Caddy

MegaBACE cathode automation

User Manual

Part Number: D2K2 0416 01
(version 1.8)

WATREX®

Watrex Praha, Ltd.
www.megabace.net

List of Contents

1. Preface

1.1 About this manual

The *Caddy User's Manual* describes how to use Caddy 1000 cathode automation instrument to automatically run multiple runs on MegaBACE 1000 DNA analysis System. First part of this booklet (Introduction to Caddy system and Safety precautions) includes introductory and safety information about the Caddy system. Second part (Operating Caddy Instrument and Troubleshooting and maintenance) describes how to use the instrument and gives guidance to solving potential problems.

1.2 Assumptions

TRAINED OPERATOR
The operator of Caddy 1000 instrument is assumed to be trained in the correct operation of the instrument and the safety issues. Throughout the Caddy instrument documentation the word "you" refers to the trained operator. Please, read and understand thoroughly all directions and procedures described in the following text before operating the instrument.

GENERAL SKILLS
The general software related instructions in this manual assume that you have basic computer skills. You should be familiar with Microsoft Windows graphical user interface, you should know how to use a mouse.

MEGABACE SKILLS
The MegaBACE specific instructions in this manual assume that you are familiar with the functionality of Instrument Control Manager (ICM) software. For all inquiries relating to the use of MegaBACE DNA analyzer refer to MegaBACE documentation.

1.3 Signs used in the text

WARNING
This icon indicates a possibility of injury or death to the user or other persons if the precautions or instructions are not observed.

CAUTION
This icon indicates that damage to the instrument, loss of data or invalid data might occur if the user fails to comply with the advice given.

IMPORTANT
This icon highlights information that is critical for optimal performance of the system

1.5 Before you begin

Before using the Caddy 100 cathode automation system, familiarize yourself with:

- Chapter 5: Introduction to Caddy 1000 system
- Chapter 6: Operating Caddy 1000 Instrument
- Chapter 7: Maintenance and Troubleshooting

2. Identification of your Caddy system

Your Caddy 1000 system is can be identified from its part and serial numbers located on the serial and version number label. Please, specify these two numbers whenever contacting technical support.

2.1 Serial and version number label

You can find the serial and version number of your Caddy 1000 instrument on the manufacturer's label. The label is located on the side of the plate hotel and is easily accessible after opening the plate hotel. Figure 5 shows the serial and version number label.

Figure 5: Serial and version manufacturer's label of Caddy 1000 system.

2.2 Manufacturer contact

Watrex Praha s.r.o.
Hostalkova 42
Prague 6
CZ – 169 00 Czech Republic
Phone: +420-2-20513446
Fax: +420-2-20513448
http://www.megabace.net
e-mail: info@megabace.net

2.3 Certifications

Declaration of conformity

Manufacturer´s name:

WATREX Praha, s.r.o.

Manufacturer´s address:

Hošťálkova 42
169 00 Praha 6
Czech Republic

declares in sole responsibility that the product P/N: D2K2 041001

Caddy 1000 - MegaBACE cathode automation

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is in conformity with the following EC directives:

Low voltage directive (72/73/EWG)
Engineering directive (98/37/EC)
EMC directive (89/336/EWG)

Following safety requirements and regulations were applied for evaluation:

CSN EN 292
CSN EN 60204-1
CSN EN 61010-1
CSN EN 50081-1
CSN EN 50082-1

Prague, 3rd May 2002

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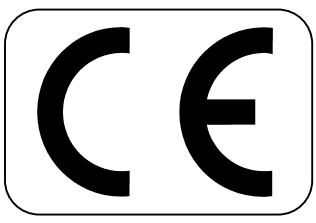
Milan Minarik, PhD. (Managing Director)

The following conformity sign is attached to the body of every instrument:



2.4 Optional extensions

Watrex Praha is currently offering anode automation as an extension upgrade to Caddy 1000 (cathode automation). The resulting Caddy 1000 Plus representing a complete MegaBACE automation is capable of handling different types of tubes including LPA matrix tubes, buffer tubes and water tubes on the anode compartment. For more information regarding Caddy 1000 Plus, contact Watrex Praha (see Chapter 2.2 Manufacturer contact).

