

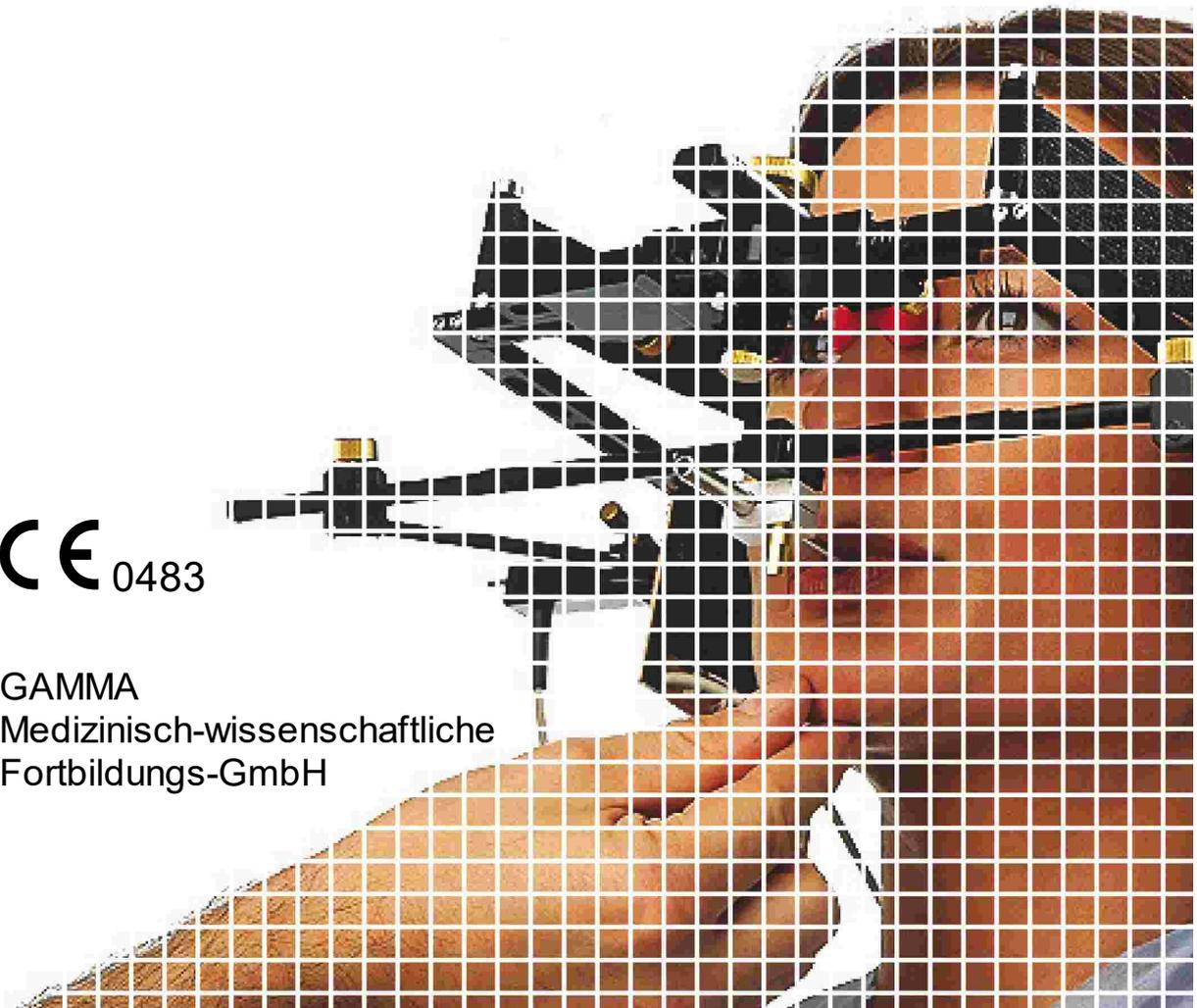
CADIAX compact 2

*A Practical Method for
TMJ Registration*

Operating Instructions 

CE 0483

GAMMA
Medizinisch-wissenschaftliche
Fortbildungs-GmbH



CADIAX compact 2

Operating Instructions

for
CADIAX compact 2, model A
Firmware version 1.14,
CADIAX compact 2, model B
Firmware version 2.13,
CADIAX 4, model A
Firmware version 2.13,
and
CADIAX compact 2 Recorder
version 2.15.0

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1 Introduction

Thank you for showing your confidence in us by purchasing the CADIAX system. You have purchased a top-quality medical device, designed based on more than 25 years of experience in the electronic con-
dylography registration.

In the following pages, we would like to help you get acquainted with the CADIAX device and its soft-
ware.

1.1 Explanation of used symbols on packaging and device

The following symbols are used on the product and/or within the operating instructions:



Attention: See accompanying instructions



Attention: Magnetic field



Follow operating instructions



Phone number



Fax number



E-Mail address



Internet address



Manufacturer



Manufacturing date



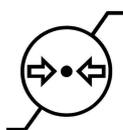
Serial number



Upper and lower limit for temperature



Upper and lower limit for relative humidity



Upper and lower limit for atmospheric pressure



Do not sit on the device



Do not step on the device



Type B applied part



Dispose separately from other waste material



Direct Current (DC)



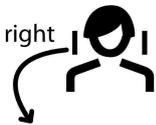
Universal Serial Bus (USB)



Foot switch



or Measuring sensors of the right patient side



or Measuring sensors of the left patient side



1.2 Important safety considerations



For your own safety, as well as for operational safety, please read these instructions thoroughly, before beginning to operate the device. Always comply with any and all warnings included in these instructions, and/or on the device itself.

1.2.1 General safety instructions



The device must be operated in a roomy area, in order to allow for proper dissipation of heat.

Never operate the device in areas where there is a danger of water or other liquids seeping into the device.

The device is powered by the computer it is connected to, through the Universal Serial Bus (USB). Only connect the device directly to a computer's USB terminal. Never operate the device through a USB hub and never use alternative power sources of any kind.

Never set up the system in the proximity of potential fields of electromagnetic interference (loudspeakers, mobile phones, sterilizers, etc.).

Never attempt to repair the device yourself. All repair work must be done by authorized, trained technicians.

In the following cases disconnect the device from the computer and contact a qualified service technician:

- If water or other liquid seeps into the device.
- If the device does not operate properly, although the operating instructions have been followed correctly.
- If the device has fallen down or if the housing is damaged.
- If the device shows noticeable deviation from its normal operation.

Please make sure that the device is set up on a smooth, even surface, which is longer and wider than the device itself.

The surface on which the device stands must be sufficiently stable, as the device could be badly damaged by shaking or falling.

In choosing the working area and/or storage area, make sure that the device is not subject to extreme deviations in temperature or humidity, as well as to direct sunlight and excessive heat.

Make sure that the device is not subjected to vibrations and jolts.

Also make sure that the cable does not pose a hindrance (tripping hazard).

Do not sit on the device since this may cause it to be severely damaged.



Do not step on the device since this may cause it to be severely damaged.



1.2.2 Special information about medical electrical devices

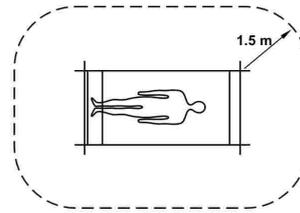
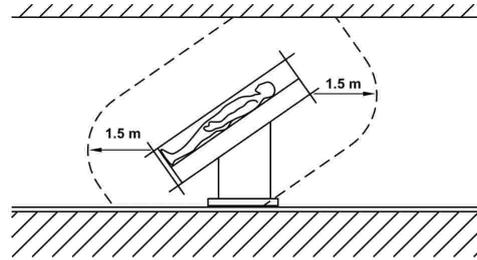
1.2.2.1 Setting up the CADIAX device



If the computer connected with the CADIAX device is in the proximity of the patient, it must have been tested in compliance with standard EN 60601-1.

