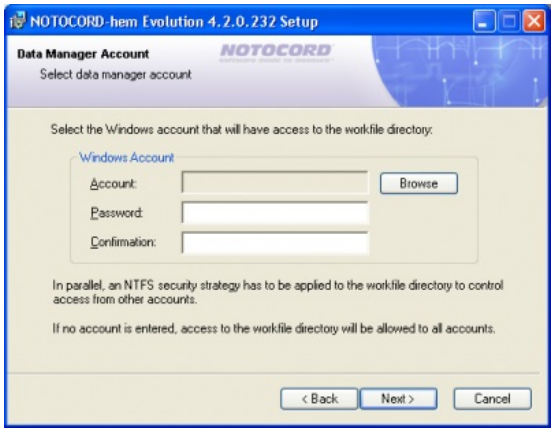
When working in a GLP environment, we recommend to choose the "*Shared by all users*" option for workfile directory. The directory proposed by default is C:\Program Files\Notocord\Data.

Comments:

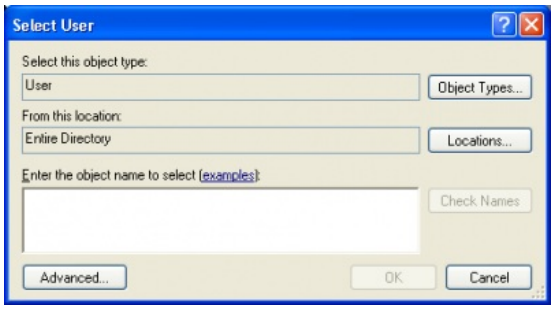
- By selecting the default workfile directory shared by all users ("Notocord\Data" sub-directory of "Program Files"), simple users are limited to read-only access, as it is the default Windows configuration for this directory.
- The installation process is longer when the workfile directory already contains many files. The process is extended by the time needed to assign specific NTFS rights to these files.
- If you select another directory, you should then apply NTFS access restrictions (i.e. set read-only mode) for simple users.

If you select custom directory for each user, the installation program will not be able to automatically set the specific NTFS rights.

Once the workfile directory has been selected, click on "*Next*".

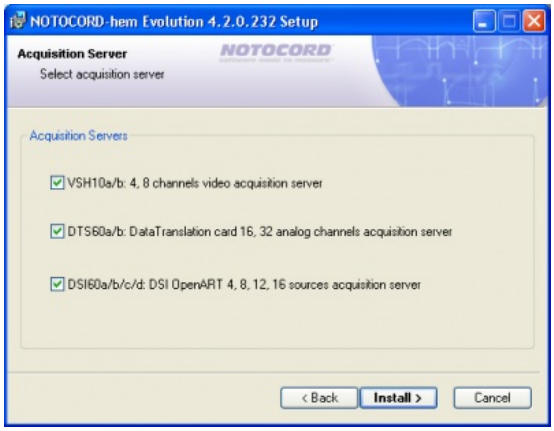


To select the Windows account which will be used to administer NOTOCORD-hem data, click on the "*Browse*" button.



Select just one account in the standard Windows dialogue box to select the user.
Once selected, this account appears in grey in the "*Account*" field.
Type the password corresponding to this account in the "*Password*" field, and re-type it in the "*Confirmation*" field.

Click on "*Next*".

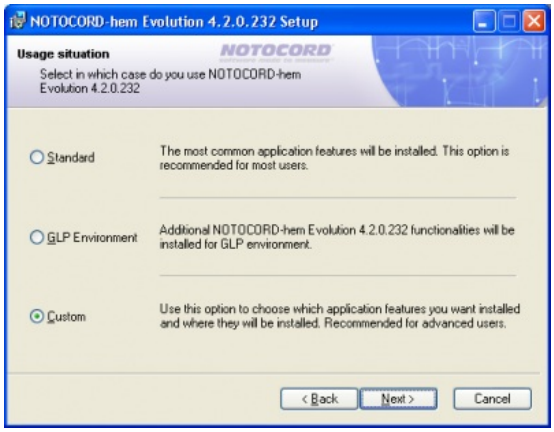


Select the acquisition server(s) you have in your license, by ticking the relevant box, and then click on "*Install*".

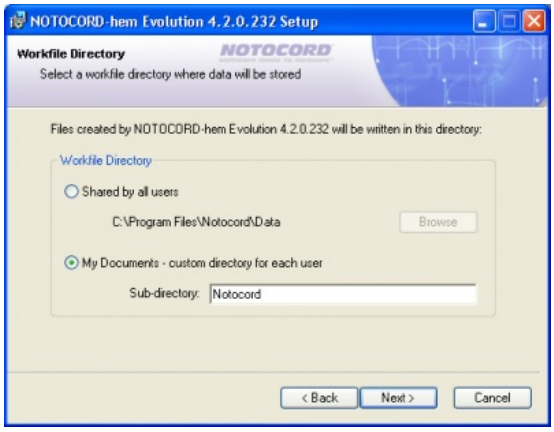
Installation is undertaken automatically and a progress bar informs you on how operations are progressing.
Click on "*Finish*" to close the window.

To complete the final stage by installing the license, go straight to the next part "*License installation*".

Custom installation



Select "*Custom*" and click on "*Next*".



The *Custom* installation starts by selecting the default directory where files produced by NOTOCORD-hem will be written.

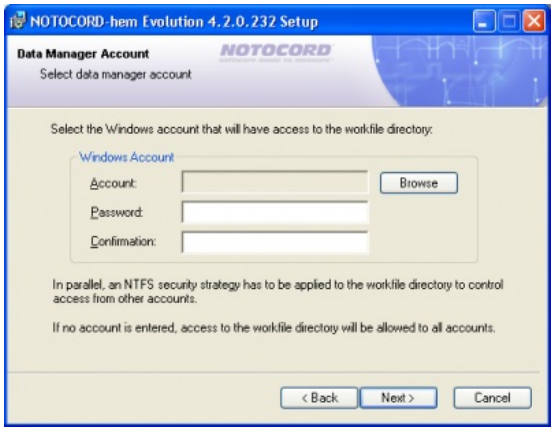
- Choose individual user directories so that each user can save his/her data in his/her personal directory. The default directory used by NOTOCORD-hem corresponds to a sub-directory called "*Notocord*" in the "*My documents*" directory of the user who opens the Windows session. You can type the name of the sub-directory of your choice in the "Sub-directory" box.
- Choose one shared directory for all users to allow the files produced by NOTOCORD-hem to be easily shared regardless of which user opens the Windows session. The workfile directory proposed by default is C:\Program Files\Notocord\Data.

Set the GLP mode

When working in a GLP environment, we recommend to choose the "*Shared by all users*" option for workfile directory.

Click on "*Next*".

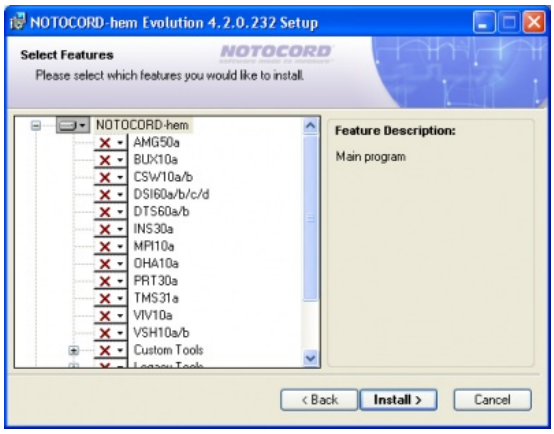
The installation program displays the screen for selecting the Windows account assigned to secure NOTOCORD-hem data access and to set the relevant NTFS rights for the workfile directory.



To select the Windows account which will be used to administer NOTOCORD-hem data, click on the "*Browse*" button.
Select just one account in the standard Windows dialogue box to select the user.
Once selected, this account appears in grey in the "*Account*" field.
Type the password corresponding to this account in the "*Password*" field, and re-type it in the "*Confirmation*" field.

Click on "*Next*".

Install the software features

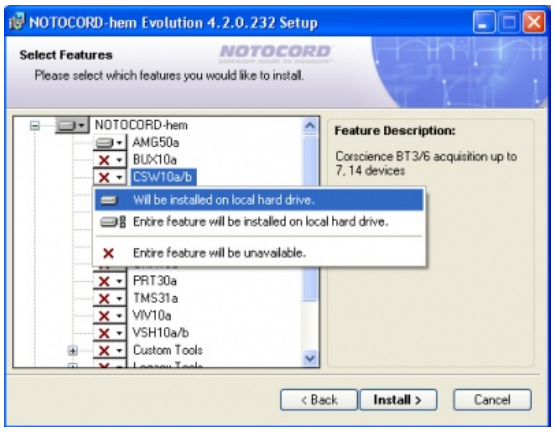


Select the feature(s) you want to install from the following list in accordance with your NOTOCORD license:

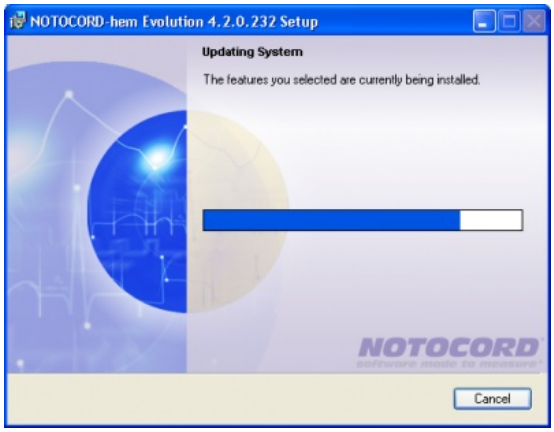
- AMG50a: Activates GLP and 21 CFR Part 11 mode of NOTOCORD-hem.
- BUX10a: Buxco MAX II / MAX 1500 Acquisition server.
- CSW10a/b: Corscience BT3/6 acquisition up to 7, 14 devices
- DSI60a/b/c/d: DSI OpenART 4, 8, 12, 16 sources acquisition server
- DTS60a/b: DataTranslation card 16, 32 analog channels acquisition server
- INS30a: GW Instruments Instrunet acquisition server
- MPI10a: Matlab Link for NOTOCORD-hem
- OHA10a: Ohaus Adventurer balance server
- PRT30a: Continuous thermal printer AR200 driver
- TMS31a: TMS acquisition server
- VIV10a: Vivometrics LifeShirt acquisition
- VSH10a/b : 4, 8 channels video acquisition server
- Custom Tools: Customized Notocord tools
- Legacy Tools: Tools from older NOTOCORD-hem versions
- LMG10a: System ensuring security of video data streams
- MON10a: Remote monitoring of video data streams
- Third Party Tools: Non-Notocord developed softwares

Do not hesitate to ask your NOTOCORD contact person for confirmation of the features you need to install in regards of your license.

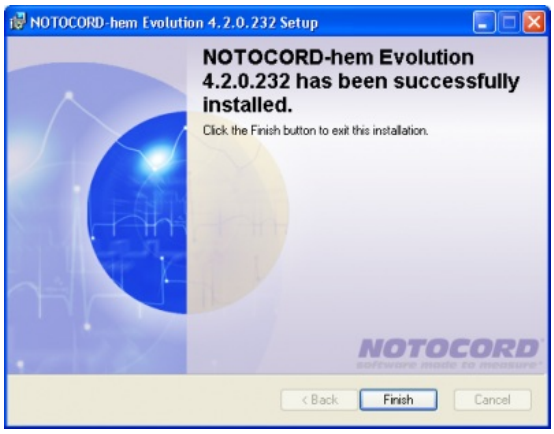
To select a software feature:



Right click on the feature to install.
Click on "*Will be installed on local hard drive* "
Then, click on the *"Install"* button.



Installation is undertaken automatically and a progress bar informs you on how operations are progressing.



Click on "*Finish*" to close the window.

To complete the final stage by installing the license, go straight to the next part "*License installation*".

License Installation

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General principles

NOTOCORD licenses installation is done through the **TokenManager** application (TOM) supplied with the software installation CD-Rom. TokenManager allows the software Rights of Use management for licenses installation / uninstallation from a floppy disk or an electronic file.

There are 2 types of NOTOCORD licenses:
- *Electronic license:* NOTOCORD license supplied to the customer as a .lic file, and requiring an activation key to be installed on a workstation.
- *Diskette license:* NOTOCORD license supplied to the customer as a protected yellow floppy disk.

Please, refer directly to the chapter concerned by your license type.

Electronic license

What do you want to do?

Case n°1: License Installation
Case n°2: License Uninstallation
Case n°3: License Transfer
Case n°4: License Modification

For further information, please refer to the *Licensing* reference document.

Prerequisites:

1) You must have access to the e-mailbox to which will be sent:

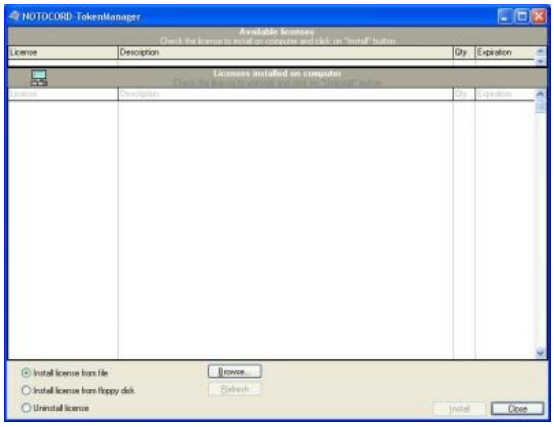
- the .lic license file containing your rights and the modules,
- the activation key,
- the confirmation messages.

This e-mail address is the one given by the customer to the NOTOCORD Sales Representative in the license order.

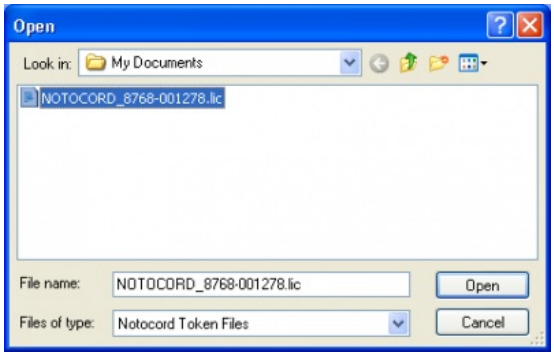
2) You must beforehand have uninstalled any diskette license present on this workstation. Indeed, electronic and diskette licenses cannot be installed on the same computer.

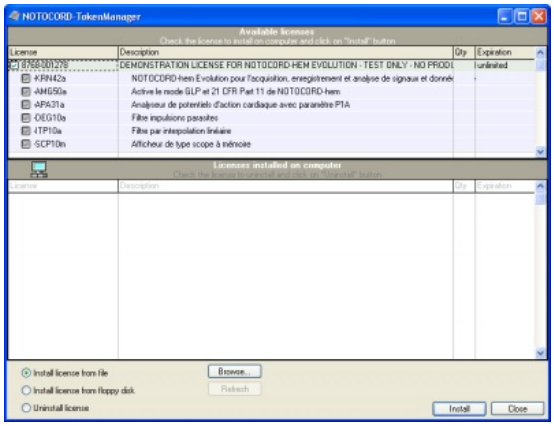
Case n°1: License Installation

Save the .lic license file you received by e-mail, in a folder on the end-user workstation.
Launch the TokenManager program accessible via the menu: Start > All Programs > NOTOCORD-hem Evolution > TokenManager.



Click on *Install license from file*.
Then, click on *Browse* and select the .lic file.



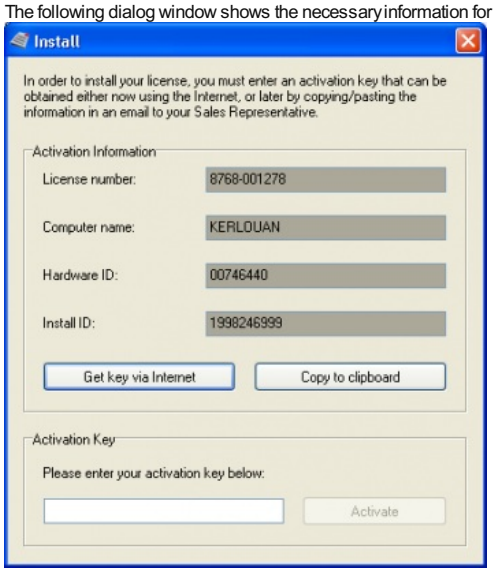


The TokenManager window contains 2 parts:

- The upper grid shows the license to be installed and its contents.
- The lower grid shows the list of licenses and their contents installed on your computer.