3. Caddy 1000 specifications

3.1 Applications

Caddy 1000 is designed to operate cathode compartment of MegaBACE 100 genetic analyzer. It's main application is in automated loading of sample and buffer plates as well as buffer and water tanks during a series of up to 6 runs in Sequencing, Genotyping or SNP Genotyping MegaBACE configurations.

3.2 Manuals (related resources)

In addition to the *Caddy User's Manual*, Watrex Praha provides the following publications for Caddy 1000 systems:

- MacroEditor user's manual: Provides useful guidance on how to setup sample definitions for MegaBACE Instrument Control Manager

- Caddy Control Center quick navigation guide: Provides quick reference on how to use Caddy Control Center (CCC) software.

3.3 Dimensions and weight

Caddy 1000 dimensions are 46 cm (width) x 32 cm (length) x 90 cm (height)

Caddy 1000 weight is 68 kg (150 lbs)

3.4 Voltage requirement and power consumption

Caddy 1000 requires stable power to work properly. It is recommended to use an uninterruptible power supply (UPS) to protect instruments electronics in the event of power failure. Unprotected power outage can cause damage to the instrument.

Caddy 1000 voltage requirement is 115/230 V/50-60 Hz
Caddy 1000 power consumption is 160 VA (VoltAmperes).

3.5 Safety

Before using the Caddy 100 cathode automation system, familiarize yourself with safety precautions described in detail in Chapter 8: Safety Information

4. Unpacking and installation information

Only Watrex Praha personnel or a specialist with installation training certification issued by Watrex Praha is allowed to unpack the package with Caddy 1000 system and to perform the installation. Watrex Praha will assume no responsibility or liability for injury or death caused by unpacking or installation by unauthorized person(s).

5. Introduction to Caddy system

5.1 System hardware components

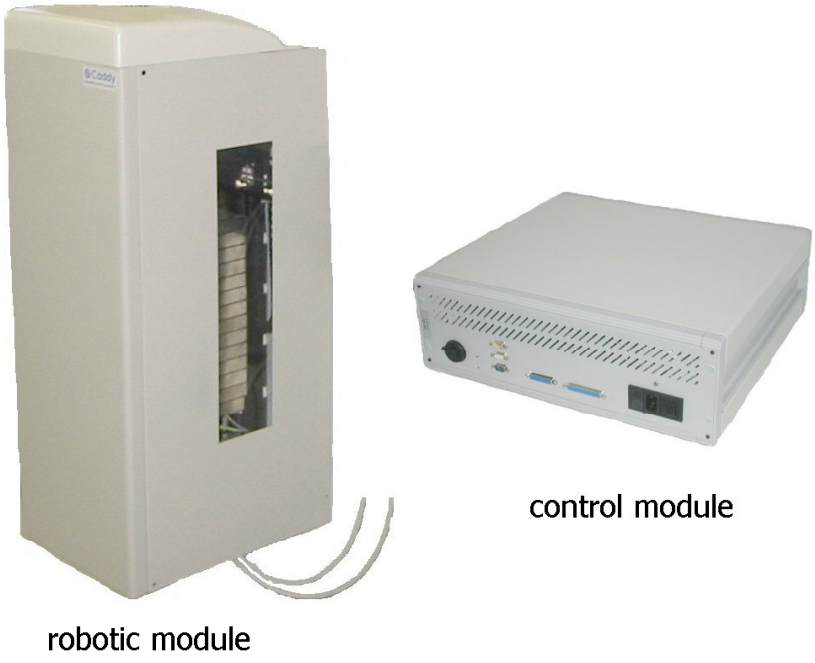


Figure 1: Robotic and control modules of Caddy 1000 system

Caddy 1000 cathode automation systems consists of the following main components:

- Robotic module (referred to as the robot)
  The main mechanical part of the system positioned in front of the MegaBACE instrument and fixed to the MegaBACE table. It is further consisting of:

  - Elevator with gripper
    - unit moving the containers between the plate hotel drawers and the MegaBACE
  - Climber with liftboy
    - robotic part that opens and closes the plate hotel drawers
  - Slider tractor with hook
    - device that pulls out the cathode slider with the tray
  - Plate hotel
    - unit storing multiple containers (plates or tanks)

- Control module (referred to as the electronics box)
  The module including PC boards and circuits with following functions:
  - enabling communication between the robot and the PC computer
  - sending commands to move the stepper motors
  - receiving status signals and error commands from sensors

5.2 Caddy terminology

Table 1: Individual components shown in Figure 2.