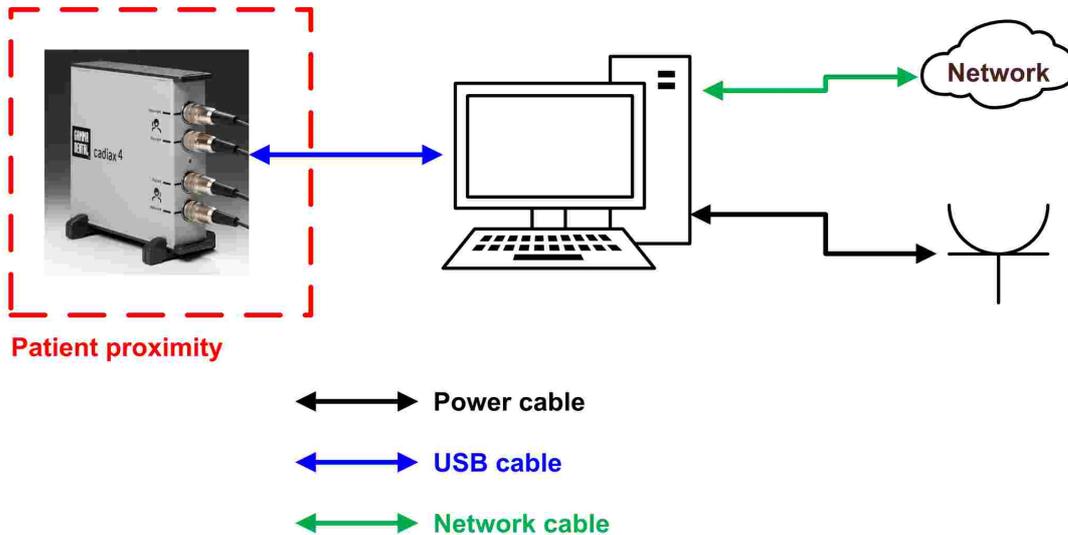
The patient proximity (definition according to standard EN 60601-1) is the area within which the patient could, intentionally or unintentionally, come into contact with:

- either any parts of the medical electrical device/system, or
- with someone using or touching a part of the device/system.

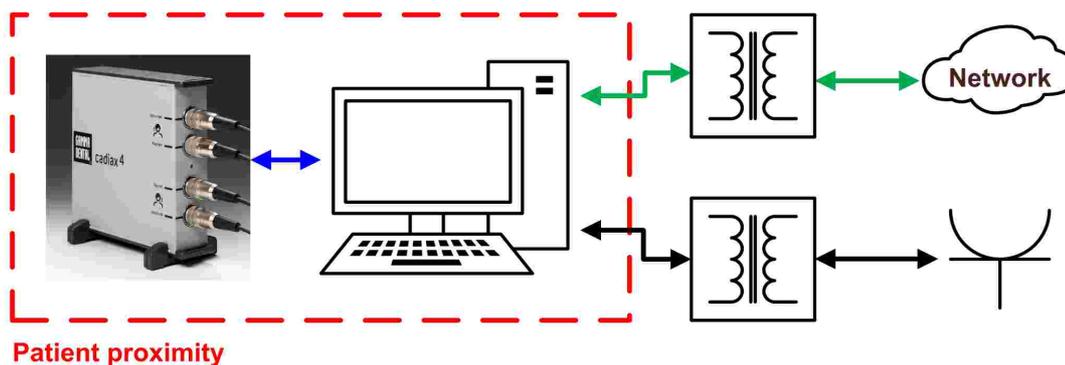


Definition of patient proximity, according to standard EN 60601-1

If the computer connected with the CADIAX device is not built according to standard EN 60601-1, it must be set up outside the proximity of the patient.



If such a computer is set up inside the patient's proximity, it and all devices connected to it (e.g. monitor) have to be isolated according to EN 60601-1. Power sources have to be connected through a medical isolation transformer and tethered network connections through a medical network isolator.



Avoid using the CADIAX device directly next to other devices or stacked on top of other devices, as this could lead to faulty operation. If, however, it is necessary to use the device in the manner stated, the CADIAX device as well as the other devices must be monitored to ensure they are working properly.

1.2.2.2 Operating the CADIAX device



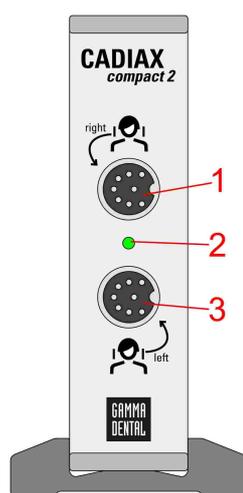
Only switch the device into recording mode after the measuring sensors (flags and styli) are completely mounted.

Make sure that the sensors are not touched during the registration, not by yourself nor by the patient.

Always switch off the recording mode before detaching the flags and styli from the face bow.

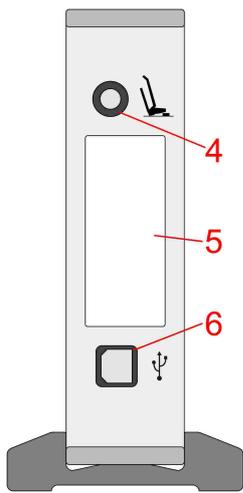
1.2.2.3 Features of the CADIAX compact 2 device enclosure

The enclosure of the CADIAX compact 2 main unit has the following features:



Front side

- 1 Connector socket for the measuring sensors of the right patient side
- 2 LED for indication of the current device status (refer to chapter "Status indication of the CADIAX device" 171)
- 3 Connector socket for the measuring sensors of the left patient side

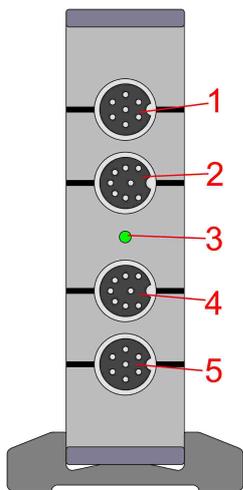


Back side

- 4 Connector socket for the foot switch
- 5 Type label with information regarding the manufacturer and the device
- 6 USB 2.0 (type B) connector socket for the cable connection to the PC

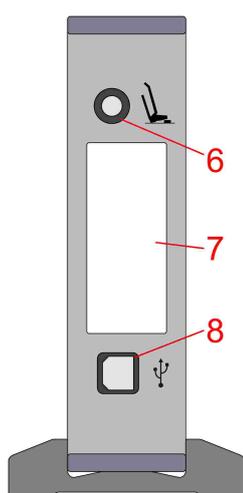
1.2.2.4 Features of the CADIAX 4 device enclosure (compact sensor set)

When using the "compact" sensor set, the enclosure of the CADIAX 4 main unit has the following features:



Front side

- 1 Unused connector socket
- 2 Connector socket for the measuring sensors of the right patient side
- 3 LED for indication of the current device status (refer to chapter "Status indication of the CADIAX device" ¹⁷)
- 4 Connector socket for the measuring sensors of the left patient side
- 5 Unused connector socket