Tick the box corresponding to the license you wish to install on this computer. A license must be installed entirely. The installation of a single module of the license is forbidden.
Click on *Install*.

The following dialog window shows the necessary information for generating an activation key.



There are 2 cases:

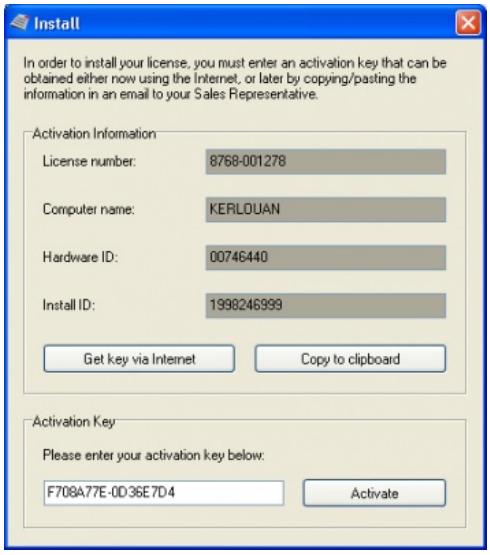
- The end-user computer is connected to the Internet:

Click on *Get key via Internet*.
An information, or error, message appears with the action outcome.
If the action succeeds, you receive your activation key directly by email .

- The end-user computer is not connected to the Internet:

Click on *Copy to Clipboard*, in order to automatically copy the activation information contained in the dialogue window. You must send NOTOCORD these 4 IDs by e-mail, fax or telephone. For that purpose, contact your Sales Representative or your Customer Support Engineer. You will receive the activation key at the email address given in the license order.

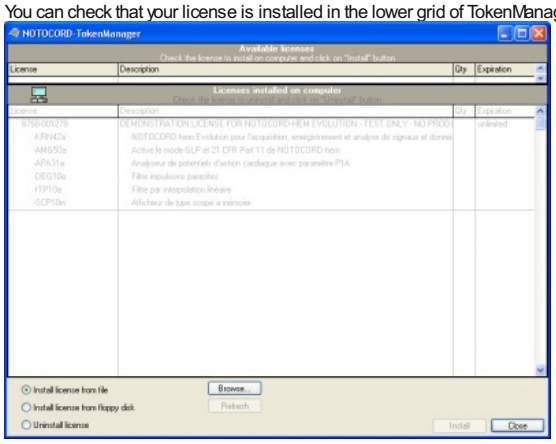
Copy and paste the activation key into the *Activation Key* field.



The button *Activate* becomes active.
Click on *Activate*.
If the action is successful, a confirmation message appears.
The license is then activated on this workstation. It is now impossible to install it elsewhere.

If the action fails, an error message appears. Please, refer to the *Licensing* reference document to understand the cause of the error.

You can check that your license is installed in the lower grid of TokenManager, as shown in the figure below:



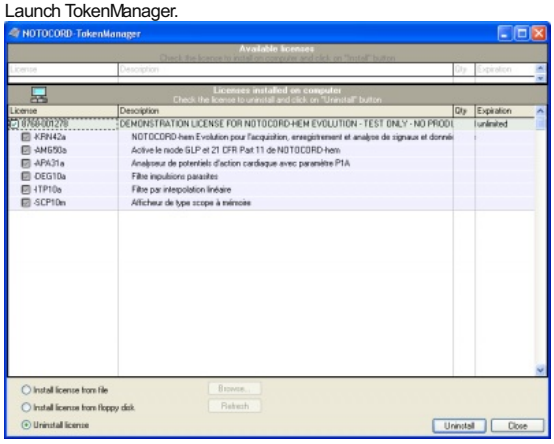
Case n°2: License Uninstallation

When should you uninstall your license?

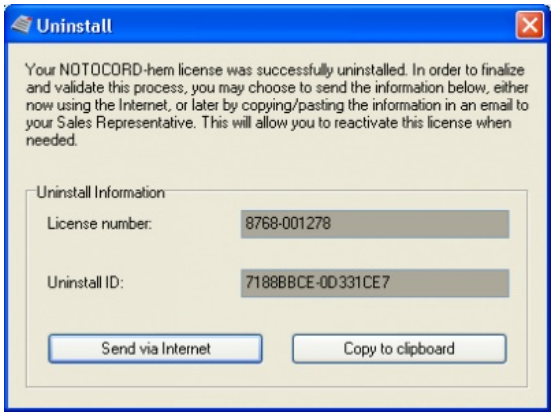
- License transfer on another workstation,
- Software uninstallation on this workstation,
- License modification.

Uninstallation procedure:

Launch TokenManager.



Click on *Uninstall license* and select the license to be uninstalled.
Click on *Uninstall*.



Uninstallation has been done. An uninstall ID is generated. This code must be sent to NOTOCORD in order to:
- confirm that the uninstallation took place,
- update your license,
- allow you to reinstall it later.

Send the Uninstall ID:

- via the « Send via Internet » button if your computer is connected to the Internet,
- by email, fax, or telephone to your Sales Representative or NOTOCORD Customer Support, after having copied the 2 IDs by clicking on « Copy to clipboard ».

A confirmation or error message appears to inform you about the outcome.

Case n°3: License Transfer

When should you transfer your license?

- Installation of the license on another computer,
- Changing computer.

Transfer procedure:

Uninstall your license following the chapter « Case n°2: License Uninstallation » instructions.
Reinstall your license following the chapter « Case n°1: License Installation » instructions.

Case n°4: License Modification

When should you modify your license?

- Purchase of a new module,
- Purchase of a new functionality,
- Move to GLP.

Procedure:

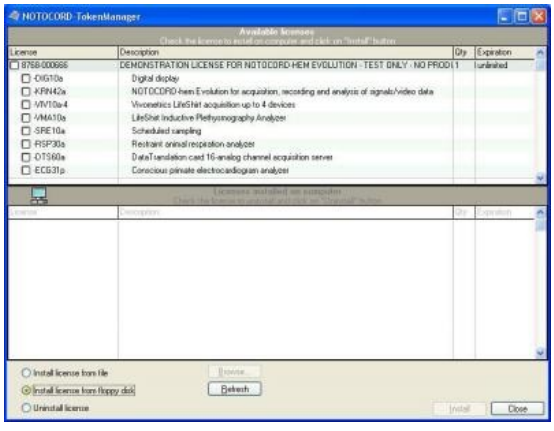
Following the purchase of new module(s) or functionalities(s), you receive at the email address supplied to NOTOCORD in the license order, a new .lic file containing the electronic license and your new rights (cf. prerequisites).

Uninstall your license following the chapter « Case n°2: License Uninstallation » instructions.
Reinstall your new license following the chapter « Case n°1: License Installation » instructions.

Diskette license

Take the yellow floppy disk containing your license.

If you are installing NOTOCORD-hem software and the floppy disk is already inserted in the floppy drive, then the TokenManager application will open automatically.
Otherwise, insert your yellow floppy disk into the floppy drive.
Then, launch TokenManager program accessible via the menu: Start > All Programs > NOTOCORD-hem Evolution > TokenManager.



The window of TokenManager consists of 2 parts:

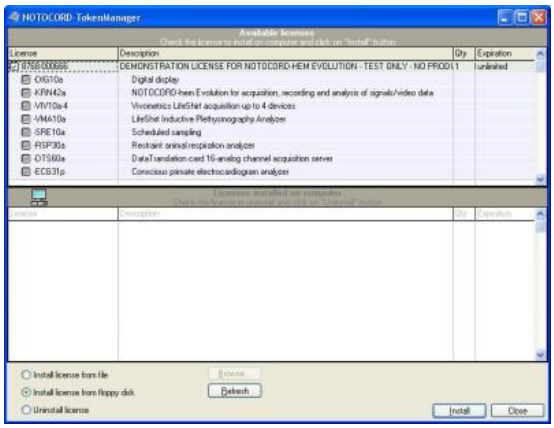
- The upper grid shows the list of licenses to be installed and their contents.
- The lower grid shows the list of licenses and their contents already installed on your computer.

Click on the « *Refresh* » button to post your floppy disk licenses in the upper grid.

What do you want to do?

Case n°1: License Installation
Case n°2: License Uninstallation
Case n°3: License Transfer
Case n°4: License Modification
For further information, please refer to the *Licensing* reference document.

Case n°1: License Installation



Click on *Install license from floppy disk* .
Tick the box corresponding to the license you want to install on this computer, and then click on *Install*.
The license is installed on this computer.

To check that your license is installed, it should appear in the TokenManager lower grid.

Remove the floppy disk from the floppy drive.
Keep the floppy disk for further uninstalllation of the license on this computer.

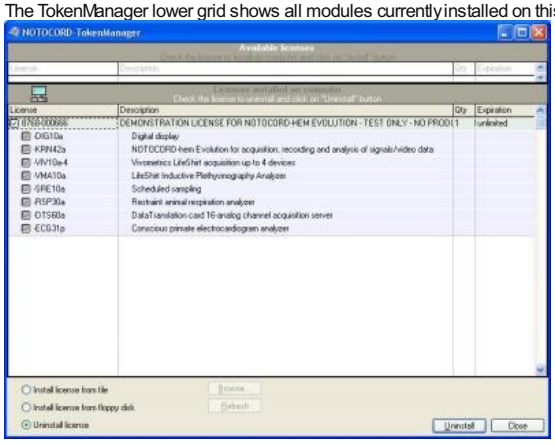
Case n°2: License Uninstallation

When should you uninstall your license?

- License transfer on another workstation,
- Software uninstallation on this workstation,
- License modification.

Uninstallation Procedure:

Insert your yellow floppy disk in the floppy drive.
Launch TokenManager.
Click on *Refresh*.
The TokenManager lower grid shows all modules currently installed on this computer.



Select the license to be uninstalled.
Click on *Uninstall license*.
Now, these modules appear in the upper grid of TokenManager.

Case n°3: License Transfer

When should you transfer your license?

- Installation of the license on another computer,
- Changing computer.

Transfer procedure:

Uninstall your license following the chapter « Case n°2: License Uninstallation » instructions.
Reinstall your license following the chapter « Case n°1: License Installation » instructions.

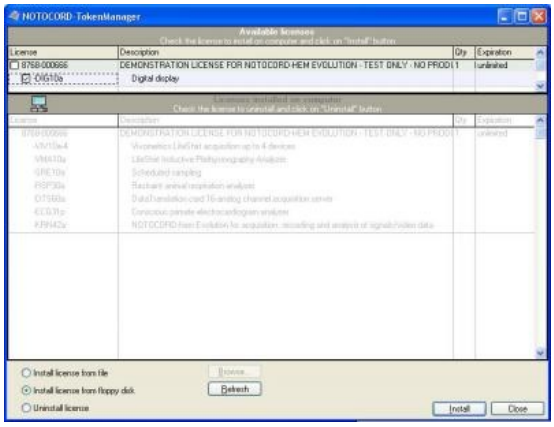
Case n°4: License Modification

When should you modify your license?

- Purchase of a new module,
- Purchase of a new functionality,
- Move to GLP.

Procedure:

Insert the floppy disk with your new module into the floppy drive.
Launch TokenManager program.
Click on *Refresh*.



Click on *Install license from floppy disk* .
Select in the TokenManager upper grid, the tokens you want to install.
Click on *Install*.
The new installed modules are now visible in the TokenManager lower grid window.

Close the window, the update is effective.
Remove the floppy disk from the floppy drive. Keep it for further uninstallation of the license on this computer.

Support Questions

What can you do in case of:

- Computer crash (mother board, hard disk, system) with an electronic license was installed on it?

Contact NOTOCORD Customer Support, to desactivate your license. Then you can reinstall it on another computer.

- Computer crash (mother board, hard disk, system) with a diskette license was installed on it?

Use your Backup floppy disk. Then contact NOTOCORD Customer Support to have a new Backup floppy disk.

- Loss of your .lic license file?

Contact NOTOCORD Customer Support: your .lic file will be sent again.

- No reception of the e-mail containing the .lic file?

Contact NOTOCORD Customer Support to check the validity of your e-mail address.

- No reception of the e-mail containing the activation key?

Contact NOTOCORD Customer Support to check the validity of your e-mail address.

Regarding the origin of error messages, please refer to the *Licensing* reference document.

Get Started

Configuring acquisition

Focus on NOTOCORD-hem configuration

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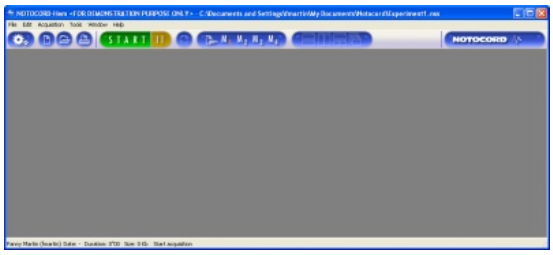
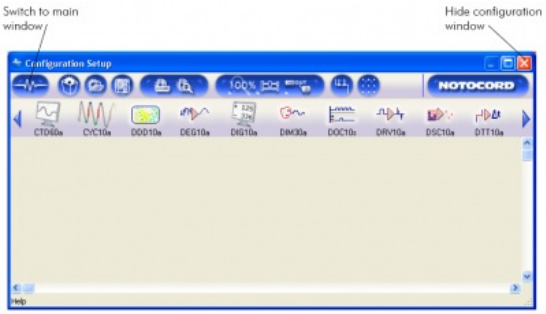
Display and configuration windows

NOTOCORD-hem starts with the Main window displayed full screen.



NOTOCORD-hem display two windows:
- The *Main window* displays your signals, raw signals, and calculated data during the experiment.
- The *Configuration window* is used to set up your protocol.

You can switch from one to the other by clicking the corresponding top left icon (or by pressing simultaneously Ctrl key and space bar).



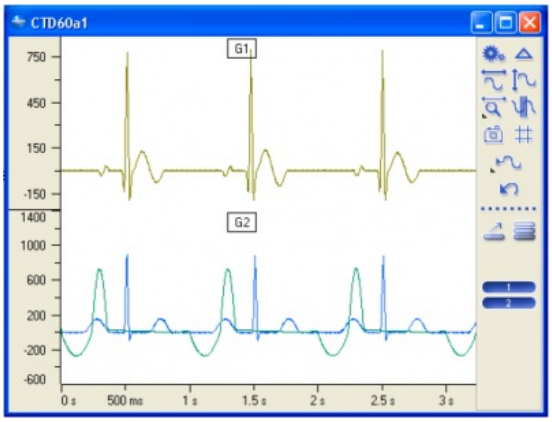
Note: You can resize and arrange the two windows so as to view them together and easily switch from one to the other.

Module configuration

Introduction: Default modules

NOTOCORD-hem comes with four default modules:

- NSR10a: Acquisition module employing data previously saved as a NSS file (Note that NOTOCORD-hem generated data files are identified by the .nss file extension). It allows you to simulate a previously performed acquisition. In order to help you learn to use the software, the NSR10a acquisition module has been preconfigured to read a simulation file loaded at startup containing ECG and ABP signals.
- CTD60a: Display module used to view signals in a continuous manner. The Continuous display window can contain one or more graphs. Each graph can show one or more signals.



- CYC10a: Processing module used to determine the cycle of a generally repetitive signal and calculate its characteristic points (maximum, minimum, highest slope).
- KBD30a: Tools module used to set markers indicating key moments during a test (for example, the injection of a given product at a given time).

Note: The various modules available in the Configuration window are normally sorted by tabs. You can also display the modules without sorting them. To do this, right-click the modules toolbar and deselect "Arrange modules in tabs".

Setting up a module

Aconfiguration is created by setting up the various modules required and connecting them together in the Configuration window (for some modules, certain parameters must also be specified).
To set up a module, proceed as follows:

Click the corresponding module type (NSR10a acquisition module in this example).

Point and click where you wish to set up the module.