Front, right, left panel	Sheet metal skins protecting the user from moving parts inside the instrument
Top cover	Removable upper plastic skin. It can only be removed when the instrument is disconnected from power to recover from a hardware collision situation
Frame	Basic body structure of the instrument
Elevator	Device that transports the gripper up and down
Gripper	Claws grabbing and holding the container during the transfer.
Climber	Device positioning liftboy at the slot.
Liftboy	Slot opening device.
Slider tractor with hook	Device opening (pulling out) the cathode slider
Plate hotel	Storage cabinet for 18 sample and/or buffer plates and a single water or buffer tank.

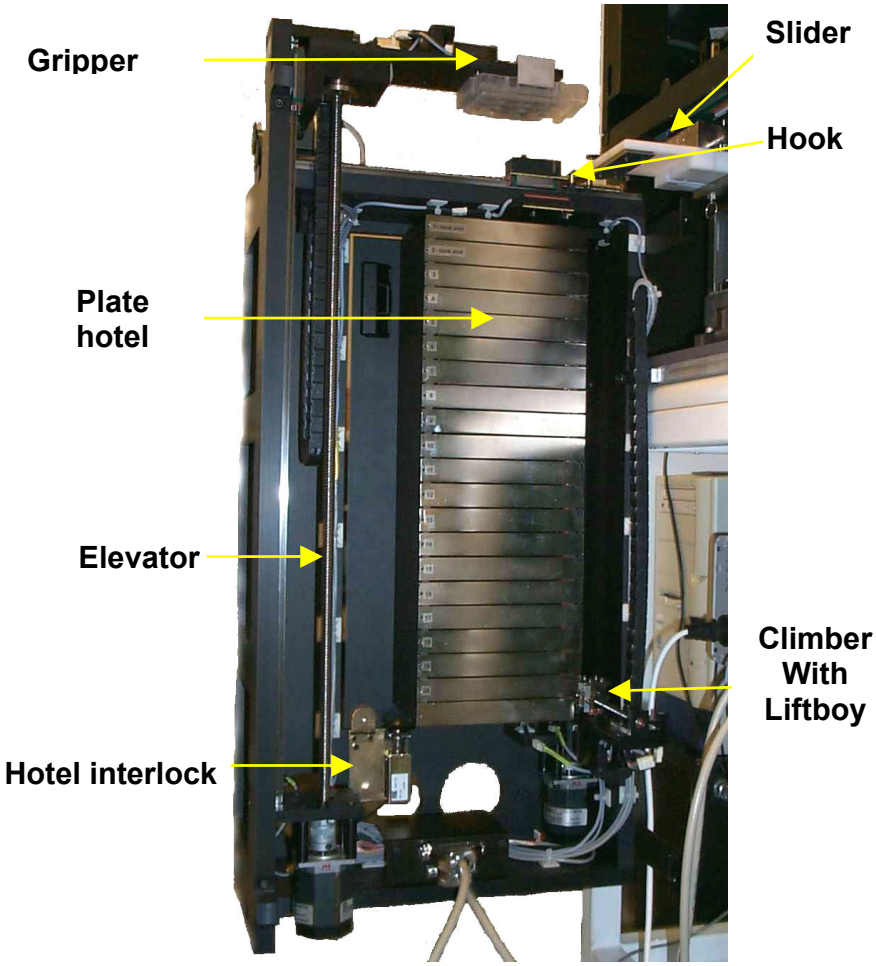


Figure 2: Individual components of Caddy 1000 robotic module

5.3 System functions

Caddy 1000 cathode automation instrument is designed to:

- Store sample plates, buffer plates, water tank or buffer tank prior to their transfer to the MegaBACE DNA analyzer
- Communicate with MegaBACE controlling software (ICM) to synchronize operations with MegaBACE workflows
- Transfer predefined containers according to the currently running MegaBACE protocol
- Detect and report any errors resulting from incorrect container selection (for example an exchange of plate and tank)

5.4 Overview of instrument operations

Main steps when running a series:

A. User loads sample and buffer plates into the plate hotel according to the slot filling scheme generated by Cathode Automation Wizard software (CAW).
B. Using Direct Control Mode (described in section 4.5), user loads water tank (in Sequencing and Genotyping application) or buffer tank (in SNP Genotyping application) into the MegaBACE tray
C. User starts predefined automation series using [Automation Start] protocol from Instrument Control Manager (ICM)
D. As a first step in each series, robot removes the water or buffer tank from the MegaBACE tray and transfer it into the slot No. 1
E. After removing the tank, robot executes transfers of individual containers according to the instructions received from ICM as required by the currently running protocol
F. At the end of the series, robot returns the tank back to the MegaBACE cathode tray and (if selected during the series definition) lowers the MegaBACE temperature (sleep mode)

Detailed description of sub-steps of each plate or tank transfer:

A. Cathode slider is lowered and locks into the hook.
B. Slider is pulled out by the slider tractor, exposing the tray with the container to be removed.
C. Climber is positioned at an empty slot, the liftboy opens the empty slot.
D. Gripper takes the container from the tray and returns to its home upper position.
E. Slider is positioned in a parking position (pushed half way into the MegaBACE) to allow gripper to pass on its way down to the slot.
F. Gripper is lowered, places the container onto the empty slot and then returns back to the home upper position.
G. Liftboy closes the slot with the old container, shifts to the next slot position and opens the slot with a new container.
H. Gripper is lowered to take the new container and then raised back to the home upper position.
I. Slider is pulled from the parking position to the fully open position (home position).
J. Gripper places the new container into the tray
K. Slider is placed back into the MegaBACE.
L. MegaBACE cathode is raised, releasing itself from the hook.

6. Operating Caddy Instrument

The Caddy 1000, cathode automation instrument requires specific startup procedures to prepare the instrument for operation. Chapter 4.1. describes the procedures you use to start the instrument for first-time operation and after shutdown for service, repair or storage. Chapters 4.2. and 4.3. describe procedures for typical operation of the system.

Chapter 4.4. provides aborting and shut down procedures. Chapter 4.5. contains information about Direct Control mode used for MegaBACE service and maintenance protocols such as Focus Capillaries, Flush and Dry Capillaries etc.

6.1 Power up and initialization

In general, you leave the instrument power permanently on unless the instrument is being serviced or stored for a longer period of time. Before starting the hardware, make sure the power cord and the emergency foot switch cord are properly installed. Also, make sure the communications cables between the control module and the PC are properly connected.

6.1.1 Starting hardware

Always turn on the instrument and computer in the following order: Turn on the PC computer first, boot the Windows system, then turn on the main switch on Caddy control module. The light tower should turn red after turning on the control module. Wait at least one minute after turning on the hardware, then start the software.

6.1.2 Starting Caddy Control Center software (CCC)

Start Caddy Control Center software (usually installed as caddy.exe executable file in ..\Program Files\Watrex\Caddy folder. CCC is running as a background application showing only a small yellow triangle icon in the bottom right corner. By right-click on the yellow CCC icon, the main menu is opened as shown in Figure 6.