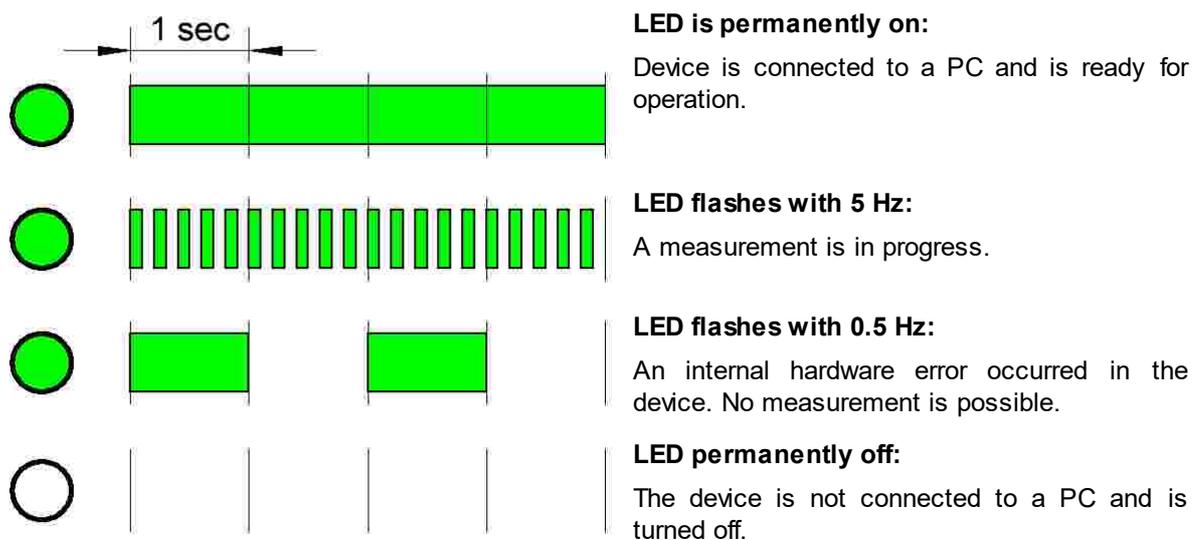


Back side

- 6 Connector socket for the foot switch
- 7 Type label with information regarding the manufacturer and the device
- 8 USB 2.0 (type B) connector socket for the cable connection to the PC

1.2.2.5 Status indication of the CADIAX device

The CADIAX device indicates its operating state via a green LED on the front side of the enclosure. This LED can be in the following conditions:



1.2.2.6 Electromagnetic compatibility



Medical electrical devices require special safety precautions with regard to electromagnetic tolerance. Therefore, the CADIAX device may only be installed and put into operation according to the instructions contained in this manual. Failure to comply with the instructions herein can potentially impair the measurement accuracy stated in chapter "Technical data" ⁷⁴.



Only use accessories which are explicitly approved for CADIAX devices. Using other accessories, especially cables which are longer than the cable lengths prescribed below, can lead to increased emission of interferences, or to reduced interference immunity of the CADIAX device, which may lead to faulty operation.

The following accessories to the CADIAX system affect the system's electromagnetic compatibility and may be replaced by the user. Components not listed here may only be replaced by the manufacturer.

Accessory	Maximum cable length
Foot switch	3.0 m
USB cable (USB 2.0, type A plug to type B plug, shielded)	3.0 m
CADIAX "compact" sensors	1.5 m
CADIAX "diagnostic" stylus (only applicable to CADIAX 4 devices)	1.5 m
CADIAX "diagnostic" flag (only applicable to CADIAX 4 devices)	1.5 m



Portable and mobile HF-communication appliances, e.g., mobile telephones, cordless telephones, computers, and laptops with activated WiFi, etc., can have detrimental effects on medical electrical devices. Do not operate the CADIAX device in the proximity of these potential sources of interference, and make sure to adhere to a safe distance of at least 30 cm. Non-compliance can lead to reduced performance of the device.

1.2.2.7 Connecting other devices



Devices connected to analog or digital interfaces must be certified to satisfy the applicable standard EN specifications (e.g., EN 60950 for data-processing devices, or EN 60601 for medical electrical devices). In addition, all configurations must satisfy system standard EN 60601-1. Whoever connects supplementary devices to the signal input or outlet units is the system configurator and therefore responsible for ensuring that system standard EN 60601-1 is adhered to.

1.2.3 Contraindications - Limitations to application



When operating the CADIAX system, the following conditions can hinder or limit its application:

- **Cognitive abilities:** Patients who are not able to follow or carry out the attending dentist's instructions correctly (e.g., where to move the lower jaw, etc.), for physical or psychological reasons.
- **General clinical symptoms:** Patients with illnesses that do not allow for the attachment of a face bow for registration purposes. Illnesses may be physical or psychological in nature (e.g., spastic, epilepsy, claustrophobia, injury or disease of the skull or soft-tissue structures of the skull, ears, etc.).
- **Dental clinical symptoms:** Patients with odontopathy or periodontal disease, which excludes the mounting of a clutch (parodontosis, loose teeth, damage to the tooth substance, changes in the mucous membranes in the mouth or pharynx, etc.).

- **Certain diseases in the ear region:** Patients with diseases in the ear region which exclude the fixation of the face bow in the auditory canal (e.g., painful inflammations, tinnitus, ear pain, etc.).
- **Muscle pain in the head and neck region:** Patients with extreme muscle pain in the head and neck region that are not able to wear the face bow for the duration of the examination.
- **Patients between 0 and 9 years of age:** Experience has shown that children are first able to follow the dentist's instructions well enough to lead to a successful examination from about 10 years of age onwards. In addition, existent deciduous teeth can make it difficult to fix the clutch.
- **Wearers of implants:** Patients with active implants (e.g., cardiac pacemakers) should be handled cautiously when using the CADIAX magnet-sensor system, as the stylus tip, to which a magnet is attached, could come into proximity of such implants.

1.2.4 Magnet sensor system



The CADIAX Magnet-Sensor system ("M"-Sensor) contains a magnet in the tip of the stylus. For this reason, special care is necessary when using it with patients with cardiac pacemakers or implanted defibrillators. Make absolutely sure to adhere to the necessary safe distances! If necessary, consult the responsible cardiologist. If in doubt, refrain from using the CADIAX "M" Sensor system.

1.3 Intended purpose

The CADIAX system is designed for registration and display of hinge axis movements of the human mandible, conversion of these movements to the intercondylar distance of an articulator, and calculating the settings for this articulator, appropriate to the patient.

The system is used by dentists and dental technicians.

1.4 About this manual

The authors of this user manual assume that the reader has a basic knowledge of condylography, working with a face bow, and the transfer of its head-related data into an articulator.

In addition, a sound basis in the Microsoft Windows operational system is required. The user should be able to work with the user-interfaces and other operational elements of the Windows programs.

This handbook is not a substitute for a basic education in using the Windows operating system. If you have only little or no education in Windows, we recommend that you first become acquainted with the system. This will make it much easier to work with the CADIAX software.