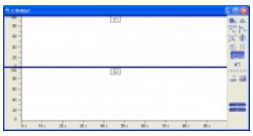
Notes:
- To position a module in the Configuration window, click the module and drag it to the required location.
- To delete a module, click it and press the Delete key.
- Important: You cannot set up a module during acquisition (except for display modules, which can be set up any time).

Linking two modules

Set up a second module (CTD60a module in this example) to the right of the first module.

Click the + sign on the display module once to obtain two display graphs (each successive click adds a graph).

Note: As soon as the display module is set up, the corresponding display window shows up in the Main window. Depending on the number of graphs selected, the display window will be divided into an equivalent number of sections.



Click and drag the output of the NSR10a module towards the corresponding input of the CTD60a module. When you see that the target input is covered by a yellow grid, you can release the mouse.

Module name modification

Amodule's default name consists of its function followed by an order number (CYC10a1, CTD60a2…).

Displaying signals

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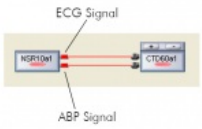
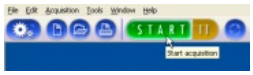
Once you have configured your test, you can display the acquired signals, as well as the results of the various processing tasks applied to them.

Note: The following example corresponds to the continuous display of two ECG and ABP default signals provided by the NSR10a module. We recommand that you set up the same configuration.



Starting the acquisition process

There are several ways to start the acquisition process. The typical way is to click the *START* button in the Main window. 

Note: Important - In the main window's toolbar, the NOTOCORD logo in the upper right hand corner shows a sine wave when acquisition is in progress.

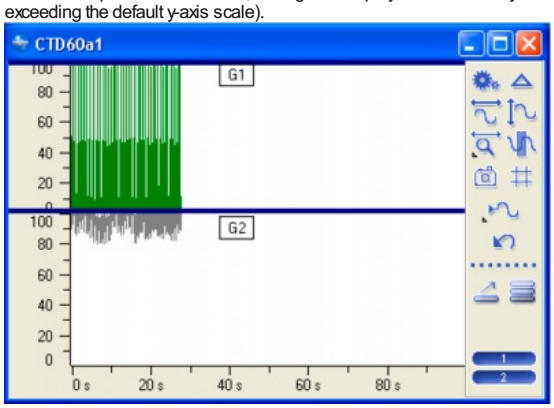
In addition, the various module outputs will flash at regular intervals and the traffic light icon on each module will light up (normally green) to indicate that acquisition is in progress.

You can also start the acquisition process in one of the following manners:

- From the *Acquisition* menu, select *Start*
- Ctrl+A shortcut

Zoom and scaling options

Once the acquisition has started, the signals displayed are not always immediately readable, as shown in the example below (curves overly compressed or exceeding the default y-axis scale).

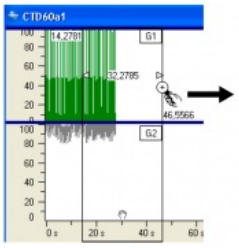
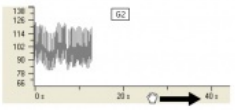


Important: During acquisition, mouse manipulations on time scale (i.e. dragging, expansion or compression) will stop signal scrolling. To resume scrolling, click the *Scroll* button or use the corresponding keyboard shortcut Ctrl + S.

NOTOCORD-hem provides several zoom and scaling options:

Horizontal zoom

Shortcut	Action	Illustration

Ctrl key + drag and drop a graph	Hold down the Ctrl key, click one of the graphs and drag the mouse sideways (the 3 numbers displayed indicate the width of the zoom region selected, its starting point on the x-axis and its end point on the x-axis). When you release the mouse, all the graphs in the display window will be zoomed accordingly.	
Ctrl key + drag and drop the x-axis	Hold down the Ctrl key, click the x-axis (the cursor turns into a closed hand) and drag the cursor towards the right (time scale expansion) or towards the left (time scale compression).	

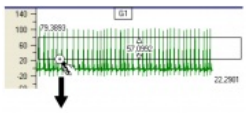
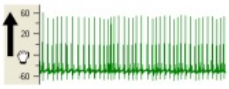
Notes:
1) The left limit of the time scale remains fixed.
2) You can also use the following keyboard shortcuts: Ctrl + → (expansion) or Ctrl + ← (compression). In this case potential signal scrolling is not interrupted.

Y-axis scaling

Button / Shortcut	Actions	Illustration
Y-axis scaling button / Ctrl + Y 	Click the graph to be scaled (two thick borders will appear), then click the Y-axis scaling button.	

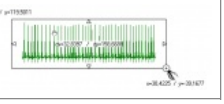
Note:
- Important: When a graph does not show up in the display window, y-axis scaling may be required (the graph may simply be out of scale).
- To scale all the graphs in the display window, click the Y-axis scaling button twice (not a double-click).

Vertical zoom

Shortcut	Actions	Illustration
Shift key + drag and drop the graph	Hold down the Shift key, click a point on the graph, drag the cursor upwards or downwards and then release the mouse. Only the graph selected will be zoomed.	
Ctrl key + drag and drop the y-axis	Hold down the Ctrl key, click the y-axis and drag the cursor upwards (expansion) or downwards (compression).	

Notes:
1) The lower limit of the y-axis remains fixed as far as possible.
2) You can also use the following keyboard shortcuts: Ctrl + ↑ (expansion) or Ctrl + ↓ (compression).

Zoom region selection

Shortcut	Actions	Illustration
Ctrl + Shift keys + rectangle	Hold down the Ctrl and Shift keys and use the mouse to select the region of the graph to be enlarged, then release the mouse (the numbers displayed indicate the dimensions of the region selected and the coordinates of its top left corner).	

Note: The width of the region selected is applied to all the graphs in the display window.

Zoom command button

Button	Action	Illustration
	Right-click this button to select the type of zoom command to be applied.	

Type of Zoom	Illustration

Horizontal zoom (applied to all graphs)

Vertical zoom (applied to selected graph)

Rectangular zoom (horizontal zoom applied to all graphs, vertical zoom applied to selected graph)

2x zoom (200% zoom applied to both X-axis and y-axis of selected graph)

Select the type of zoom command to be applied (your selection will be stored in memory), then click the Zoom command button and select the region of the graph to be enlarged. Release the mouse to apply the zoom command (if you chose the 2x zoom command, just click the graph to be enlarged).

Horizontal and vertical displacement

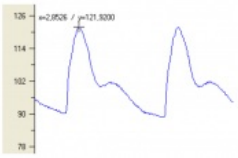
To move the display portion along the x-axis, click the x-axis and drag the mouse sideways. Release the mouse to display a new portion of the graph.
You can also use the → and ← keys to displace the graph in regular increments.

The vertical displacement procedure is exactly the same: Click the y-axis and drag the cursor, or use the ↑ and ↓ keys.

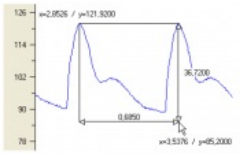
Additional display options

Coordinates of a point or portion of a curve

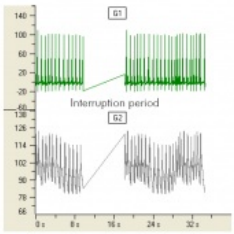
Click any point on a graph to display its coordinates. If coordinates are not displayed immediately, slightly drag mouse while pressing the left button.



To display the coordinates for a region, select the region using the mouse



Displaying an entire test

Button / Shortcut	Actions	Illustration
X-axis scaling button /  Ctrl + X	Click the X-axis scaling button to display all signals throughout the duration of the test (including periods during which acquisition was stopped).	

Note: You can use this command at the start of the acquisition process to immediately obtain an enlarged view.

Scrolling mode selection

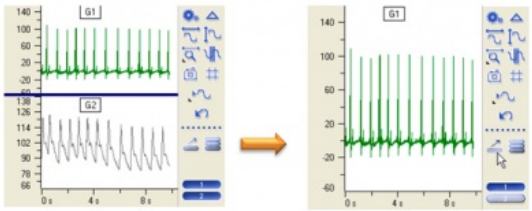
During acquisition, NOTOCORD-hem allows you to view signals in three scrolling modes: Window scrolling, Replacement scrolling, and Continuous scrolling.

Button	Actions	Illustration
 Scroll button	To select the scrolling mode, right-click the Scroll button.	

Select the scrolling mode required and click the Scroll button (the mode selected is stored in memory).

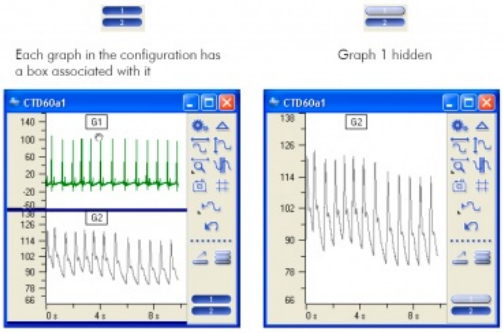
Scrolling mode	Description	Illustration
Window scrolling	When the curves displayed reach the end of the display window, a new signal image is displayed.	
Replacement scrolling	Instead of being displayed in a new window, the new signal image replaces the previous one. The current point is indicated by a vertical line moving from left to right.	
Continuous scrolling	The signal image scrolls continuously (new values are displayed at the right end of the window).	

Displaying a graph full screen

Button / Shortcut	Actions	Illustration
Full screen graph button  or Ctrl + F	Select a graph and click the "Full screen graph" button to display the graph full screen. Click this button again to redisplay all of the graphs.	

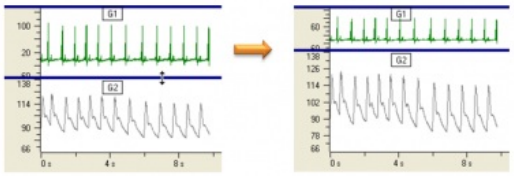
Hiding a graph

The graphs shown in a display window are identified by numbered boxes under the toolbar in the right-hand section of the window. To hide a graph, click the box with the corresponding number (the box will then look "closed"). The display window will then only contain the remaining graphs.



Modifying the height of a graph

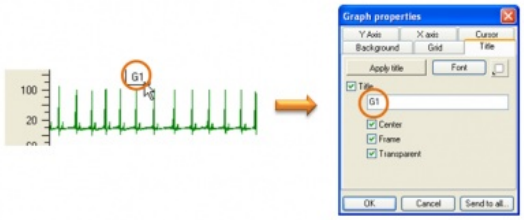
To modify the height of a graph, click one of the horizontal lines delimiting the graph selected and drag the mouse upwards or downwards. The y-axis scales for the graph selected and for adjacent graphs concerned by the modification will be automatically expanded or compressed accordingly.



Reassigning an equal height to all graphs displayed (i.e. not hidden): Click on the tile button.

Changing the name of a graph

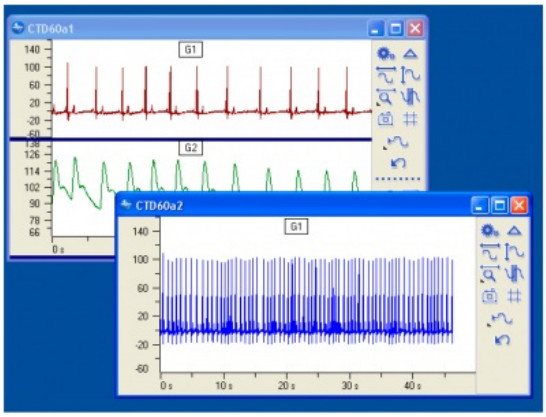
Double click on title and type new title in the displayed properties dialog box.



Note: You can also click the name box and drag it to any location in the display window, or even delete the name.

Using multiple display windows

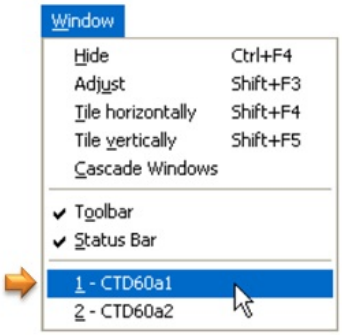
Instead of adding additional display graphs into the same window (thus making it harder to read the various signals displayed), it is sometimes more convenient to open a new display window and arrange the various windows as you like.



You can use the *Tile horizontally*, *Tile vertically*, *Adjust* and *Cascade* buttons to arrange the various display module windows in the Main window .

Hiding a display window

Clicking the  icon in the top right-hand corner of a display window does not "close" the window but just hides it. To restore the window, select it from the Window menu in the Main window.

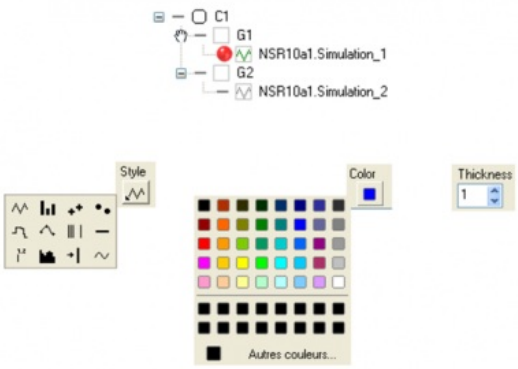


Display window configuration

You can specify the style (crosses, points, vertical lines, etc.), color and thickness for each curve in a display window.

Button	Action	Illustration
	To configure a display window, click the top left button in its toolbar. The "Display configuration" dialog box appears. - The left part of this dialog box lists all available data. - The right part lists the data connected to the display module inputs (the tree-structure showing the names of graphs and display modules is initially closed).	

To change the display of a data, select it in the right part of the dialog box (a small red ball appears) and choose the style, color and thickness required.



Note: The left part of the dialog box lists all data for the current configuration, including data corresponding to display modules which have been deleted.

We recommend that you experiment with different types of configurations so as to become familiar with the various possibilities.

Using event markers

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Basic principle

- Event markers are used to identify specific moments in the course of an experiment (such as the injection of a compound, at a given time ...).

- Event markers can be set by pressing either a function key (F1, F2, F3...F8), each key corresponding to an event marker channel. Or after an acquisition by 1st navigating to desired area and then right click on the mouse and select *Insert marker*.

- Each event marker has a type and a label associated with it. Event marker types are used to distinguish between different types of events. For example, type 0 may correspond to events concerning the injection of a product and type 1 may correspond to events involving observations.

Note: The default event marker type is 0.

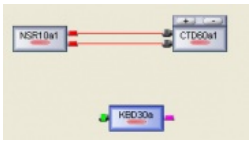
- Event marker labels are used to specifically identify marked events.

Configuration

Setting up the KBD30a module

In order to specify and make use of event markers, the KBD30a module must first be set up.

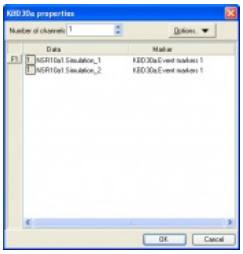
Set up the KBD30a module in the *Configuration Setup* window.



Note: Important - A *Configuration Setup* window cannot contain more than one KBD30a module.

Choosing the number of event marker channels

Double-click the KBD30a module to display the *KBD30a properties* window.
Enter the number of event marker channels required in the *Number of channels* field.
Note that only the first eight channels are connected with F1, F2, ...F8.



Several different combinations of event marker channels + types can be used, depending on the way you like to work and the nature of the tests to be carried out. For example, you can assign one event marker channel per animal and specify the operations carried out using event marker types.
You can also assign an event marker channel for each type of operation and use event marker types as an additional means to distinguish between various operations.

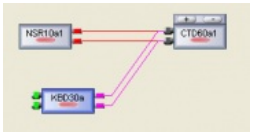
KBD30a module outputs

After you have clicked *OK* in the *KBD30a properties* window, the amount of KBD30a module inputs and outputs will correspond to the number of channels assigned.
The inputs remain "on standby". They are used in association with event marker channels activated by either a pushbutton or a function key.
Outputs can be connected to display modules so as to view the corresponding event markers.

Note: An event marker can be viewed in any graph, independently of the signal it is assigned to (i.e., an event marker channel associated with a given signal can be displayed in a graph corresponding to another signal).