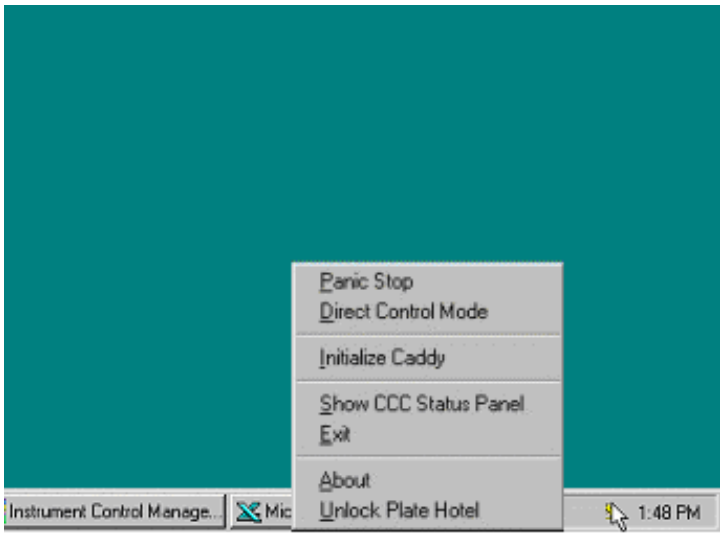


Figure 6: Accessing the Caddy Control Center main window by right-clicking on the tray icon.

6.1.3 Initialization

It is important that the control module first establishes a communication and then all sensors of the systems are tested and all movements are calibrated. After starting CCC software, an initialization process will be automatically started.

If necessary, you can abort the initialization process using the Panic abort function from the CCC right-click menu. For more information about aborting instrument operation see Chapter 6.5.

Upon initialization, control module will establish a communication connection with the robotic module, then the robotic module will sequentially calibrate all moving axes and motors.

The calibration procedure is essential for proper instrument operation. Do not perform any MegaBACE operations during the Caddy initialization procedure

A manual initialization can be performed at anytime by activating the “Caddy Initialize” option from CCC right-click menu.

6.1.4 About PC computer clock speed

In some special cases slow PC computer clock speed can cause occurrence of an error message if a manual initialization is activated immediately after start of CCC software. If your computer is slow, wait at least 10 seconds following CCC start before starting the manual initialization.

6.2 Loading sample and buffer plates

To load sample and buffer plates into the hotel, select the “Unlock Plate Hotel” option from the CCC right-click menu. After unlocking, you have 10 seconds to open the plate hotel. If you do not open the hotel during the 10 seconds interval, the plate hotel will be locked again. After opening the plate hotel, manually slide out individual slots to load the plates. Each plate slot (slots 3 through 20) is equipped with a positioning pin to prevent incorrect plate orientation in the MegaBACE tray. The plate positioning pin is shown in Figure 7.

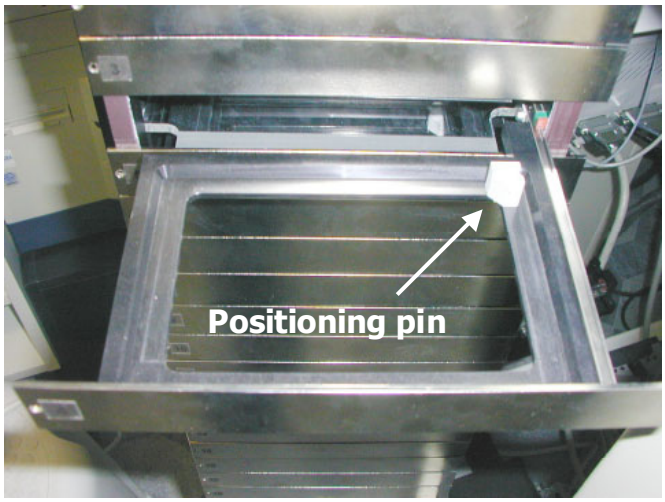


Figure 7: Plate slot with the positioning pin.

6.3 Loading water or buffer tank

Water tank is used during standard Sequencing and Genotyping workflows. With Caddy instrument, only a single buffer tank is used during SNP Genotyping workflow. Water or buffer tank must be only placed in slot No. 1. In order to refill tank with new water, replace water tank by buffer tank etc. you have to use Direct Control mode described in Chapter 6.6

Do not try to overcome the plate hotel interlock or to gain access to the plate hotel through any other opening. Reaching into the instrument from the plate hotel side during the instrument operation can cause a serious injury. Opening of the plate hotel during normal instrument operation can cause a serious damage to the instrument.

6.4 Running a series

Caddy 1000 cathode automation instrument is designed to allow for unattended execution of multiple runs by sequentially loading containers (plates and tank) into the MegaBACE tray. The unattended series can consist of multiple runs using either single-injection workflows for Sequencing and Genotyping applications or multiple-injection workflows for SNP Genotyping application.