1.5 Symbols and notations

Special attention will be brought to important aspects using the following symbols:

	Warning	Possible sources of error, or the danger of a possible operational error.
--	----------------	---

 **Attention** Especially important information regarding the topic being described.

 **Information** Useful tips and tricks.

The following symbols and notations will be used in this user manual to describe certain commands and instructions for operating the software:

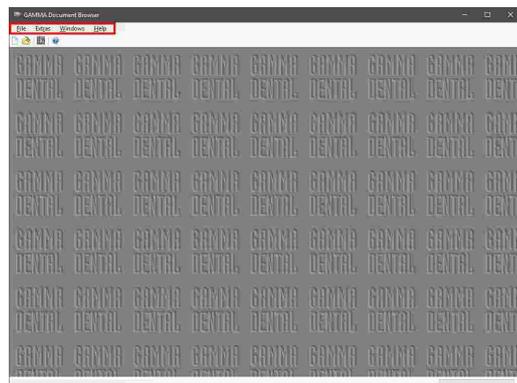
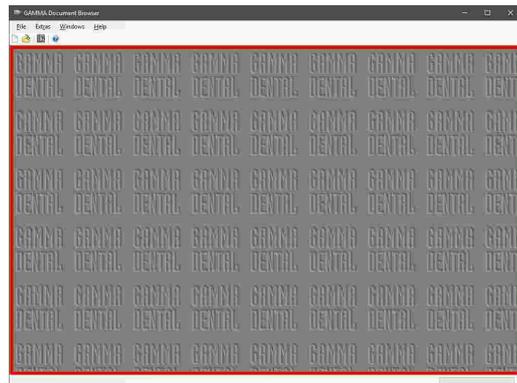
- Designations of keys will be written in italic font style. For combinations of keys, the individual key specifiers will be concatenated with plus signs (+). For example, *Ctrl+D* means: Hold down the *Ctrl* key on your keyboard and simultaneously press the *D* key.
- Names of menu items in the software will be written in italic font style. If several menu items need to be selected in succession, they will be concatenated with arrows. For example, *File → Close* means: First, click on the *File* menu item in the menu bar, then click on the menu item *Close* in the opened menu.

The first occurrence of ***Special Terms*** that may be used in subsequent descriptions are highlighted in bold and italic font style.

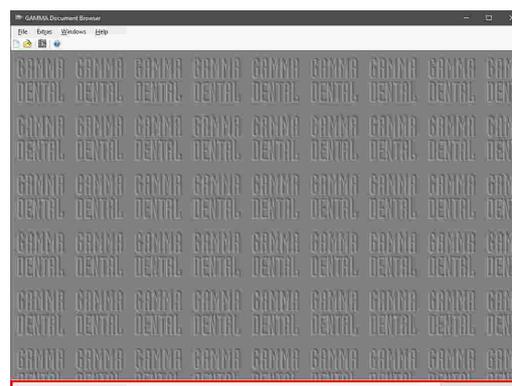
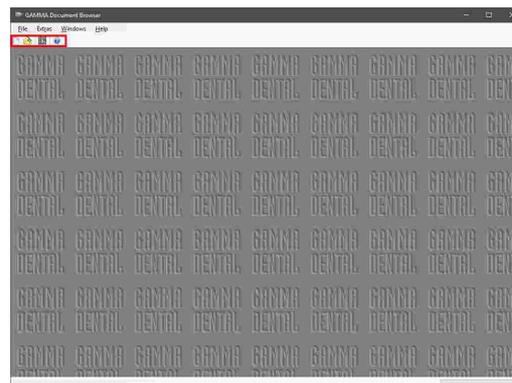
1.6 User interface terminology

All GAMMA software applications use a user interface layout consisting of the following parts:

- The ***Working Area*** is the area of the application that displays the actual patient data and will therefore receive the highest amount of attention and interaction.
- The hierarchical menu structure of the ***Menu Bar*** at the upper border of the window provides access to many of the application's functionalities. Most general application settings that are independent of the actual patient data can be configured here.



- The **Tool Bar** that is located below the menu bar provides icons to quickly access commonly used functionalities. The availability of these icons can depend on the actual state and working context of the application.
- The **Status Bar** at the lower border of the window displays contextual information regarding the actual state of the application as well as progress information in the case of long-running tasks.



1.7 Scope of delivery



The accompanying packing list describes the exact scope of delivery. After taking delivery of your CADIAX system, please make sure to immediately check the package contents for completeness and faultless condition.

The CADIAX system does not include the material for fixing the occlusal-tray clutch on the lower jaw teeth of the patient. You will need suitable bite registration material (e.g. Exabite II by GC) and the appropriate dispenser.

For fixing the para-occlusal clutch, you will need a composite for temporary restorations (e.g. Protemp II by 3M) and a temporary cement such as a zinc-oxide cement (e.g. TempBond by Kerr) or a carboxylate cement (e.g. Durelon by 3M).

Furthermore, a face-bow system is required for mounting the CADIAX measuring sensors, such as Condylograph or Condylograph comfort by GAMMA. Such is not included in the regular scope of delivery of the CADIAX system.



Please contact your local distributor for further information.

1.8 System requirements

A computer is required in order to use the CADIAX system. The following computer system requirements apply:

Component	Minimum specification
<i>Operating system</i>	Windows 7 with Service Pack 1, Windows 8.1 with Update 1, Windows 10 version 1909 or higher 32-bit or 64-bit
<i>Processor (CPU)</i>	Entry-level multi-core processor (Intel Core i3/i5 or comparable)
<i>Main memory (RAM)</i>	2 GB
<i>Hard drive space</i>	2 GB
<i>Screen resolution</i>	1280 × 720 pixels
<i>Color depth</i>	24 bit (RGB)

2 Preparing to operate the CADIAX device

Before beginning to work with the CADIAX system, several preparatory steps must be carried out.

2.1 Installing the software

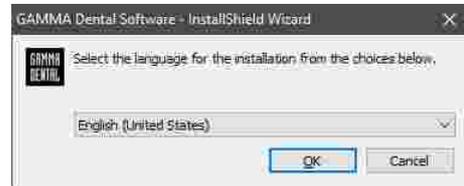


Install the software before connecting the CADIAX device to your computer for the first time. This will install the necessary drivers to let your operating system to recognize the device.

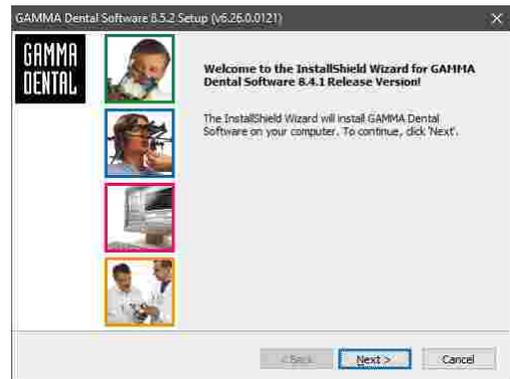
Put the CD-ROM into your computer's optical drive. After a short time, the installation routine should start automatically. If this is not the case, you can also start the installation by executing the file *setup.exe* that you will find on the disc.

If you received a digital copy of the setup, you can start the installation by executing the received file.

When installing the CADIAX software, you will be asked to specify the preferred language of the software. It can also be changed at any time after the installation.



In the following dialog, click on *Next* to start the installation procedure.

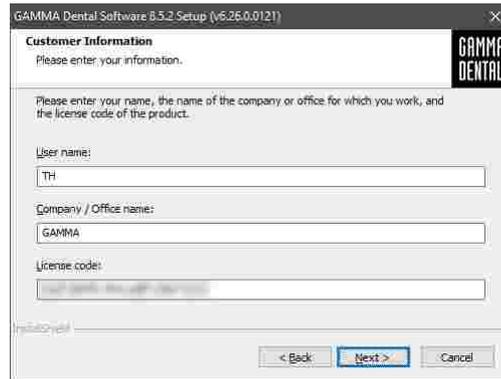


Please read through the conditions in the license agreement carefully. If you accept its terms, select the appropriate option and continue by clicking *Next*.