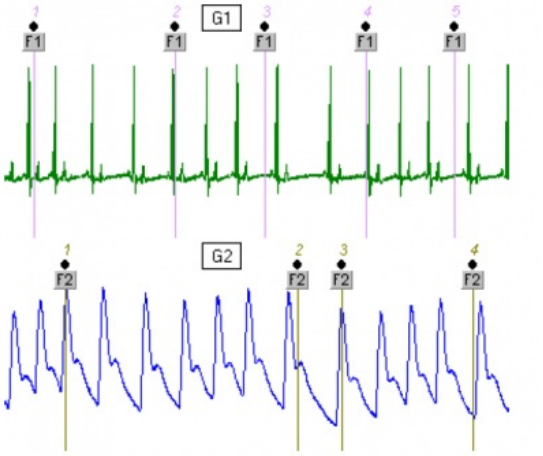
Display

Set up the following configuration:
Event marker channel 1 is assigned to the ECG signal of the NSR10a module. Channel 2 is assigned to the ABP signal.



- Switch to the Main window.
- Start the acquisition and then press the F1 and F2 keys several times (in any order).
- Stop the acquisition.

Event markers are represented by long vertical lines of various colors (each event marker has its own color). Above each event marker line, there is an order number, a dot and a box containing the function key associated with the corresponding marker. For example, the number 3 above the F2 box stands for the third event marker of channel 2.

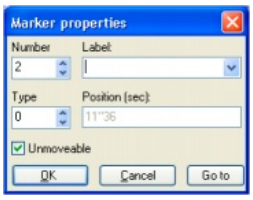


Note: - You can have two identical numbers one after the other when they correspond to different event marker channels.

Click on the signal with the right side mouse button.
In the context sentive menu, choose *Insert marker* and select one of the two channels with the left side mouse button.
Amarker is inserted and is displayed on the graph.

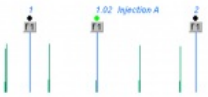
Specifying event marker labels and types

- Double-click an event marker (you can double-click the corresponding line, dot or box) to display the *Marker properties* window for this marker.
- The *Number* field indicates the order number for the marker you selected (for example, 2nd event marker of event marker channel 1).
- Enter a *Label* to identify the event marker.
- Select the event marker *Type* (0 to 99 - the default type is 0).
- Click *OK*.



The event marker's label and its order number with respect to the type and channel will now be displayed above the corresponding line (in the example shown, the event marker is of type 2 and corresponds to channel 1).

The other event markers for this channel are renumbered accordingly.



Switching from one event marker to another

You can navigate directly from one event marker to another of the same channel.
There are three ways to do this:

- Right-click an event marker and choose the destination
- Double-click an event marker, select the target marker number and click *Go to* ...
- Select an event marker and use one of the following keyboard shortcuts: Ctrl+M (next marker of the same channel), Shift+Ctrl+M (previous marker of the same channel).

Moving an event marker

The default settings do not allow you to move event markers once they have been positioned.

If necessary, you can reposition a marker by unchecking the *Unmovable* box in its *Marker properties* window.

Managing files

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Saving the current configuration

Once the configuration has been generated, it can be saved under a user specified explicit name so that it can be reused by other applications.

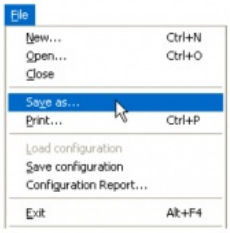
Note: A configuration mainly includes:
– The configuration diagram (module layout and parameter settings, links between modules),
– The display layout, size and parameter settings (type of signals, color, line thickness),
– The size and layout of the Main window and the *Configuration Setup* window.

To save the current configuration, click on the *Save configuration* button in the configuration screen or on the item with this name in the *File* menu and specify the name of the configuration file and where to save it.

Saving the data file under another name

You can save your data files under a different name than the one assigned when they were opened or created.

To do this, use the *File* > *Save as* command from the main screen and specify the name of the data file and where to save it.

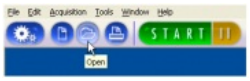


Loading a configuration other than the current one

Click on *Load a configuration* in the *Configuration Setup* window or use the *File* > *Load a configuration* command.

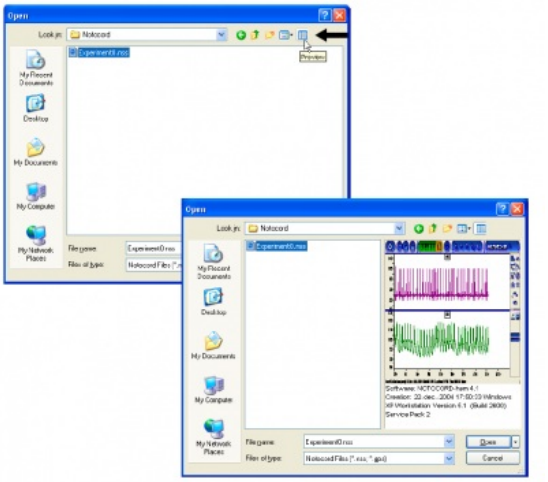
Opening a data file

You can open a data file by clicking on *Open* in the Main window or by using the *File* > *Open* command.



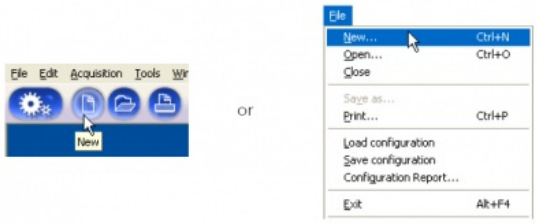
File selection window opens. When a .nss file is selected in the list, its preview is displayed by clicking on the ad hoc menu's tab.

Preview corresponds to the display of the main screen as it was by closing the file.

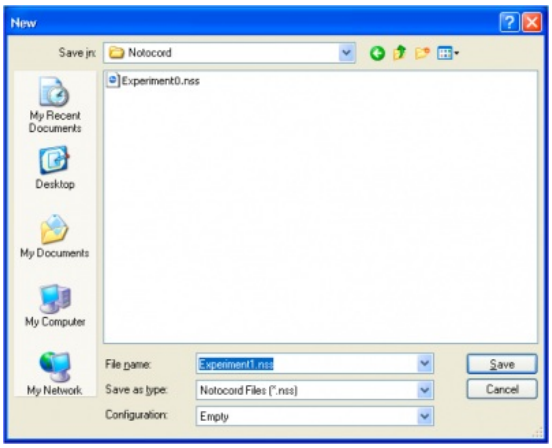


Creating a new data file

To create a new file, you can click on *New* in the Main window or run the *File > New* command.



The opening window enables you to set the file's location and name, and required configuration.



The options available are:

- Default: Loads the saved configuration as the default configuration (refer to the next paragraph).
- Memo 1, Memo 2… Loads the configuration assigned to the Memo 1, Memo 2… button (see below for a description on how to assign a configuration to one of these buttons).
- Current: Retains the current configuration.
- Empty: The configuration window is clear of all modules.
- More: Loads the selected configuration.

Saving the current configuration as a Memo

You can save the current configuration as a base for working on other experiments.

The first method, described above, includes saving the configuration under an explicitly entered name and calling it back up during other experiments.
The second useful method is to record a configuration as a *Memo*, which remains available and specific for each user.

To assign the current configuration to a *Memo* button, hold left mouse button pressed on one of the toolbar M buttons until the color becomes red.

After releasing the mouse button, the *Memo* button number turns from white to red. This indicates a configuration has been assigned to this particular *Memo* button.
Once the current configuration has been stored in a *Memo*, it can be called back in any application by simply clicking on the corresponding button

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Note: To assign a name to a *Memo*, click with the right mouse button on the corresponding button and select the *Memo editing box*. The name entered will be displayed in the bubble displayed for the *Memo* button.

Analyzing with Microsoft Excel®

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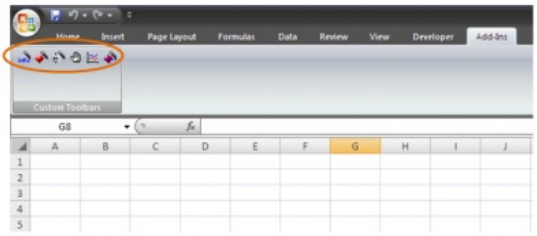
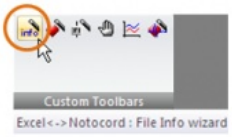
Notes:
- This section assumes that you are familiar with the use of Microsoft Excel®.
- It briefly describes the analysis features provided by Microsoft Excel®. These features are described in detail in the chapter on data analysis.

During the NOTOCORD-hem installation a function is added to the system createing a link between Microsoft Excel® and NOTOCORD-hem.

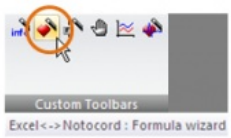
Upon opening Microsoft Excel® you will find five buttons added to your Microsoft Excel® toolbar. These buttons or "wizards" help for data extraction and analysis.



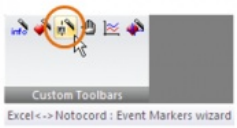
To extract various information from a data file (filename, acquisition duration, acquisition start time, etc.)



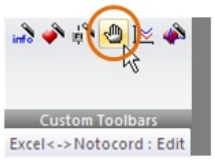
To extract experiment information (values, average, number of points, maximum, etc.)



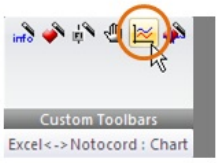
To extract information on markers: number, type, assigned keys, name, etc.



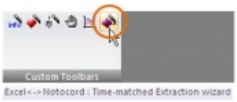
To visually redefine the data analysis field.



To quickly draw a graph that represents the extracted data.

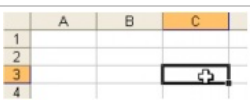


To ensure extracted data match appropriate events (eg: extracted data really correspond to a fully detected heartbeat).
(This Time-matched extraction wizard is only available with an activation key).

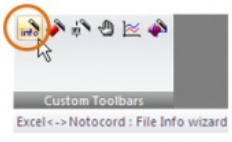


Extracting file data

From the Excel® spreadsheet, select the cell where you wish to place information on the data files.

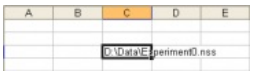


Click on the "File information" wizard.



The window that is displayed lets you select the file to analyze along with the information that you wish to place in the cell.
Select the file that you wish to analyze using the Browse button.

Select the information that you wish to place in the cell and validate it. The cell contains the selected information.

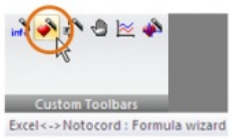


Note:
When you select a cell containing data generated by one of the wizard, the formula bar displays exactly how the data was extracted into Excel.
=Ns.File("R:\Data\Experiment0.nss")
As a general rule, each cell or group of cells that contains information generated by one of the three wizards (file information, data, markers) has a corresponding formula such as *Ns.<Function>("<File>";<parameters separated by semi-colons>)*

Placing data in the spreadsheet

Experiment data is extracted as follows:

Select the cell where you wish to place the data.
Click on the "Formula" wizard.



It calls up the following screen.

Click on the "Select working file" button.

Click in the field and then on the cell that contains the filename. The field is then framed by a dotted blinking line. The field contains the cell's absolute address.

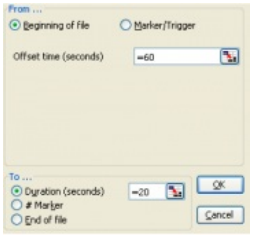
Note: You can also select the file using the Browse button.

Then click on the "Select data" button.

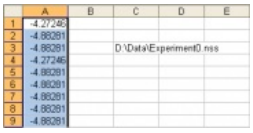
The Browse button calls up the window that displays the data for the selected file. Select the required data and validate twice.

Specify the data that you wish to extract (values, average, minimum, maximum, number of points, etc.).

Specify the analysis zone duration, e.g. a 20 second window starting 1 minute after the start of the file



Validate the formula definition window. The active cell — or those that follow — will then contain the required information.



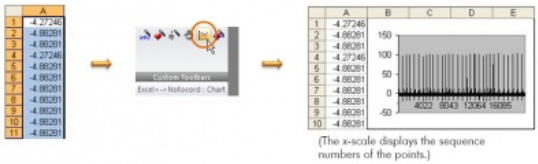
Note: Important - The cell may display the #NA or #Zone error message. Click on the edit wizard to see if you have incorrectly set up the formula wizard or if there is no data in the section you are trying to extract.

Automatically building graphs

You can quickly obtain a graph that illustrates the data calculated by the "Formula" wizard.

First select the values zone that you wish to display, then click on the Graph button.

You can then perform all of the actions supported by Excel® on the graph.

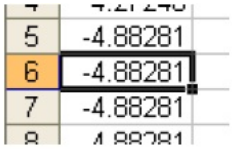


Note: Once the graph has been generated, any change to the data configuration will impact the graph.

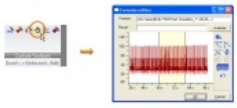
Displaying the analysis zone

You can display the analysis zone of a cell or column with the "Edit" wizard. This allows you to perform a visual inspection of the data. It also allows you to change the starting point and duration of your analysis zone.

Click on a cell where the contents are calculated by a wizard. (In the example below the cell displays the maximum value of the signal. The analysis zone, created by the formula wizard, starts 60 seconds after the beginning of the file and has a 20 second duration.)



Then click on the "Formula editor" button.
The zone corresponds to the one configured using the Formula wizard (1 minute after the start of file; duration: 20 seconds).



You can then move the zone and/or change its width. When you validate it, the cell is automatically recalculated according to the new parameters. (For consecutive values, all of the cells are changed along with the graph that may be assigned to them.)

Note: The Evaluate button displays the result of the formula applied to the zone without changing the active Excel® cell.

Advanced Tutorials

Calibration

Calibration tutorial

ECG51a / QRS10a tutorial

How to start with ECG51a and QRS10a

Table of Contents

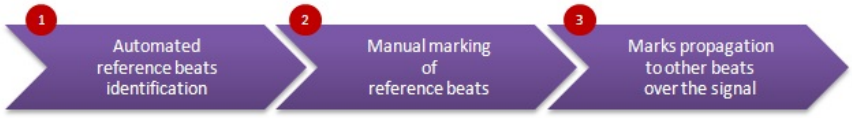
Introduction

This user guide is designed to help you get started with ECG51a and QRS10a modules. A ECG51a demo video and reference documents for ECG51a and QRS10a are also available.

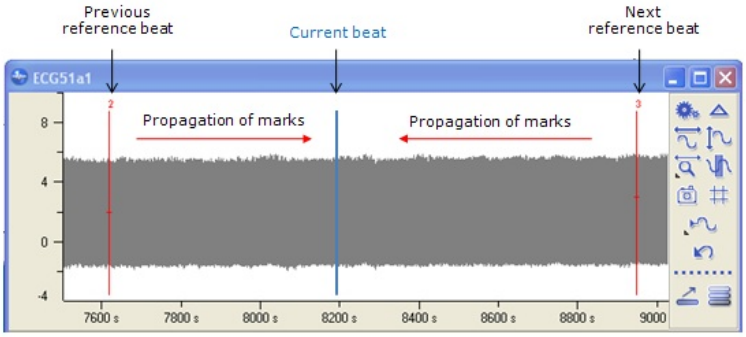
Basic principles of ECG51a analysis

Athree-step process

ECG51a module is an offline beat-to-beat analyzer based on propagation of user-defined marks (typically PQRST) in 3 main steps:

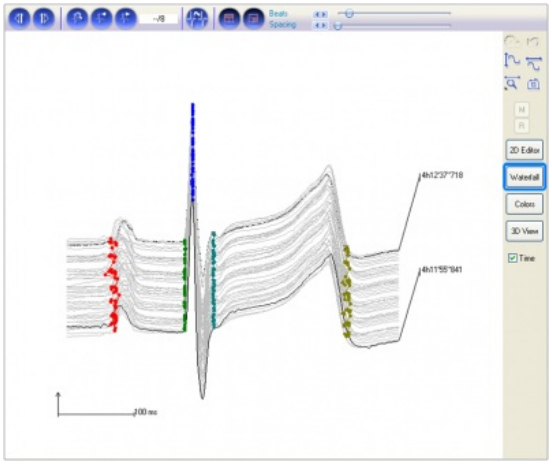


- The reference beats are file-specific and automatically identified by the module (step 1). To do so, the algorithm browses through the file and retains the most representative morphologies.
- Each reference beat is manually marked by the user (step 2).
- These user-defined marks are then applied over all the beats identified on the QRS input (step 3). The positions of the applied marks are determined by comparing the morphology of a given beat to the previous and to the next reference beats (see Figure 1).