6.4.1 Series definition

Each series to be executed by Caddy system must first be predefined using Cathode Automation Wizard software (CAW). The definition includes detailed specification of individual sample plates (sample names, marker names etc.), their positions in the plate hotel and the running contitions (injection voltage and time, running voltage and time etc.). CAW software is using standard MegaBACE principles that are used in MegaBACE Instrument Control Manager (ICM) software. Therefore it is user friendly and intuitive for every MegaBACE user. In order to find out more about CAW, check the *Cathode Automation Wizard software user's manual*.

6.4.2 Starting a selected series

After completing the series definition in CAW software, open Instrument Control Manager and make sure a correct application is selected from the drop down list according to the following:

- AUTO_Sequencing for Sequencing series
- AUTO_Genotyping for Genotyping series
- AUTO_SNP Genotyping for SNP Genotyping series

Choosing an incorrect application will later result in errors due to incorrect container type placed into the cathode tank. The series will not run properly.

When in a correct application mode, run the [Automation Start] protocol. When the [Automation Start] protocol starts you will shortly see the light tower switching from yellow (idle) to green (series in progress).

Starting protocols other than [Automation Start] will cause inconsistencies in Caddy and MegaBACE workflows resulting in ICM timeout errors. Series will not run properly.

6.4.3 Monitoring the run

Caddy 1000 instrument is equipped with signal tower that allows to monitor current status of the robot. The status signals can be following:

- RED: Caddy not initialized or Caddy error
- Yellow: Caddy initialized, Cady idle (waiting for a series start)
- Green: Series started, Caddy communicating with MegaBACE
- Blinking Green: Robot currently executing plate transfer (in motion)

All robotic movements are recorder in a logfile. When you contact service assistance, you should always include a copy of the logfiles with your error report.

6.5 Aborting instrument's operation

There are three ways to interrupt running series. Depending on the situation, you can choose either "Panic Stop" or "Emergency stop" using the emergency foot switch.

Panic Stop can be accessed from the CCC right-click menu. It is designed to be used in situations where the series can not be completed in its current form, but where there is no immediate danger of mechanical collision. A typical situation is operator's mistake such as incorrect sample assignment etc. Upon activation of "Panic Stop" the currently executed transfer will be completed and then the series will abort.

Emergency Stop is done by engaging the Emergency foot switch. It is designed to interrupt power to all motors and to instantly stop all robotic movements. The Emergency Stop should be used only in collision situation or in situation with immediate danger of collision. If you use the Emergency Stop, never turn it back on without shutting down the CCC software. You can either close the software manually or simply wait for 1 minute and it will be shut down automatically.

Turning the robotic module back on immediately (in less than 1 minute interval) after Emergency Stop was used can cause significant damage to the instrument.

After the series abort you will separately have to abort currently running protocol in ICM using the <Stop> button. It is strongly recommended that after using Emergency Stop you shut down the software, turn off power to the robotic module, wait for 5 minuters and then follow the standard Caddy startup procedure described in Chapter 6.1.

Aborting a running series though either of the above options is irreversible and has to be followed by manual Caddy initialization (see Chapter 6.1). In execute the desired runs, the series must be first refreshed in the CAW software and then started again from the beginning. The refreshing in CAW software is simply done by recalling the lastseries.caw configuration from the "Load series" option. For more details regarding series definitions, refer to the *Cathode Automation Wizard software user's manual.*

6.6 Direct Control Mode (DCM)

Caddy 1000 instrument is designed to sequentially load plates and tank into the MegaBACE 1000 DNA analyzer according to the predefined series. During a series, the timing of the plates and tank transfers is received through communication with MegaBACE control software (ICM) and repeating [Matrix Fill and Prerun] and [Inject Samples and Run] protocols.

6.6.1 About DCM

Direct Control Mode (DCM) is designed to give the user ability to load individual plates and tank into the MegaBACE tray in a semi-manual mode i.e. without a need to run predefined series. This is very useful especially when performing maintenance MegaBACE protocols such as [Rinse Tips], [Flush and Dry Capilleries], [Focus Capillaries] etc. DCM's functions are accessible from CCC right-click menu.