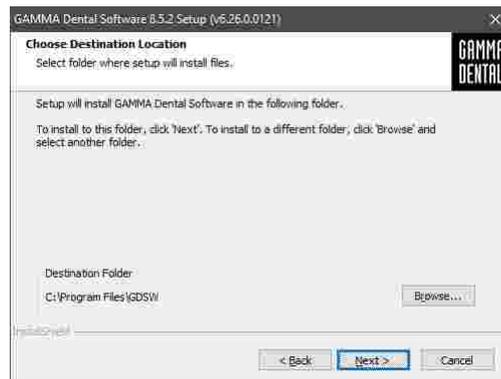


Enter your user information and your license code in the corresponding fields and click *Next* to continue.

You find the license code in the accompanying license letter or on your delivery note.



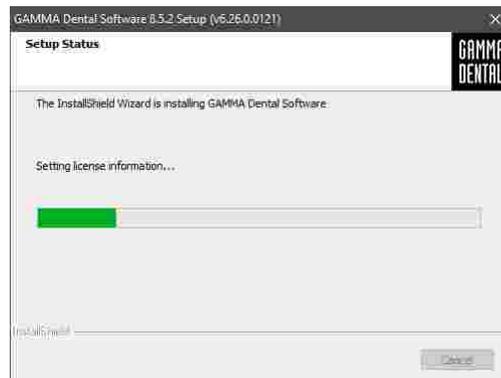
In the next step, you will be asked to which directory the program files shall be copied. We recommend using the default setting. Again, click *Next* to continue.



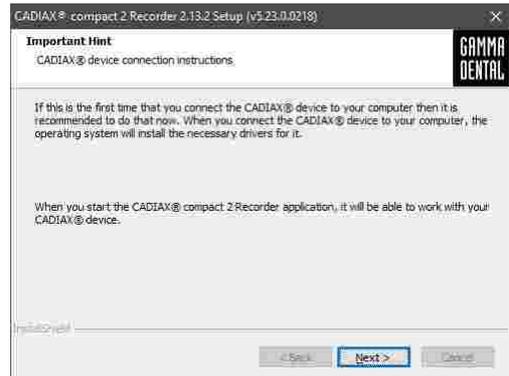
Preparations of the software installation are now completed. To start copying the program files, click *Install*.



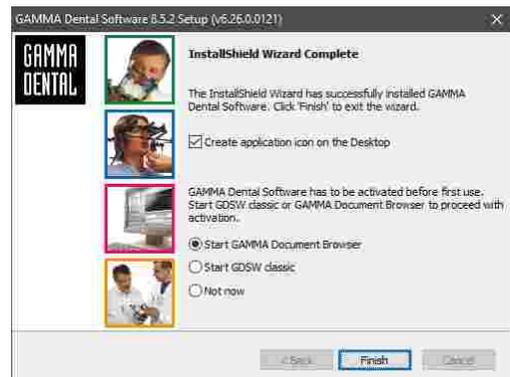
The installation routine will now copy the necessary data onto your computer. This can take several minutes.



Once the data has been copied, you can connect your CADIAX device with your PC to have your operating system configure the device driver.



Installation of the software is now completed.



2.2 Starting and activating the software

The software CADIAX compact 2 Recorder can be started through the start menu (*All Programs* → *Gamma Dental* → *CADIAX® compact 2 Recorder*) or via the link on the desktop:



If the CADIAX recording software is started as a component of GAMMA Dental Software, some features may not be available since these are integrated in the other modules of the software package.



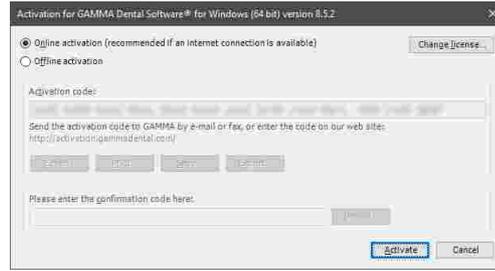
If you plan using the software on a virtual environment (e.g. Parallels Desktop), we strongly recommend to update both your operating system and your virtualization software to the latest version before activating. Otherwise, software activation might not be possible.

Please also note that an update of your virtualization software, once CADIAX compact 2 Recorder is installed, can cause hardware information used to activate the software to be changed, which will render your activation invalid. GAMMA does not take any responsibility for validity of license codes being lost this way. Furthermore, using the software on a virtual environment may cause poor performance or even the loss of certain functionalities.

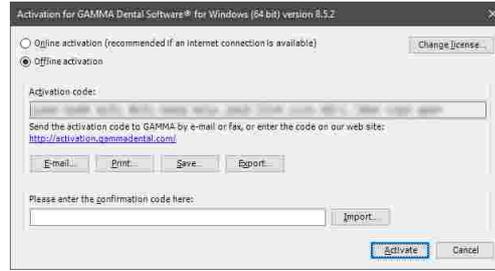
For these reasons, please deactivate all automatic update functionalities of your virtualization software and strongly consider using a native environment (on Apple Mac systems e.g. Boot-camp) instead.

When starting the software for the first time, the activation dialog will be shown.

If you are installing CADIAX compact 2 Recorder on a computer with internet connection, simply select *Online activation* and click *Activate*. No further step is required in this case and you can immediately start using the software.



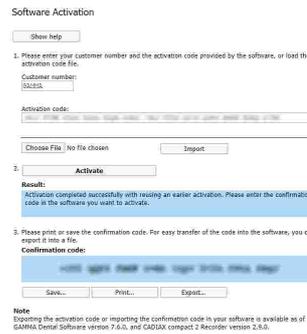
If the computer does not have an internet connection, select *Offline activation*. Send the activation code to GAMMA either via mail, fax, or visit the activation website to activate your software.



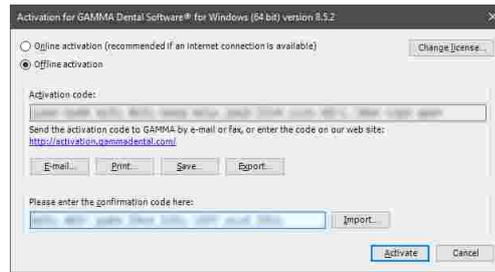
 To avoid mistakes caused by typing the codes by hand, the system provides export and import functionalities.

If you prefer to transmit your activation code via GAMMA's homepage, start your web browser and visit: <http://activation.gammadental.com/>