Triggering ECG51a with a QRS detector

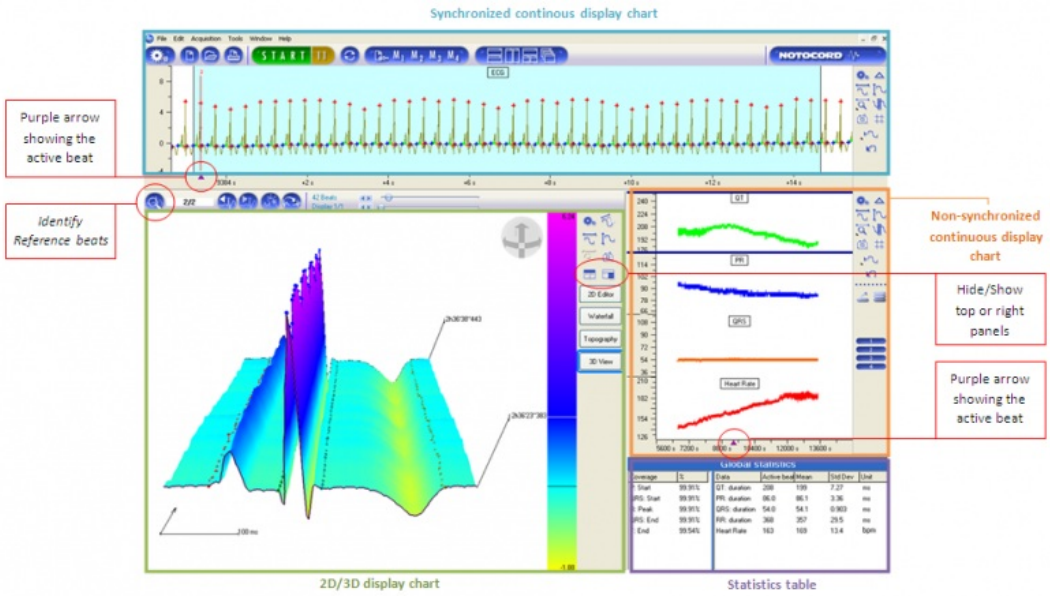
ECG51a requires triggering by another module, QRS10a for instance, which performs beat detection. Detected beat triggers must be located on the QRS complexes and connected to the *QRS* input of ECG51a. An analysis window around each QRS trigger is set to define the zone considered for the analysis of each beat. QRS triggers are also used to align multiple beats in the different 3D views offered by ECG51a (Figure 2).



For more detailed information on ECG51a capabilities, please refer to the ECG51a reference document.

Overview of ECG51a display window

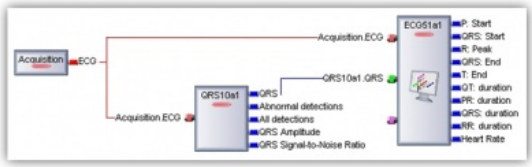
Figure 3 gives an overview of ECG51a display window after signal analysis



Modules configuration in NOTOCORD-hem

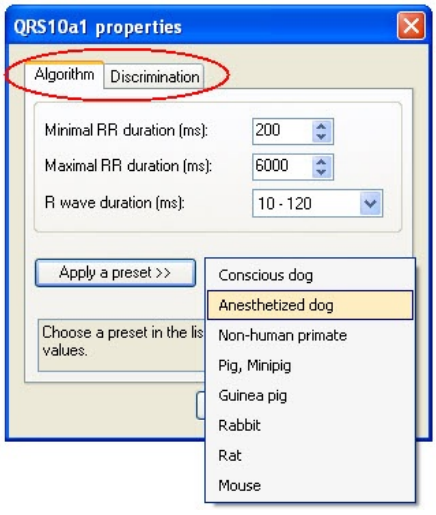
The ECG51a module has 3 inputs (*ECG*–red, *QRS*-green and *Markers*-pink) and 10 outputs as standard (Figure 4). This number may vary as more outputs can be added.
The QRS trigger can be provided by any module able to detect a cycle or an R-wave. Use of the *QRS* output of the QRS10a module, delivered with ECG51a, is recommended since QRS10a has been specifically developed for this application.

- Connect the ECG signal on the red input of both QRS10a and ECG51a modules.
- Connect the *QRS* output to the green ECG51a input.



QRS trigger generation with QRS10a module

ECG51a analysis is triggered by QRS detections, which can be generated by QRS10a. There are 2 tabs in the QRS10a properties window (Figure 5).



The first tab, *Algorithm*, allows selection of a preset for species and experimental setup.

- Set the algorithm parameters or select a preset,
- Validate it by clicking on *OK*.
- Recalculate the QRS10a module.

The second tab, *Discrimination*, contains optional user-defined discrimination parameters for refining QRS detection.

- Check *Amplitude* and *Signal-to-Noise Ratio* results on a CTD60a display.
- Apply discrimination thresholds if necessary.
- Then recalculate the module.

See examples of discrimination parameters use in chapter "Improve your analysis". For more detailed information on QRS10a capabilities, please refer to the QRS10a reference document.

ECG51a module configuration

The configuration window contains 3 tabs: *Algorithm*, *Marks* and *Calculated data* (Figure 6).

Algorithm tab

Applies a preset for your species. Parameters are used:
- to adapt the analysis to the signal,
- to define the boundaries of the beat analysis window.

Marks tab

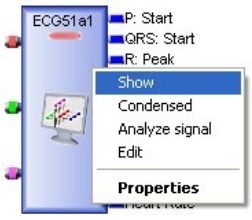
The main marks are already listed.
► You can add your own marks with the associated keyboard shortcuts, by clicking on the + button at the bottom of the screen.

Calculated data tab

A default listed is available.
► You can add your own calculated data by clicking on the + button at the bottom of the screen and by indicating the calculating formula. (Time1 corresponds to Mark1 and Time2 to Mark2).

When you are finished with setting your configuration:

- Click on *OK* to validate,
- Right-click on ECG51a,
- Select *Show* to switch to the display screen (Figure 7).



ECG51a analysis

The analysis is performed in 3 steps:

1. Reference beats identification
2. Reference beats marking
3. Signal analysis.

Reference beats identification

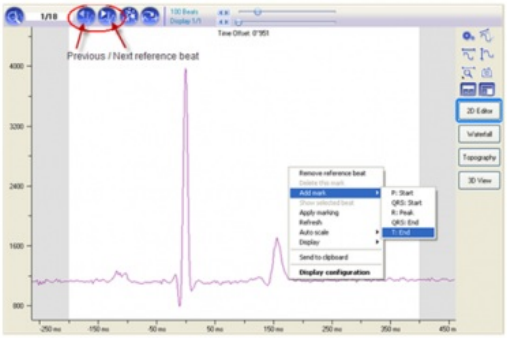
In the ECG51a display window, click on *Identify reference beats* (Figure 8).

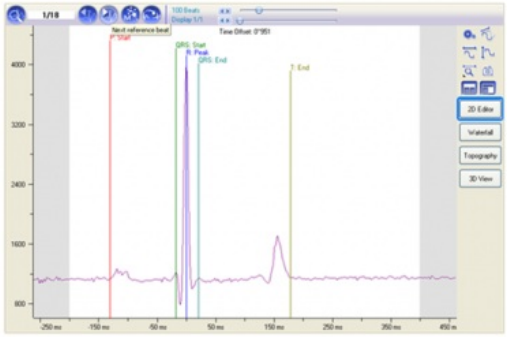
The number of reference beats appears in the horizontal bar above the 2D/3D chart menu. In Figure 9, 18 reference beats are identified by ECG51a (with #1 being displayed).

Reference beats marking

The first reference beat is displayed in the 2D/3D chart (Figure 10).

- Click on the chart to activate it.
- Use either keyboard shortcuts to mark the reference beat (P, Q, R, S, T) or right-click on the chart to open the pop-up menu and use the *Add mark* option (Figure 11).
- Click on the *Next* button to move to the next reference beat.





► Apply marking option for facilitated marking

- Use the *Apply marking* button to mark the active reference beat (Figure 12). *This function compiles all existing reference beats marks in order to automatically mark the current/active reference beat*.
- Add any missing mark and/or adjust the marks.

Marking mode: When you press ctrl + click on the *Apply marking* button, the button remains in an active state, providing a pre-marking for each visualized reference beat. There is no need to click on the button for each beat.

Tips
► If you hesitate on how to position marks correctly, *T: End* for example, here are some ways to help you out:

- You may check the *QT: duration* value of the current reference beat in the statistics table.
- You may check the neighboring beats by clicking on the 2D/3D chart to activate it, and then by navigating between beats with the left and right keyboard arrows.

► If a dash appears in front of the number of reference beats (e.g. -/18), then the active beat is not a reference beat. Move to the previous or next reference beat.

Signal analysis

When marking is finished:

- Apply it to the rest of the signal with the *Analyze signal* button (Figure 13).

Once the signal analysis process is complete:
- Marks are visible in the upper display chart.
- The *Global statistics* panel (on the bottom right corner, Figure 3) indicates the coverage percentage (Figure 14). For each mark, the coverage is calculated as (number of marks / number of input QRS triggers) over the whole signal.
- The non-synchronized continuous display chart, above the *Global Statistics* panel, shows an overview of PR, QT, QRS intervals and Heart Rate.

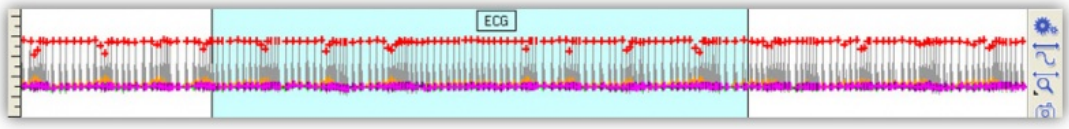
Coverage	%
P: Start	87.33%
QRS: Start	99.73%
R: Peak	99.73%
QRS: End	99.74%
T: End	95.19%

This chart is useful to observe potential drug effects and monitor data quality. Indeed, if you notice any interval instability in a particular area on this chart, right-click on it to see the identification numbers of the corresponding reference beats and access them to check the marks.

See an example of interval instability at the end of this guide in the chapter "Improve your analysis".

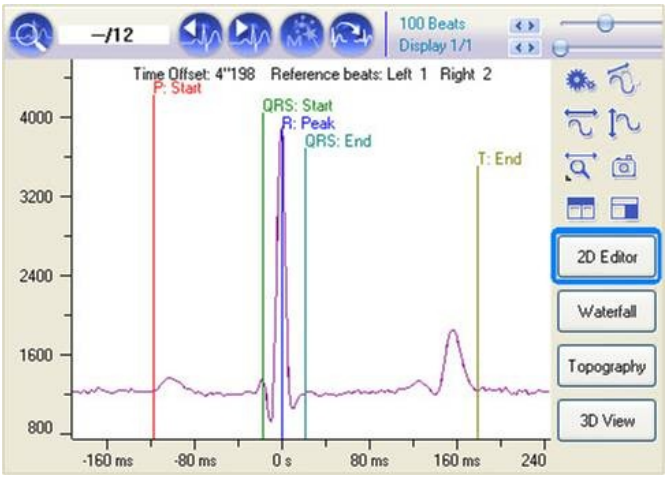
Views
The 2D/3D chart of ECG51a offers 4 visualization modes: *2D Editor*, *Waterfall*, *Topography* and *3D View*.
Except for the *2D Editor*, each view shows multiple beats aligned on their QRS trigger.

The blue zone in the upper continuous display (Figure 15) represents the portion of signal displayed in the 2D/3D chart. This blue zone is synchronized with the 2D/3D chart. For example, if you increase the number of beats displayed in the 2D/3D chart then the size of the blue zone increases. If you go through the signal using the 3D view, the blue zone moves simultaneously.

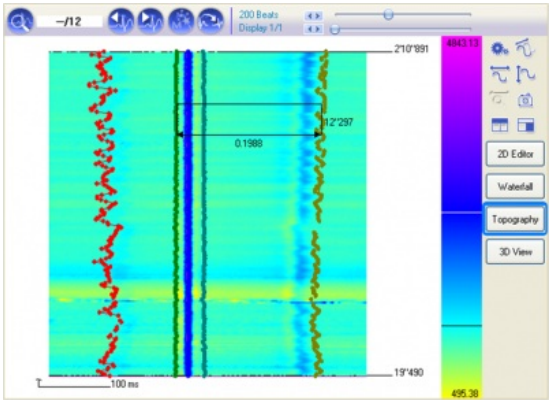


Here is a non-exhaustive list of basic actions to perform using the different views:

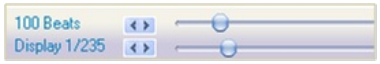
► To visualize marks on individual beats and navigate from one beat to another, use the *2D Editor* view (Figure 16) and move from one beat to another with the left and right keyboard arrows.



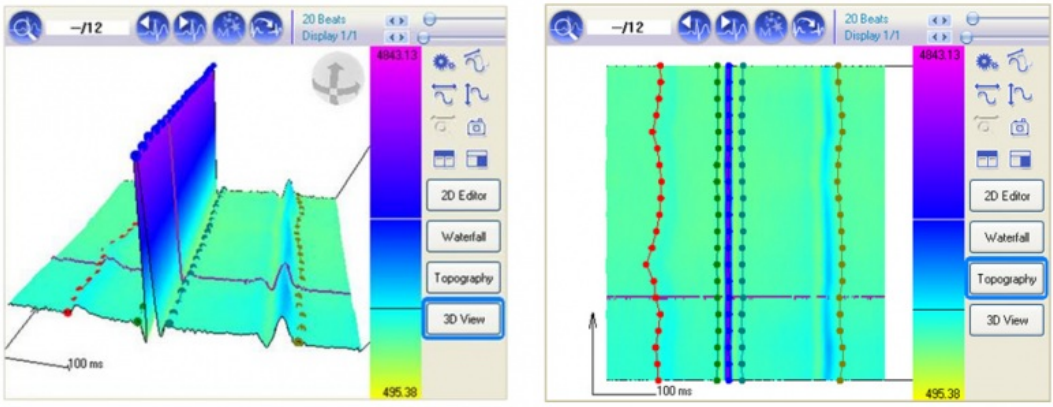
► To visualize and/or edit reference beats, use the *2D Editor* view (Figure 16) and move from one reference beat to another with *Previous* and *Next* reference beat buttons or by using the up↑ and down↓ keyboard arrows.
► To measure PR or QT interval duration, use the *Topography* view, left-click on the graph and move the mouse to make the dimensions appear (See Figure 17).



► To get a whole signal overview, use the *Topography* view, right-click on the chart area and select *Signal Overview*. It automatically adapts the *Display 1/n* parameter in order to spread the chosen number of displayed beats (*# Beats*) over the whole signal (Figure 17 and Figure 18).
The Signal overview option in Topography view is convenient for setting the parameters in the ECG51a properties window before the analysis. To exit signal overview, decrease the Display 1/n parameter, and select a beat of interest on the Continuous Display by choosing Show beat # in the right click popup menu.



► To move the whole graph in the 2D/3D chart area, right click and simultaneously move the mouse.
► To select a particular beat on the graph, use Ctrl + click on the beat of interest. This beat is highlighted as shown on Figure 19. This active beat is also designated in the Continuous Display by a purple arrow underneath (see Figure 3), showing its position in the whole signal.