DCM has all necessary functionality to lower and raise cathode before loading plate or tank. Do not use MegaBACE Instrument Control Studio (ICS) to manipulate cathode during DCM's operation. Lowering or raising cathode during DCM's operation can cause collision resulting in a significant damage to the instrument.

6.6.2. Main DCM window

Selecting "DCM" option from CCC right-click menu will open a main DCM window called DCM terminal (see Figure 8). The terminal includes three buttons:

Figure 8: Main windows of the Direct Control mode (DCM) terminal

Refill Tank:
This option is used to reload the MegaBACE tray with any container type. It can be used for example to refill water tank with fresh water after an overnight sleep. It can also be used to replace tank or plate that is currently inside the MegaBACE with any

new type – tank of plate. You have to keep slot No. 1 in the plate hotel empty. The current container will first be transferred from the MegaBACE into slot No. 1, then the plate hotel will be unlocked and you will be prompted to replace it with a new container (tank or plate). After that you hit the <continue> and the tank in slot No. 1 will be returned back into the MegaBACE.

Open ⇐> Close:
This option is used just to activate MegaBACE cathode door sensor. It is useful in case when the *Refill Tank* option was used to replace a container and the operation did not finish in a time limit. For example, during [Rinse tips] protocol the user is asked to enter a new water tank. If the user does not replace the tank within a given time period (usually between 120 and 240 seconds) a Timeout error message will be displayed by ICM. In order to prevent a need of repeating the entire transfer, it is possible to click <Retry> option from the ICM error message and then just to activate the cathode door sensor using the *Open ⇐> Close* function.

In DCM mode the system will always check availability of an empty slot in the plate hotel before transferring the container. If the slot is not empty, the program will abort all operations and shut down the Caddy Control Center. You will then have to reinitialize.

If you are replacing current container with a new container using the *Refill Tank* option, you have 3 minutes to replace the old container in the plate hotel slot with the new one and to close the plate hotel. If the container is not replaced during this 3 minute interval, the system will report and error, the signal tower with switch to a red light and the software will be shut down.

It is recommended that you always close the DCM terminal after the transfer has ended. If you leave the terminal open, you run into a risk of software conflict with the MegaBACE Instrument Control Manager (ICM).

7. Troubleshooting and maintenance

Caddy 1000 instrument is equipped with numerous sensors and self-monitoring features to uncover any potential errors or collision states. There are two main error modes for the MegaBACE working with Caddy automation related to either of the system components:

7.1 Mechanical errors of the robotic unit (collision)

The most common cause of mechanical collision is
- repowering Caddy after a previous collision without closing the CCC software
- manual lowering of the cathode during Caddy initialization

- manual lowering of the cathode during robotic movement

Recovery method:
In all these cases, 30 seconds (crash timeout) after the crash all power to the motors will be automatically disconnected and the CCC software will be shut down. If the crash is discovered before the crash timeout, emergancy stop button can be used to stop all motors. After that the software MUST be closed. The emergency button can be switched on only after waiting for at least 5 minutes.

7.2 Caddy Control Center (CCC) software errors

These errors are very rare and should be reported as soon as possible. Recovery

Recovery method:
Check ICM for the current status of the MegaBACE. If running, let the run come to ist end (data will be preserved). If ICM shows a timeout error, click on <ABORT> in the ICM error message window. Close the CCC software. Turn off Caddy robotic unit. Wait for at least 1 minute. Turn on Caddy robotic unit and start CCC software. If there is a water tank inside the MegaBACE follow the standard procedure for starting a series. If there is a plate inside the MegaBACE follow the procedure for the Direct Control Mode (DCM), put the water tank into the MegaBACE and then turn into standard procedure for starting a series.

7.3 Service of Caddy instrument

To protect your warranty and for proper operation, the instrument must be serviced only by an authorized service representative. If the instrument is not working correctly, contact Watrex Praha support. When you contact Watrex Praha for support, please, supply the following information:

- Caddy serial number
- Caddy Control Center (CCC) software version number
- Cathode Automation Wizard (CAW) version number
- MegaBACE serial number (check MegaBACE documentation for details)
- ICM version and build number (check MegaBACE documentation for details)

8. Safety information

The Caddy 100 cathode automation instrument and its accessories have been designed for safe operation. It is imperative that you follow the precautions in this Chapter.