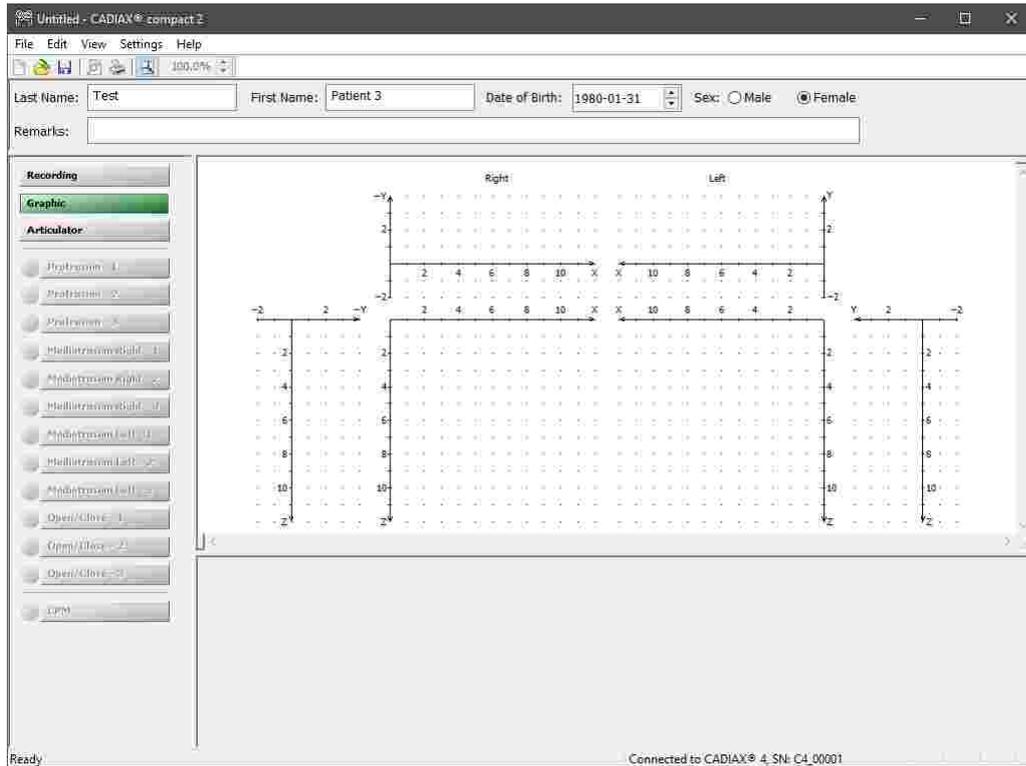
Enter your customer number and the activation code and click on *Activate*.



Enter the resulting confirmation code that you will see on the website in the activation dialog. By clicking on *Activate*, the activation is now also completed on a system without internet connection.

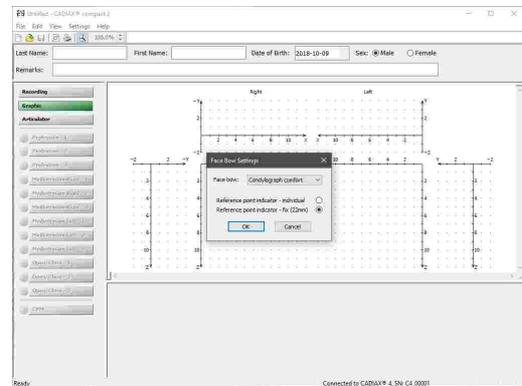


Upon successful activation, the software is ready to be operated.



2.3 Setting the face bow

To set the type of the face bow you use for recording, use the menu *Settings* → *Face Bow*.



STOP The various face bows have different scales for entering face geometries. If a wrong face bow is selected or a wrong scale value is entered, the recordings can not be recalculated correctly. This can lead to a distorted picture of the recorded condylar tracks and, in some circumstances, to a falsification of the calculated value settings for the articulator.

The face bow Condylograph comfort may be used with either of the following reference point indicators.



The fixed reference point indicators P (Patient) and T (Transfer).

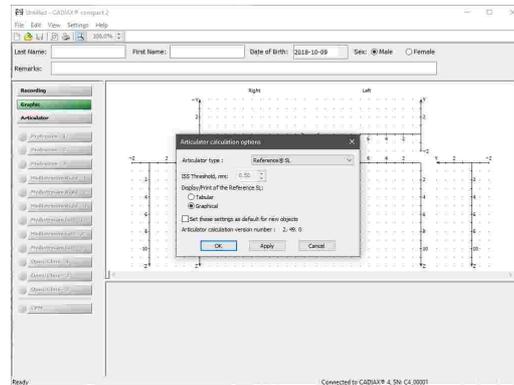


The individual reference point indicator.

i The fixed reference point indicators are mounted at a height of 22 mm, which cannot be adjusted. If the anatomical situation of the patient requires a different height, the individual reference point indicator should be used.

2.4 Setting the articulator

Also, set the articulator type that you use in the menu *Settings* → *Articulator*.



CADIAX compact 2 Recorder supports the following types of articulators (in alphabetical order):

Amann Girrbach

- Artex Arcon AP
- Artex Arcon AR
- Artex CP
- Artex CN
- Artex CR
- Artex CT
- Artex Nonarcon TK
- Artex Nonarcon TR
- Artex SL

Denar

- Denar Anamark
- Denar D5A (Calculation in retrusive mode "R" or in intercondylar mode "I")
- Denar Mark 320
- Denar Mark 330
- Denar Mark II

Hanau

Hanau 96H2
Hanau Modular
Hanau Wide-Vue

Ivoclar Vivadent

Ivoclar Stratos 200
Ivoclar Stratos 300

KaVo

KaVo Protar

Panadent

GAMMA

Reference A
Reference I
Reference LF
Reference SL

SAM

Whip Mix

Model 2240
Model 2340
Model 3040
Model 3140
Model 8500

You can find further information regarding the calculated articulator settings in chapter "Calculating articulator settings" ⁶⁰. See chapter "Immediate side shift (ISS)" ⁷³ for more information regarding the ISS threshold.



If you want to save your settings as default values for future recordings, you can mark the corresponding check box.

3 Recording TMJ movement



The CADIAX system allows joint movement recording by usage of both anatomic (arbitrary) and kinematically determined (individual) joint axis. For recording on kinematically defined (exact) joint axis, the face bows Condylgraph or Condylgraph comfort are required.

In principle, the registration of mandibular movement is always carried out in the following steps:

1. Preparations^[31]
2. Fixing the clutch onto the teeth of the lower jaw^[31]
3. Mounting the upper face bow
 - a. Anatomic face bow^[36]
 - b. Condylgraph^[41]
 - c. Condylgraph comfort^[44]
4. Mounting the writing bow
 - a. to the arbitrary face bow^[38]
 - b. to Condylgraph or Condylgraph comfort^[47]
5. Attaching the measurement flags and styli
 - a. on the arbitrary face bow^[40]
 - b. on the Condylgraph or Condylgraph comfort^[51]
6. Recording the joint track curves^[55]
7. Registration of CPM^[57] (if a para-occlusal clutch is used)
8. Finishing the registration, saving data^[58]

3.1 Posture of the patient

The patient should sit in an upright and relaxed position. Body movements during condylography recording can change the hinge axis position and should be avoided. The head should be held upright and the upper spine in the habitual normal position, i.e. not be bended forward or backward. It is recommended to use a head and neck support.

Glasses, earrings, hair barrettes, etc. of the patient should be taken off. Electrostatically charged hair can cause artifacts in the recordings. This effect is intensified by hairspray. For this reason, the patient should wear a cap, e.g. a surgical cap as used by surgeons. Long hair should be combed back behind the ears.

3.2 Instructing the patient

Explain the lower jaw movements like protrusion, retrusion, mediotrusion and medio retrusion to the patient. Ask the patient to execute all these movements completely and as far as possible. Practice these movements before mounting the face bow.

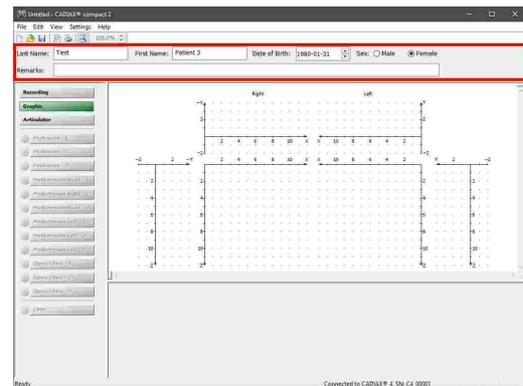
3.3 Preparations

Before starting the registration, prepare all necessary devices and materials.

Connect the CADIAX device to your computer and start the recording software. If the device has been detected, this will be indicated in the status bar of the software. If this is not the case, you can find information for error correction in the chapter "Troubleshooting" ⁶⁸.