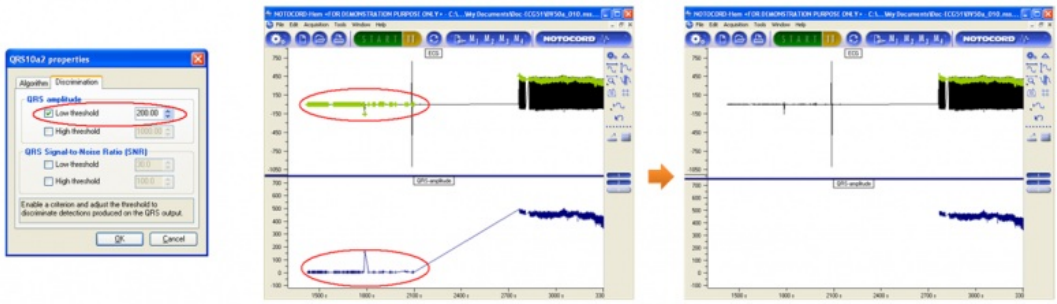


Improve your analysis

Improve QRS detection

QRS10a detects QRS complexes and can be used to trigger ECG51a analysis. Wrong QRS detections can be filtered out using the *Discrimination* tab of QRS10a properties.

Remove noise and artifacts detected as QRS complexes using QRS amplitude parameter.



In Figure 20, ECG signal and detetected QRS complexes (green) are displayed on the upper graph. *QRS Amplitude* output is displayed on the lower graph. Noisy beats can be rejected from QRS output by using the *QRS amplitude* parameters of QRS10a *Discrimination* tab.

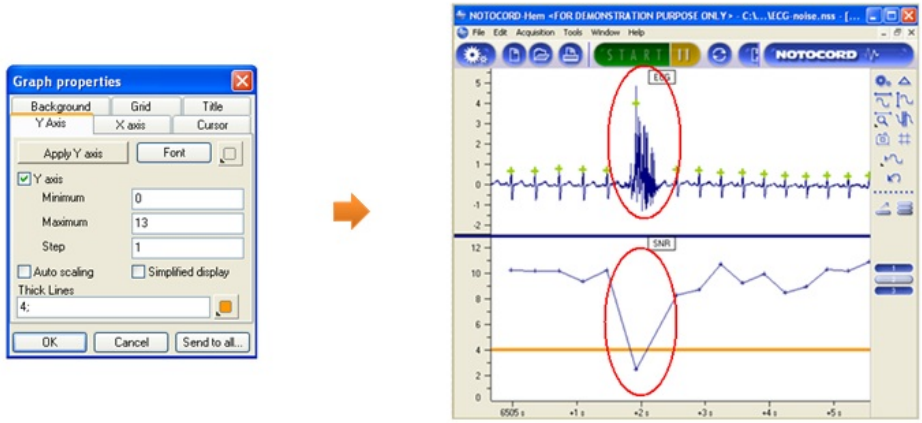
- Apply a Low threshold equal to 200 (in this example) for the amplitude (Figure 22).
- Recalculate the QRS10a module.

Check the results (Figure 21):
- New *QRS* output is displayed (green).
- Rejected QRS complexes are stored in the *Abnormal detections* output of QRS10a and removed from the *QRS* output used to trigger ECG51a.

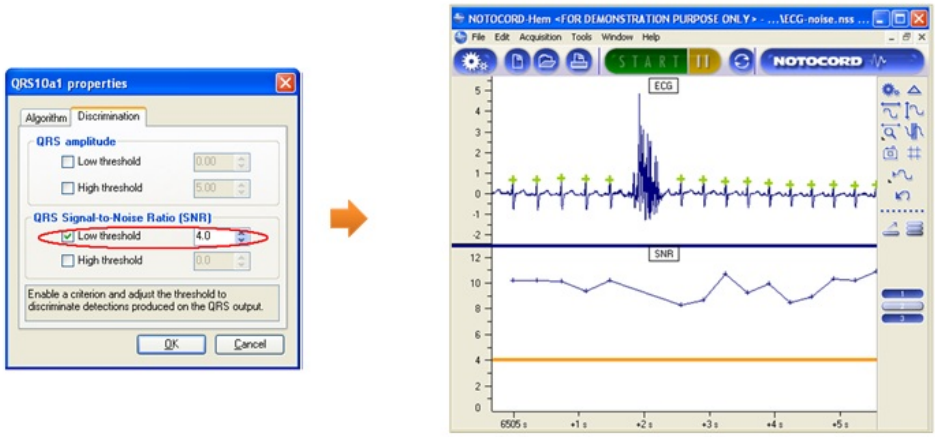
Remove noise and artifact detected as QRS complexes using *Signal-to-Noise Ratio* (SNR) parameters

On Figure 24, ECG signal and detected QRS complexes are displayed on the upper graph. *QRS Signal-to-Noise Ratio* output is displayed on the lower graph. Noisy QRS can be rejected from the *QRS* output using the *SNR* parameters of QRS10a *Discrimination* tab.

Tip!
To check the threshold is appropriate for the whole signal, add a horizontal line on the display by double-clicking on the Y-axis (Figure 23).



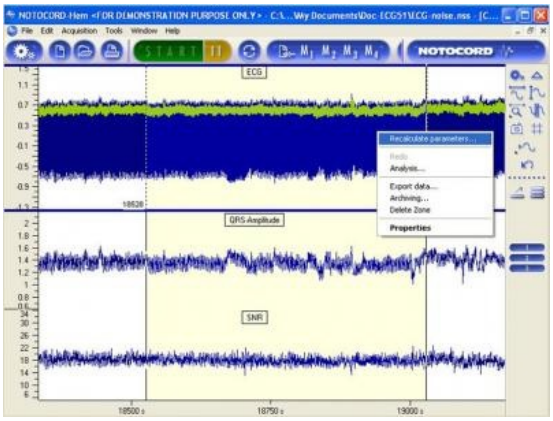
- Apply a *Low threshold* equal to 4 (in this example) for the *SNR* (Figure 25).
- Recalculate the module.



Check the results on Figure 26:
- New *QRS* output is displayed (green).
- Rejected QRS complexes are stored in the *Abnormal detections* output of QRS10a and removed from the *QRS* output used to trigger ECG51a analysis.

Limit analysis to a specific zone of interest

On Figure 27, ECG signal and detected QRS complexes are displayed on the upper graph. *QRS Amplitude* and *QRS Signal-to-Noise Ratio* outputs are displayed on the lower graphs.

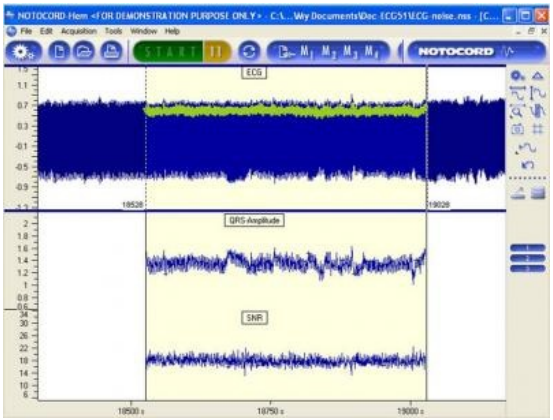


If your ECG51a analysis should be performed on a specific zone of interest, you can recalculate the QRS10a module on this zone alone.

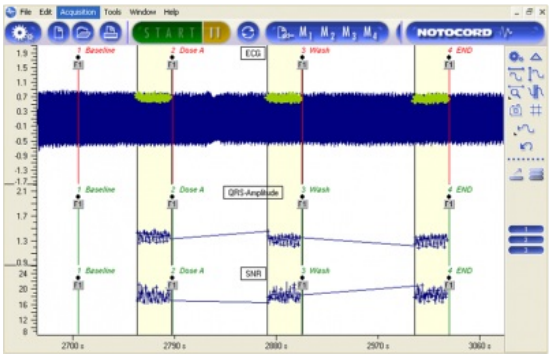
- Click on *Insert a vertical zone* and place the analysis zone.
- Right-click on the zone. Select the *Properties* option and set the zone width and onset.
- Select *Recalculate parameters* to recalculate QRS10a module on the zone alone.

Warning: calculations outside this zone will be lost (except for calculations of earlier zones).

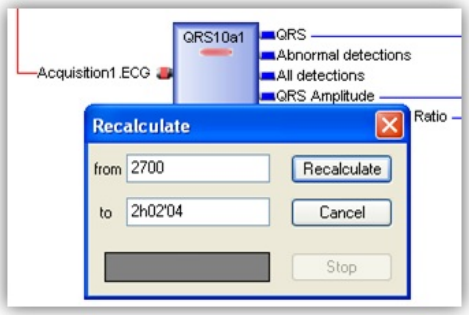
New *QRS* output is displayed (green) and can be used to trigger ECG51a.



Tips!
Several zones can be calculated successively with an automated module such as QRS10a. See example on Figure 29. When recalculating a new zone, two cases may arise:
- If the recalculation zone overlaps an existing calculation zone, then previous data are deleted and replaced.
- If calculation zones do not overlap, then the existing data located before the new zone are saved while the existing data located after the new zone are deleted.



► If you need to run the analysis from the *Baseline* marker, you can recalculate the QRS10a module from the time of the *Baseline* marker. For instance, on Figure 30, QRS10a recalculation starts 2700 seconds after the beginning of file.



Add/remove a reference beat

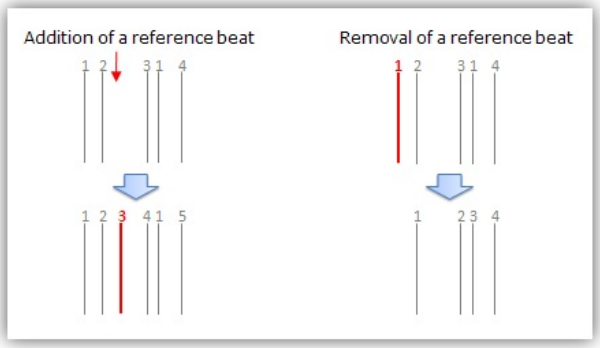
Add a reference beat

⇒ When do you add a reference beat?
When you notice that a zone of interest was not analyzed, or not correctly analyzed.

Warning: Adding a reference beat may increase coverage locally, but may decrease coverage in other areas, in which the previous set of reference beats was more appropriate. Therefore, adding a reference beat is not recommended for improving global coverage.

⇒ How do you add reference beats?
- Display the beat of interest in the *2D Editor* view,
- Right-click on the chart and select *Set as reference beat*.

⇒ What is the consequence on reference beat numbering?
Reference beats identification numbers are updated according to the chronological order of their occurrence. See Figure 31.



Remove a reference beat

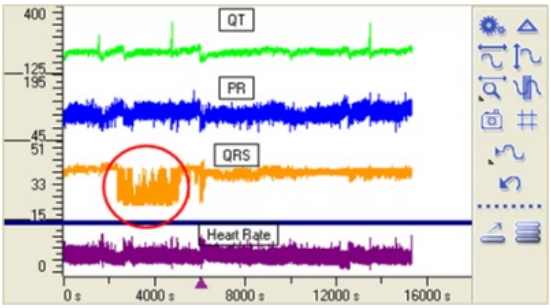
⇒ When do you need to remove a reference beat?
This option may be useful when
- a reference beat is identified on a beat where manual positioning of fiducial points is difficult or not possible,
- several reference beats are detected in a noisy zone that is not really of interest to you.

⇒ How do you remove a reference beat?
- In the *2D Editor* view, display the reference beat you want to remove,
- Right-click on the chart and select *Remove reference beat*.

⇒ What is the consequence on reference beat numbering?
Reference beats identification numbers are updated according to the chronological order of their occurrence. See Figure 31.

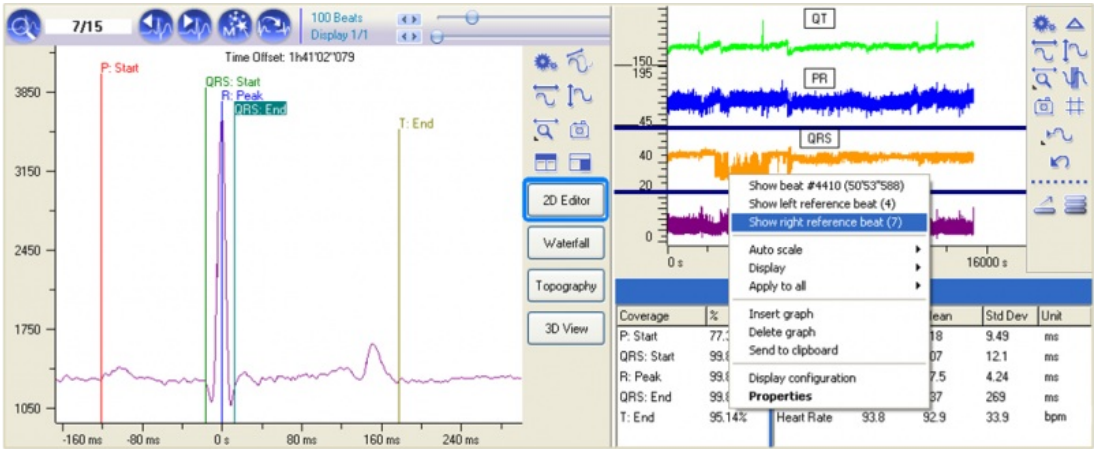
Find the origin of an interval instability

The non-synchronized continuous display shows calculated data, such as interval durations. It is useful to observe potential drug effects and monitor data quality. Instability on *QRS: duration* data is circled on Figure 32.



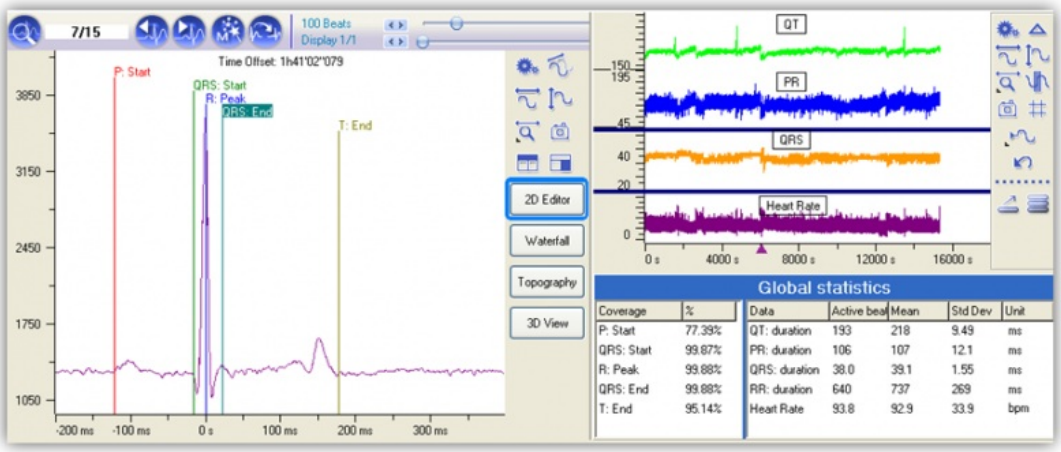
Check if this instability comes from an incorrect reference beat marking:

- Right-click on the area of interest.
- Select *Show left reference beat* or *Show right reference beat* . Identification numbers of the left and right reference beats are indicated in brackets.
- Check reference beats marking on the *2D Editor* chart.



In the example above (Figure 33), *QRS: duration* interval instability is explained by *QRS: End* incorrect manual marking on reference beat #7.

- Move the *QRS: End* mark to the correct position towards the right end side.
- Run the signal analysis again. See the results on Figure 34.



Excel®: Time-matched extraction wizard

How to use the Time-matched extraction wizard in Microsoft Excel®

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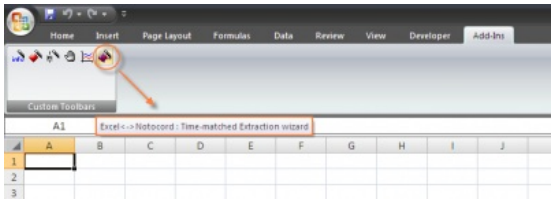
The time-matched extraction wizard function has been added to NOTOCORD-hem in March 2009 and is available with version 4.2.0.230 onwards.



Overview

The time-matched extraction wizard allows the extraction of data related to a range of reference time points. Time is always the reference and the data can be of the following types: values, durations and counts.

There are two possible extraction modes:

Exact matching: the software retrieves the data at the exact time defined by the reference time point.

Application example: Beat to beat analysis
Eg: The range of reference time points is defined by the R peaks and the selected data is QT duration. The extraction wizard retrieves the QT interval value related to each R peak. If there is a detection issue (eg: no T-end detected), then cell data for the QT interval shows N/A.