8.1 General safety precautions

While using Caddy instrument you should follow the laboratory procedures appropriate for the experiments you are performing.

The operator of Caddy 1000 instrument is assumed to be trained in the correct operation of the instrument and the safety issues. Throughout the Caddy instrument documentation the word “you” refers to the trained operator. Please, read and understand thoroughly all directions and procedures described in the following text before operating the instrument.

Using controls making adjustments or performing procedures other than those specified in this user’s manual may result in hazardous exposure to moving parts. Such exposure can cause injury or death

8.2 Moving parts

Under normal operating conditions you are protected from moving parts. The body of the instrument is manufactured from solid stainless steel. The skins will protect you from coming in contact with motors, gears or other moving elements. The plate hotel is equipped with an electromagnetic interlock that will prevent you from opening the hotel during instrument operation. Upon initiation, the emergency foot switch will stop power to all motors, hence, halt all movements.

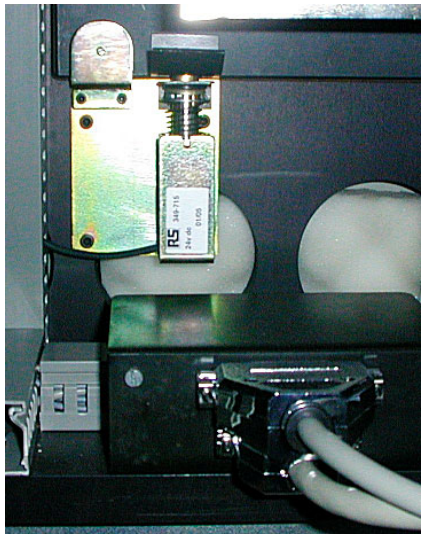


Figure 3: Detail of the plate hotel interlock

Do not remove any panels for any reason. Do not defeat the sensors or interlocks or try to gain access through any other opening.

You can, however, unmount the top cover when the instrument is disconnected from power to gain access to the gripper to recover from a hardware collision situation (see Chapter X for details).

8.3 Electrical connections

Caddy system is powered at 110V or 240 V (depending on local powering system) by a single power cord connected to the control module. In addition the emergency foot switch is connected to the control module. Figure 4 shows connectors of the control module.

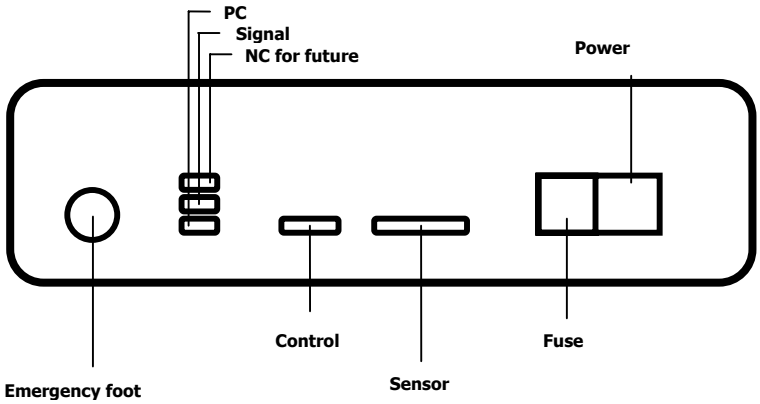


Figure 4: Connections of the Caddy 1000 control module

Use only the cords supplied with the instrument. Make sure cord is in a good condition and is not frayed. Use of incorrect power cord can cause damage to the instrument. Never dismantle the emergency foot switch. Use of frayed or damaged power cord or emergency switch cord can cause injury or death

It is recommended to use an uninterruptible power supply (UPS) to protect instruments electronics in the event of power failure. Unprotected power outage can cause damage to the instrument.

8.4 Chemicals

Use good laboratory procedures and follow the manufacturer's precautions when working with chemicals. Watrex Praha is not responsible or liable for any damages caused by or as a consequence of the use of hazardous chemicals.