3.3.1 Entering patient information

Next, enter the patient data into the input fields above the coordinate system.



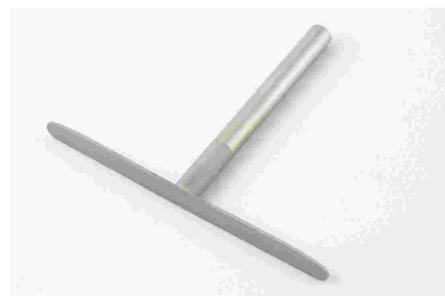
If CADIAX compact 2 Recorder was started from GAMMA Dental Software, the patient data will be filled out automatically and cannot be changed.

3.3.2 Fixing the clutch onto the lower jaw teeth

There are two different kinds of clutches available for attaching the lower face bow to the lower jaw. These are:



The occlusal-covering tray clutch.



The para-occlusal clutch.

In the case of edentulous patients, the clutch can also be attached to the lower jaw using a mandibular clamp.



The occlusal-covering tray clutch and the functional occlusal clutch are shipped in non-sterile condition and must be disinfected and/or sterilized before use. For the hygienic instructions regarding cleaning and reuse, please refer to chapters "Functional occlusal clutch" ⁷⁵ and "Occlusal tray clutch" ⁷⁵, respectively.

STOP Examine the periodontal status of the lower jaw dentition. In case of a poor periodontal situation, either refrain from using the clutch, or, at the attending dentist's responsibility, take suitable precautionary measures (e.g., blocking out). Areas of the dentition, undercut to the occlusal plane, should always be blocked out with appropriate material (e.g., soft wax), even with patients that have a healthy periodontal status.

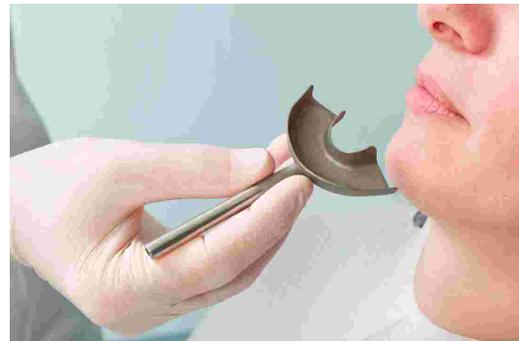
If you fix the clutch to a provisionally cemented denture, the possibility arises that the denture can become loose due to mechanical influences. In such cases, you must determine whether provisional cementing is appropriate or not.

! Check whether the clamp on the writing bow can be pushed onto the clutch shaft easily. If this is not the case, do not continue using that particular clutch.

3.3.2.1 Fixing the occlusal tray clutch

i If you are using a para-occlusal clutch, you may skip this section.

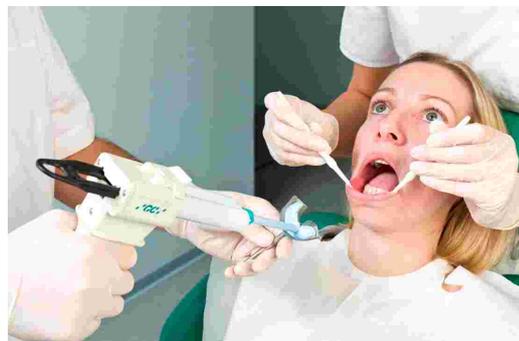
The occlusal tray clutch is available in multiple sizes. Select a clutch of an appropriate size for the patient.



i Before introducing the silicone material, inlay the clutch with 3 thin rolls of soft wax (diameter 3-4 mm). The rolls are attached at diagonals to the arch, one in the front and two in the back. They provide predetermined breaking points, which will make removing the clutch much easier.

STOP Use exclusively a silicone adhesive (bite registration material), with a Shore-hardness of maximum A60. Follow the manufacturer's instructions!

Fill the clutch to maximum 2/3 with the silicone material.



Place the filled clutch onto the lower jaw teeth and set the shaft in a median-sagittal position. The patient draws back the lower jaw and closes, thus automatically positioning the shaft so that the smallest possible locked bite is achieved.



Before mounting the lower face bow, the silicone must be completely set, with the patient's mouth slightly open. Follow the manufacturer's instructions! It is advisable to leave a separate material sample extra-orally with which you can check the hardening process. Make sure that no interferences occur in the back areas, caused by material being squeezed out.

3.3.2.2 Fixing the para-occlusal clutch



If you are using an occlusal tray clutch, you may skip this section.

When using a functional occlusal clutch, you can analyze the effects of occlusion on the TMJ position and hinge axis movement. Condyle position measurements (CPM) can be carried out directly in the patient's mouth, so you no longer need to measure CPM on mounted casts. The functional occlusal clutch is located outside of the occlusion, so it doesn't touch the upper jaw teeth, neither in intercuspation, nor in function.

For fixing the para-occlusal clutch you will need a composite for temporary restorations (e.g. Protemp II by 3M ESPE).



Additionally, you will need a temporary cement such as a zinc oxide cement (e.g. TempBond by Kerr) or a carboxylate cement (e.g. Durelon by 3M ESPE).



Place the clutch in the patient's mouth and bend the wings to fit on the lower tooth arch. Allow 1-2 mm of space between the teeth and the clutch, for the plastic.



Place a wax plate between the upper and lower teeth, and have the patient bite down. The wax plate prevents the plastic from flowing onto the upper teeth, and eliminates the tiresome job of having to polish the clutch's plastic surface.



Prepare the composite according to the manufacturer's information.



Coat the surface of the clutch, which should be facing the labial and buccal teeth, with a 2 mm thick layer of plastic. Wait until the material begins to set.



Place the clutch in the patient's mouth and instruct the patient to close, without allowing the upper teeth to touch the clutch (check this).

The clutch shaft should lie in the median sagittal plane.

Wait until the material has set, then remove the clutch from the patient's mouth.



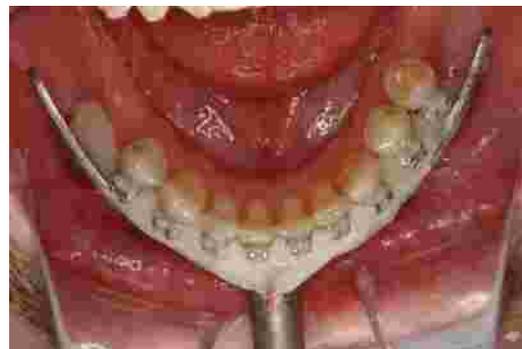


Remove any excess interferences of the plastic material with a sharp knife or a cutter.



Use as little plastic as possible. Too much plastic often causes pain in the gums.

Check to see whether the clutch fits properly in the mouth.



 Occlusion paper marks the contacts between the clutch and upper jaw teeth, which have to be removed.

 If the plastic has not completely set yet, you can lay the clutch aside and begin mounting the upper face bow.

Prepare the cement according to the manufacturer's information.

Fix the clutch with the cement on the lower jaw teeth.



 Do not fix the para-occlusal clutch onto painful or loose teeth.

After the registration, the clutch can be removed easily. The teeth will only need a light cleaning (scaling). The same plastic-coated clutch can be re-used for the same patient (residues on the clutch do not necessarily need to be removed).

3.4 Mounting the anatomic facebow

3.4.1 Preparing the upper face bow

The flag adapters for the Reference AB face bow have to be mounted before use, if this is not already the case.



Fixate the adapters with the accompanying screws and screwdriver to the posterior ends of the face bow. The bore for the fixing screw (the hole with the countersink) must face forward.