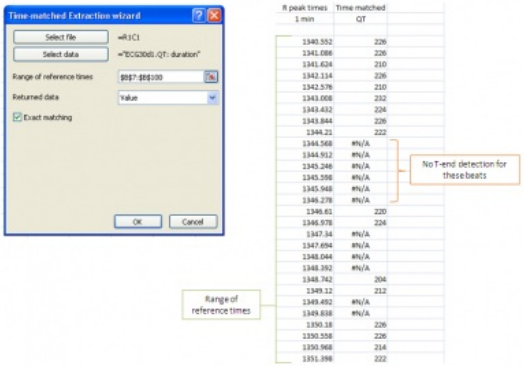
Time matching window: the software retrieves the data in a time window specified by the user (in second, before and after the reference time point).
There are 4 options for result display:

- *First value*: provides the first value in the specified time window.
- *Last value*: provides the last value in the specified time window.
- *Closest value*: provides the closest value to the reference time given.
- *Mean of value*: provides the mean of all value available in the specified time window.

Exact matching mode

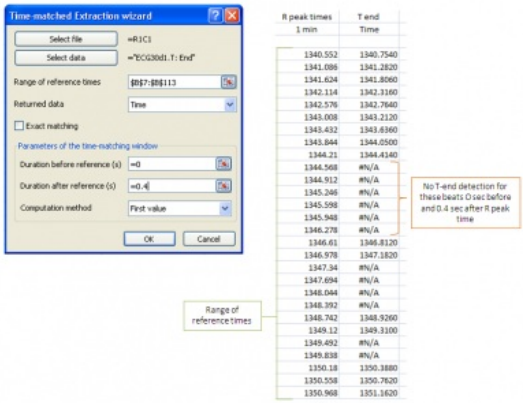
The wizard function uses the same principle as the standard extraction.

1. Extract your range of reference time points.
2. Select the file and data you want to extract.
3. To define the reference time points: select in the Excel® table the time range for which related data will be extracted (ensure the whole range is selected).
4. Choose the output type (value, duration or count).



Time-matching window mode

1. Unselect the *Exact matching* option, and fill in the *Parameters of time-matching window*.
2. Define the search window by giving the duration before and after the reference time.
3. Select the computation method (*First value* by default).


Time-matched Extraction wizard
Select file
=R1C1
Select data
="ECG30d1.T: End"
Range of reference times
$B$7:$B$113
Returned data
Time
Exact matching
Parameters of the time-matching window
Duration before reference (s)
=0
Duration after reference (s)
=0.4
Computation method
First value
OK
Cancel
R peak times
1 min
T end
Time
1340.552 1340.7540
1341.086 1341.2820
1341.624 1341.8060
1342.114 1342.3160
1342.576 1342.7640
1343.008 1343.2120
1343.432 1343.6360
1343.844 1344.0500
1344.21 1344.4140
1344.568 #N/A
1344.912 #N/A
1345.246 #N/A
1345.598 #N/A
1345.948 #N/A
1346.278 #N/A
1346.61 1346.8120
1346.978 1347.1820
1347.34 #N/A
1347.694 #N/A
1348.044 #N/A
1348.392 #N/A
1348.742 1348.9260
1349.12 1349.3100
1349.492 #N/A
1349.838 #N/A
1350.18 1350.3880
1350.558 1350.7620
1350.968 1351.1620
No T-end detection for these beats 0 sec before and 0.4 sec after R peak time
Range of reference times

PV Loop

Guidelines on volume signal management and Baan's equation application

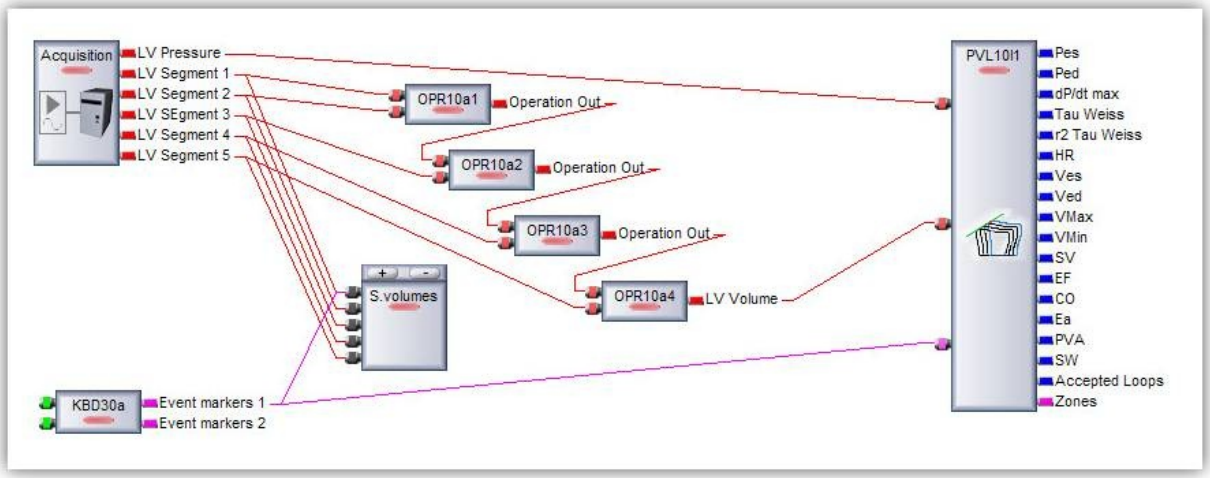
Table of Contents

Introduction

This tutorial provides guidelines on volume signals management and Baan's equation application. As a general rule for any module, recalculation must be done after each step in order to analyze the right volume signal.

Volume signals connection to PVL10I module

Connection of *n* volume signals to the PVL10I volume input is achieved using *n-1* OPR10a modules (simple arithmetic operation between 2 signals). For example, 4 OPR10a modules are needed to connect all volume signals from a 5-segments catheter (Figure 1). By default, OPR10a is suitable for summing up all segment volumes without causing any change in the properties window.



Before using all segments to estimate the ventricular volume, we suggest verifying that: 1) all segments provide a real volume measurement, and 2) segment volumes are synchronized. If these two requirements are not met, the catheter might have to be moved and / or the segment excluded from the ventricular volume calculation.

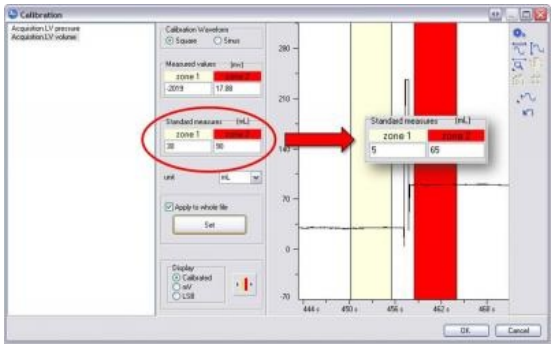
Baan's equation application

Parallel volume removal

Two methods exist to remove parallel volume from signal volume:
- One for one-segment catheters only,
- One for one-segment and multi-segment catheters.

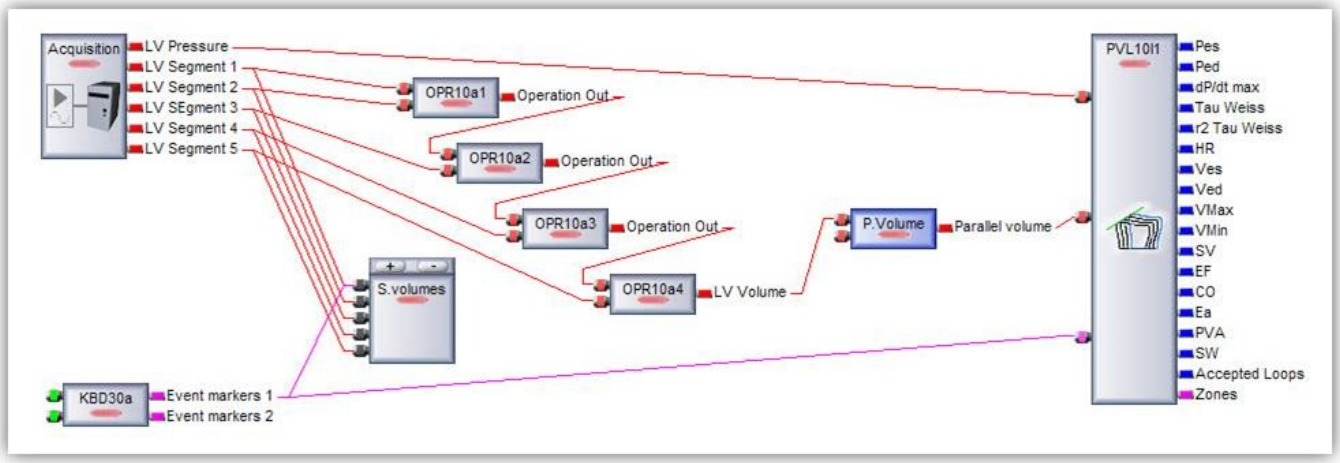
One-segment volume catheter

After computation, the parallel volume is directly entered as an offset in the calibration window. Zone 1 and 2 standard measures are modified by subtracting parallel volume from current standard measures (Figure 2).

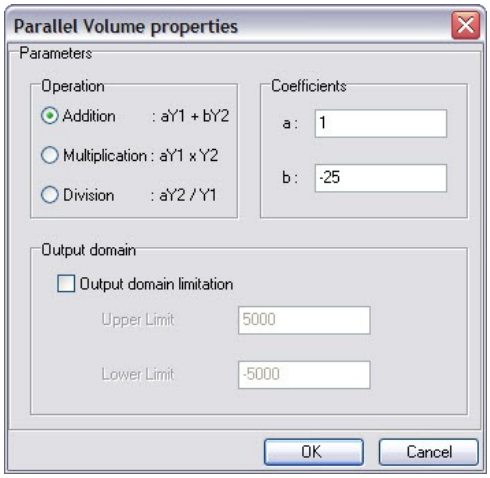


One or multi-segments catheter

The parallel volume cannot be applied as an offset in the calibration window for multi-segments catheters. An additional OPR10a module has to be inserted between the last OPR10a module (used to sum up all segment volumes) and the PVL10I module (Figure 3).



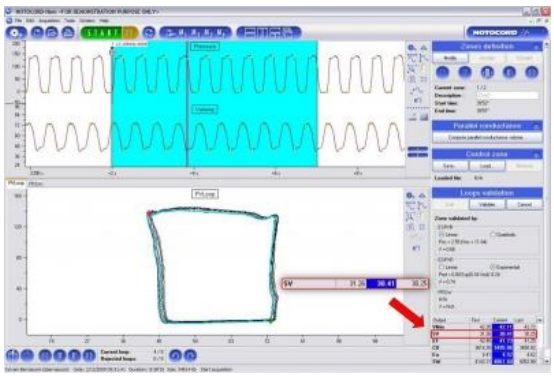
The parallel volume must then be subtracted by inserting its value as *coefficient b* in the OPR10a properties window (Figure 4).



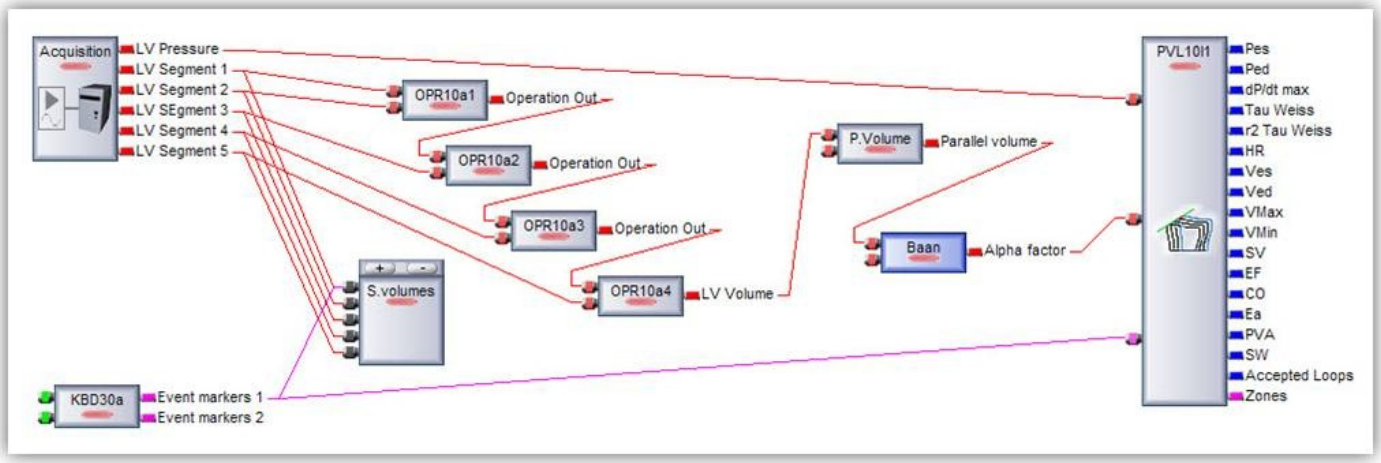
Field correction factor application

As the electrical field for measuring conductance is not uniform [1], a field correction factor α must be applied to extract the true ventricular volume, following Baan's equation: $V = 1/\alpha \times \rho L^2 (G_{measured} - G_{parallel})$
- V is the ventricular volume
- α is the field correction factor
- ρ is the blood resistivity
- L is the length between the sensing electrodes
- G is the conductance

If α is commonly assumed around 1 for a one-segment catheter (and therefore for small animals), a multi-segments catheter actually requires to estimate this correction factor.
The α field correction factor is assessed, during a ventricular steady-state, as the ratio between the Stroke Volume (SV) estimated with the multi-segment catheter (and therefore PVL10l module) and the SV estimated with another measurement technique (i.e. blood flowmeter, thermodilution…) [2].
SV values in PVL10l module are displayed in the table at the bottom right corner after validation of the steady-state zone (Figure 5).

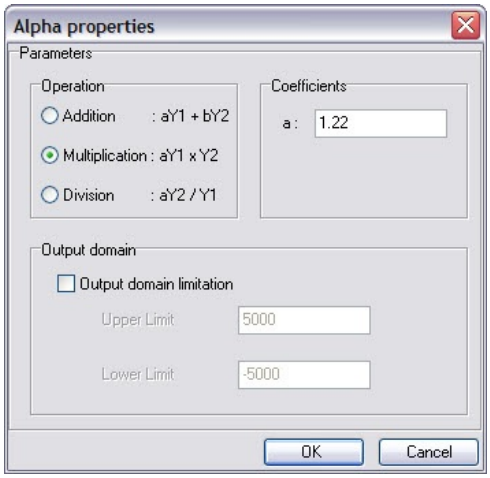


For other measurement techniques, SV is either computed directly or estimated by dividing the cardiac output by the heart rate on the same ventricular steady-state zone.
Following Baan's equation, the ratio 1/α must be computed and then applied using OPR10a (Figure 6).



This ratio can be computed directly using the following equation: $1/\alpha = SV_{other} / SV_{PVL10l}$
- SV_{other} is the stroke volume obtained using the other measurement technique
- SV_{PVL10l} is the SV computed by PVL10l module

Then, $1/\alpha$ must be inserted in the OPR10a module properties window as *coefficient a* (Figure 7).



References

[1] Baan J, Van der Velde ET, de Bruin HG, Smeenk GJ, Koops J, van Dijk AD, Temmerman D, Senden J and Buis B. Continuous measurement of left ventricular volume in animals and humans by conductance catheter. Circulation 1984;70:812-823.
[2] Feldman MD, Erikson JM, Mao YI, Korcarz CE, Lang RM, and Freeman GL. Validation of a mouse conductance system to determine LV volume: comparison to echocardiography and crystals. American Journal of Physiology & Heart Circulation Physiology 2000;279:H1698-H1707.

Appendix

Error index

Error messages encountered when using our modules and applications and related causes

Table of Contents

Please find below error messages displayed when using NOTOCORD-hem and modules ("message / cause" table),
This list is not exhaustive and will be updated as new error messages or outputs are listed.

BUX10a

Message	Cause	Observations
No Buxco device detected. Please check your hardware setup and your license.	Absence of any Buxco device or of an appropriate license.	All settings are disabled.
The Buxco device is already in acquisition with different sampling frequencies. Click here to apply the same sampling frequencies to this configuration.	The Buxco device is already used by another acquisition server with different sampling frequencies.	The *OK* button applies the sampling rates of the server already in acquisition to the selected acquisition server.
This configuration requires a Buxco device not detected on this computer. Click here to change the configuration.	The serial number of the device in the loaded configuration does not match the number of the device currently connected.	The *OK* button opens the properties window.

ECG31p

- In the presence of a QRS Detection Error marker, the RR interval duration between the two valid QRS complexes before and after the marker will not be computed. In addition, no P: Start and T: End points will be positioned between the second R-peaks preceding and following the QRS Detection Error marker.
- In the presence of an Abnormal Beat marker, the RR interval duration between the current and the preceding R: Peak points will not be computed. In addition, no P: Start and T: End points will be positioned the second R-peaks preceding and following the QRS Detection Error marker.
- In the presence of a T/P Overlap marker on the current R: Peak, no P: Start and T: End points will be positioned between this R: Peak and the preceding one. The QT interval of the preceding beat and PR interval of the current beat will not computed.

ECG51a

Message	Cause
Changes are being made. They will become effective after the next signal analysis.	Reference beats, marks, properties parameters, ECG input or trigger input have changed since the last *Signal analysis*. Output results may not be consistent with the current state of the module.
The number of beats to display is too low to overview the whole signal. The display will be set to 1/1000.	The message appears when clicking on Signal overview if the *N Beats* would imply the parameter *Display 1/n* to be higher than 1000. Then, the parameter n is set at 1000
ECG input frequency must be between 100 Hz and 5000 Hz.	*Identify reference beats*, *Apply marking* or *Analyze signal* were run with an input ECG signal outside of the supported acquisition frequency range.
No data on x input.	Both the ECG and the QRS inputs must be connected, since they are mandatory inputs.
QT duration Min parameter must be lower than QT duration Max parameter.	QT duration parameters in the *Algorithm* tab of the properties window are invalid.
PR duration Min parameter must be lower than PR duration Max parameter.	PR duration parameters in the *Algorithm* tab of the properties window are invalid.
Typical R wave duration parameter must be lower than PR duration Min parameter.	*Typical R wave duration* parameter or *PR duration Min* parameter is invalid.
Duplicated shortcut.	Several marks have similar shortcut in the *Marks* tab of the properties window.
The name of a mark is missing.	Aname must be defined for each mark, in the *Calculated data* tab of the properties window.
The name of a calculated data is missing.	Aname must be defined for each calculated data, in the *Calculated data* tab of the properties window.
Operation field of x output is empty.	The type of operation must be set for each data in the operation field of the *Calculated data* tab in the properties window.
	Each data is defined using two marks and both marks must be

Mark x field of y output is empty.	indicated for each data in the *Calculated data* tab of the properties window.

EEG10a

Message	Cause
Maximum frequency must be greater than minimum frequency for Band Name band.	For one of the activated rhythms, the minimum frequency is above the maximum frequency.
SubBand Name subband frequency must be defined within the frequency range of Band Name band.	For one of the activated sub-rhythms, the minimum or the maximum frequency is out of the defined domain of the corresponding rhythm.

License Management

Message	Cause
License installation from floppy disk is not compatible with the existing license on your computer.	Clicking on *Install* with floppy disk as a source but tokens from a .lic file (electronic license) are also activated on this computer.
License installation from file is not compatible with the existing license on your computer.	Clicking on *Install* with .lic file as a source but floppy disk tokens are also activated on this computer.
Uninstallation failed. Please contact Notocord support.	Uninstalling key could not be achieved when clicking on *Uninstall*.
Invalid activation key. Please enter it again.	Clicking on *Activate* but the key is invalid.
An activation key could not be generated for this license. Please contact Notocord support.	Clicking on *Get key via Internet* but a key cannot be generated by NOTOCORD Web Service (license already activated or non-existent license number).
An error has occurred during the connection to Notocord server. Please try again later.	Clicking on *Get key via Internet* but the NOTOCORD Web Service connection fails.
The uninstall information could not be sent to your Notocord Sales Representative. Please contact Notocord support and send the uninstall information.	Sending uninstall information but the uninstall key is not validated by Notocord Web Service (non-existent license, wrong key number).
The same license number is already installed on this computer.	Clicking on *Install* but a license with the same number is already installed on the computer.
The selected file is not compatible with license installation from file.	Selecting a token file from a floppy disk during an electronic license installation.
The selected license is invalid.	Selecting a token file with an invalid license (not expired).
The selected license has expired since %s.	Selecting a token file with an expired license.

MPI10a

Error management: messages are generated in Matlab in order to alert the user of unexpected conditions detected when running a function. The syntax of the messages is compliant with standard Matlab error messages syntax for functions.

Message	Cause
MPI10a license not found.	MPI10a token is not present or activated.
GLP file modification not allowed.	Attempt to write in a GLP file.
"filename" file not found.	The specified NOTOCORD-hem filename does not exist.
Unable to open file "filename".	NsGetDataInfo, NsGetData: source filename does not exist . NsSetData: destination filename is open and needs to be close in order to write data in it.
No "Modulename.streamname" stream in "filename" file.	The name of the specified data stream is not correct.
Stream type not accepted.	The stream type specified in input is not supported.
NOTOCORD-hem stream overwriting not allowed.	It is not possible to add or overwrite data streams belonging to NOTOCORD-hem native modules.
Stream type change not allowed.	Stream type cannot be modified.
Invalid number of input arguments.	Not enough or too many input arguments.
Invalid number of output arguments.	Not enough or too many output arguments.
Invalid input parameter: …	One of the input arguments does not have the correct type. A message identifying the cause follows.
Internal error.	Not related to any of the above or to any Matlab errors. An entry in the Notocord log file is generated.

PVL10I

Message	Cause
Please check that pressure and volume input signals are properly connected.	One of the mandatory inputs is not connected.
Analysis zone X is not included in a single acquisition period.	Zone X is not entirely included in a single acquisition period.
Pressure and Volume input signals are not sampled at the same rate in zone X.	Pressure and volume signals do not have the same sampling rate on Zone X.

Analysis zone X must include a full cycle. You may recalculate the module and then check that the analysis zones are properly defined.	Zone X does not have a minimum of two end-diastole data points.
Overlapping of analysis zones is not allowed.	At least two analysis zones are overlapping.
Analysis zone X must not contain more than Y samples.	Analysis zone contains too many samples.
Sampling rate must be within 500 Hz to 10 kHz.	Inappropriate sampling rate.
The zone defined for parallel conductance volume computation must include at least two complete cycles. You may recalculate the module and then check that the zone is properly defined and validated.	Two complete cycles are mandatory for calculating parallel conductance volume.
Error writing file X. Check your rights on this folder and available disk space.	User does not have sufficient permission on the destination folder or disk space available is not sufficient.
Error reading file X. Check your rights on this file.	User does not have sufficient permission on the source folder.

PVL10s

Message	Cause
Please check that pressure and volume input signals are properly connected.	One of the mandatory inputs is not connected. Appears when accepting zones definition.
Analysis zone X is not included in a single acquisition period.	Zone X is not entirely included in a single acquisition period. Appears when accepting zones definition.
Pressure and Volume input signals are not sampled at the same rate in zone X.	Pressure and volume signals do not have the same sampling rate on the Zone X. Appears when accepting zones definition.
Analysis zone X must include a full cycle. You may recalculate the module and then check that the analysis zones are properly defined.	Cycle definition is based on end diastole detection. Zone X does not have a minimum of two end diastole data points necessary to proceed with the loop analysis. Appears when accepting zones definition.
Overlapping of analysis zones is not allowed.	At least two analysis zones are overlapping. Appears when accepting zones definition.
Analysis zone X must not contain more than Y samples.	Analysis zone contains too many samples. Appears when accepting zones definition.
Sampling rate must be within 500 Hz to 10 kHz.	Inappropriate sampling rate. Appears when accepting zones definition.
The zone defined for parallel conductance volume computation must include at least two complete cycles. You may recalculate the module and then check that the zone is properly defined and validated.	Parallel conductance volume computation is uses the linear regression fitting the Ved-Ves or Vmin-Vmax relationship. Two complete cycles are therefore necessary to obtain the linear regression.
Error writing file X. Check your rights on this folder and available disk space.	User does not have sufficient permission on the destination folder or there is not enough disk space available. Appears when saving the current analysis zone as a control one (.pvl).
Error reading file X. Check your rights on this file.	User does not have sufficient permission on the source folder. Appears when loading a control file (.pvl) in the .nss file.

QRS10a

Error codes for Abnormal detections output.

Error code #	Exclusion origin
0	Events excluded by algorithm.
1	*QRS amplitude Low threshold* has not been reached.
2	*QRS amplitude High threshold* has been crossed.
3	*Signal-to-Noise Ratio Low threshold* has not been reached.
4	*Signal-to-Noise Ratio High threshold* has been crossed.

TMS31a

Message	Cause
Cannot launch TMS server! Check acquisition hardware and software setup.	When inserting the module in the configuration window with no TMS device currently connected.
The offset must be within … - … (mV).	Offset exceeds limit values defined by the signal type and range.

VIV10a

Message	Cause
This configuration requires the <LifeShirt name> LifeShirt that is not available.	LifeShirt device defined in the configuration of the module is not available. *Calibrate* and *OK* buttons are grayed. This message disappears when an available device is selected in the combo box.
No LifeShirt defined on this computer.	No LifeShirt device has been configured on this machine.
Unable to perform. Calibration of another LifeShirt is in progress.	Another calibration is in progress and has to be completed before the launch of the calibration process for another Lifeshirt.
	For the selected LifeShirt, the configuration of the channel in the

LifeShirt is in acquisition with a different calibration. Click here to get the calibration from the acquisition.	current NOTOCORD-hem session is different from the configuration of the same channel currently in acquisition in another NOTOCORD-hem session.

VME10v

Message	Cause
The reference marker was not found.	The number of the marker does not exist.
The Markers input not connected.	The *Event Marker* signal is not connected in input.
The beginning of the zone does not belong to an acquisition period.	Reference time (or position of marker) and Offset are outside or not in the same acquisition period. The zone must belong to the same acquisition period.
The beginning and the end of the zone do not belong to the same acquisition period.	Reference time (or position of marker), Offset and computed end time are outside or not in the same acquisition period. The zone must belong to the same acquisition period.
Not enough R peaks detected to define zone.	The number of R peaks between the boundaries of the zone is not greater than the number of beats requested + 2.
Zone duration not defined.	The duration of the requested zone is 0 or the start time is equal to end time.
No input signal detected (Input not connected or no acquisition period).	No signal is connected to the first input of the module or no acquisition has yet been made.
The zone is invalidated.	The position or duration of a validated zone has been modified.

VSH10a/b

Message	Cause
No VSH card detected. Check license and hardware setup.	No video card or appropriate license is detected. All settings are disabled.
This channel is being recorded with different settings. Click here to apply recording settings.	This channel is being recorded with different settings. Click here to apply recording settings.
VSH08a card and VSH10b license are required for this configuration.	The number of channels exceeds the license permission (only for VSH10a). The *OK* button is disabled.

XYD30a

Message	Cause
Writing to file F failed. Check your rights and available disk space on this folder.	User does not have sufficient permission on the destination folder or there is not enough disk space available. Appears when saving the current analysis zone as a control one (.xyd).
Reading file F failed. Check your rights on this file.	User does not have sufficient permission on the source folder. Appears when loading a control file (.xyd) in the .nss file.

Next module

Shortcuts in NOTOCORD-hem

List of shortcuts

Table of Contents

Main window

Shortcut	Action
Ctrl + Space bar	Switches from Main window to Configuration Setup window (and vice-versa)
Ctrl + A	Starts / Stops acquisition
Ctrl + R	Recalculates
Alt + F	Opens File menu
Alt + E	Opens Edit menu
Alt + A	Opens Acquisition menu
Alt + T	Opens Tools menu
Alt + W	Opens Windows menu
Alt + H	Opens Help menu
Ctrl + N	Creates new file
Ctrl + O	Opens file browser
Ctrl + P	Prints
Esc	Closes window (e.g. Properties window, Recalculate window, etc.)
Alt + F4	Closes NOTOCORD-hem

Configuration Setup window

Shortcut	Action
Del	Deletes selected module(s)

CTD60a/v

Shortcut	Action
Ctrl + S	Activates Scrolling function
Ctrl + F on graph	Displays the selected graph on full screen / Tiles graphs in the selected display
Ctrl + drag & drop on graph	Horizontal zoom-in
Shift + drag & drop on graph	Vertical zoom-in
Ctrl + Shift + drag & drop on graph	Zoom-in on a selected signal region
Ctrl + drag & drop on X-axis	Expands / Compress X-axis
Ctrl + Right arrow	Expands X-axis
Ctrl + Left arrow	Compresses X-axis
Ctrl + Up arrow	Expands Y-axis
Ctrl + Down arrow	Compresses Y-axis
Ctrl + X on graph	Changes X-axis scale to show whole signal
Ctrl + X on graph	Changes Y-axis scale to show whole signal
Right arrow	Navigates forward on X-axis
Left arrow	Navigates backwards on X-axis
Up arrow on graph / Y-axis	Navigates upward on Y-axis
Down arrow on graph / Y-axis	Navigates downward on Y-axis
Shift + Right arrow or Left arrow	Navigates on X-axis by as much as the scale range defined in the *Graph properties* window
Shift + Up arrow or Down arrow on graph / Y-axis	Navigates on Y-axis by as much as the scale range defined in the *Graph properties* window
Shift + F3	Adjusts graphs to window display size
Shift + F4	Tiles displays horizontally
Shift + F5	Tiles displays vertically

ECG51a

Shortcut	Action
Ctrl + click on beat	Selects beat of interest on graph
Ctrl + double-click on beat	Selects beat of interest and brings it to front
P	Inserts P: Start mark at cursor position
Q	Inserts QRS: Start mark at cursor position
R	Inserts R: Peak mark at cursor position
S	Inserts QRS: End mark at cursor position
T	Inserts T: End mark at cursor position
Ctrl + M	Applies marking to active reference beat (from all marked reference beats)
Ctrl + click on *Apply marking* button	Activates Marking mode. Marks are applied to reference beats as they become active
Ctrl + Z	General undo for mark editing and X/Y zoom
Ctrl + Del	Deletes all marks on all reference beats
Right arrow	Goes *N* beats forward (*N*= number of beats displayed in 3D View of 2D/3D chart)
Left arrow	Goes *N* beats backwards (*N*= number of beats displayed in 3D View of 2D/3D chart)
Up arrow	Goes to previous reference beat
Down arrow	Goes to next reference beat
Page up	Goes *n* x *N* beats forward (*n*= value of "display 1/n" parameter and *N*= number of beats displayed in 3D View of 2D/3D chart)
Page down	Goes *n* x *N* beats backwards (*n*= value of "display 1/n" parameter and *N*= number of beats displayed in 3D View of 2D/3D chart)
Begin	Goes to first QRS trigger of the signal
End	Goes to last QRS trigger of the signal
+	3D zoom-in centered on cursor position
-	3D zoom-out centered on cursor position

KBD30a

Shortcut	Action
F1 to F8	Inserts marker on related marker channel
F9	Inserts non-specific marker
Ctrl + M	Navigate from one marker to the next one belonging to the same marker channel
Ctrl + Shift + M	Navigate from one marker to the previous one belonging to the same marker channel

VME10e/v

Shortcut	Action
P	Inserts P: Start mark at cursor position
Q	Inserts QRS: Start mark at cursor position
R	Inserts R: Peak mark at cursor position
S	Inserts QRS: End mark at cursor position
T	Inserts T: End mark at cursor position

Old user manuals

User manuals related to older NOTOCORD-hem versions are available below:
- 3.5 (2003) version
- 4.2 (2007) version

3.5 (2003) version

User manual of the NOTOCORD-hem 3.5 version (2003)

4.2 (2007) version

4.2 (2007) version