The upper face bow is now ready to be mounted.

3.4.2 Mounting the upper face bow

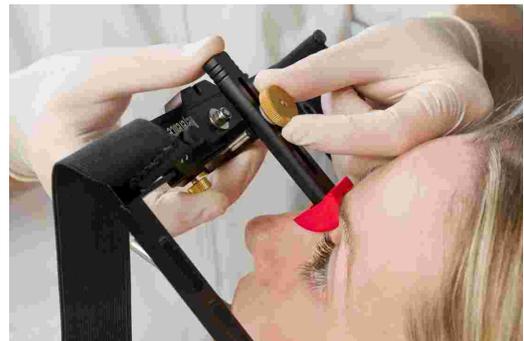
Pull back the glabella support. The retaining straps are fixed to the face bow. The base of the bite fork is not on the bow.



The porus knobs of the anatomical face bow are placed into both ear canals. The patient can actively help here. The comfortable, painless bow width is fixed on the front crossbar, with the aid of the clamp screws.



With moderate pressure, the glabella support is carefully pushed against the bridge of the nose, then lightly clamped.



The retaining straps are stretched on both sides, then closed behind the head and fastened with the Velcro fastener. The porus knobs should now tend to face dorsal to the ear canal, so that during excursive movements, the lateral condyle is not hindered. The face bow is checked for comfortable attachment. If necessary, adjust the retaining straps and/or the glabella support. Eliminate folds of skin under the glabella support by pulling the forehead skin tight and then screwing in the support.



3.4.3 Preparing the writing bow

The two axis locators are inserted into the holes for the left and right stylus and clamped firmly.



The writing bow is now ready to be mounted.

3.4.4 Mounting the writing bow

The side arms of the lower face bow are pushed completely outwards, then slightly fixated. The patient holds the lower jaw closed and in centric (retral) position. The double clamp is pushed onto the clutch.

Make sure not to loosen the clutch and check once more that it fits correctly.



The side arms are moved, so that the tips of the axis locators slide into the bores on the upper face bow, which mark the anatomical axis point. This fixes the positions of the styli on the anatomical axis, and also guarantees a correct distance to the flag.

The patient or an assistant lightly presses both guides inwards.



The writing bow is now adjusted so that it is parallel to the upper face bow. Both fixing clamps of the side arms are carefully clamped firmly.



Tighten the clamp on the lower cross bar. In doing so, support the lower face bow with your second hand to avoid too much force being transferred to the clutch. Strong force can cause pain or loosen the clutch.



It is important that the double clamp is tightened after the clamps of the side arms!

The axis locators for setting the anatomical axis can now be removed. Make sure that the positions of the side arms don't change when doing so.



If there is a change in position, this means that the system is not mounted tension-free, or that one of the clamps is not fixed properly. The mounting procedure for the lower face bow must then be repeated.

An improperly mounted lower face bow can lead to false registrations!

The mounted lower face bow, set at the anatomical hinge axis point.



3.4.5 Attaching the sensors

STOP Only touch the flags on their borders. Avoid touching the black measuring surface to prevent it from being soiled or scratched. Also make sure that recording mode is turned off while you mount the flags and styli.

Fixate the flags on the designated sockets of the upper face bow. Avoid jamming anything between the side arms and the flags in this process.



Fixate the styli with the respective screws in the retainers of the lower face bow. The cable of the stylus should hang downwards after it is fixated.

If the system is mounted properly and the lower jaw is in centric position, the stylus tip should be located in the area of the upper back quarter of the flag.



! The styli should be positioned in a way that their axis protrude by about 1 cm to the outside. This range of movement is, among other things, required for mediotrusive movements.

! The circuit between stylus and flag should always remain closed, even when the system is dismantled after use and the individual parts are stored in their packages. Improperly, jerkily breaking the circuit could lead to faults or disturbances in the system, e.g., broken cables.

STOP Avoid touching the measuring surface of the flags and the stylus pins during the measurement procedure and preparatory work. This also applies to the patient.

3.5 Mounting the kinematic facebow

3.5.1 Condylograph

3.5.1.1 Preparing the upper face bow

Before mounting the Condylograph on the patient, the forehead bracings of the upper face bow need to be pulled back.

Slightly loosen the side arm clamp screws, so that the side arms are movable in sagittal (upper clamp screw) and transversal (lower clamp screw) direction.

Loosen and remove the orbital pointer.



The upper face bow is now ready to be mounted.

3.5.1.2 Mounting the upper face bow

Adjust the width of the face bow in a way, that the side arms are in contact with the skull above the ears evenly without tension. The face bow should be adjusted symmetrically.



Fixate the flag adapters of the extension set with the respective screws on the side arms.



Put the face bow on the patient's head, whereby the glabella support is placed on the glabella and the side arms rest above the ears.



Lower the forehead supports until they are in skin contact and fixate them. An even support on forehead and glabella should be achieved, which stabilizes the face bow and significantly improves the patient's comfort.



The restraining strap is placed parallel to the side arms and fastened. Now, the face bow should hold firmly on the head without further support.



STOP Pay attention that the side arms lie above the ears. The face bow must not be pulled downwards, on the pinna, or upwards by the restraining band.

The porus knobs are inserted into both ear canals through the holes of the flag adapters.



Adjust the depth of the side arms and the height of the flag adapters to a comfortable, painless position and fixate them.

Also here, asymmetries could be caused by a flawed mounting of the bow.



Loosen and remove the porus knobs.



Attach the orbital pointer on the cross bar of the face bow and adjust it to the orbital.



To indicate the position of the orbital point with a lead mark in a subsequent x-ray, you can now mark the point on the skin.

Afterwards, fixate the orbital pointer and remove it from the face bow.



3.5.2 Condylograph comfort

3.5.2.1 Preparing the upper face bow

Slightly loosen the side arm clamp screws, so that the side arms are movable in sagittal (upper clamp screw) and transversal (lower clamp screw) direction.

Loosen and remove the orbital pointer.



Fixate the glabella support by pushing it from the side into the center position until it snaps in.



The actual nose support can easily be exchanged. It is only put on the glabella bridge.



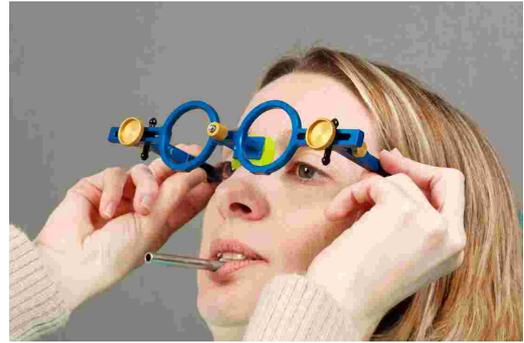
The upper face bow is now ready to be mounted.

3.5.2.2 Mounting the upper face bow

Adjust the width of the face bow in a way, that the side arms are in contact with the skull above the ears evenly without tension. The face bow should be adjusted symmetrically.



Put the face bow on the patient's head, whereby the glabella support is placed on the glabella and the side arms rest above the ears.



The restraining strap is placed parallel to the side arms and fastened. Now, the face bow should hold firmly on the head without further support.



STOP Pay attention that the side arms lie above the ears. The face bow must not be pulled downwards, on the pinna, or upwards by the restraining band.

Fixate the flag adapters of the extension set with the respective screws on the side arms.



The porus knobs are inserted into both ear canals through the holes of the flag adapters.



Adjust the depth of the side arms and the height of the flag adapters to a comfortable, painless position and fixate them.

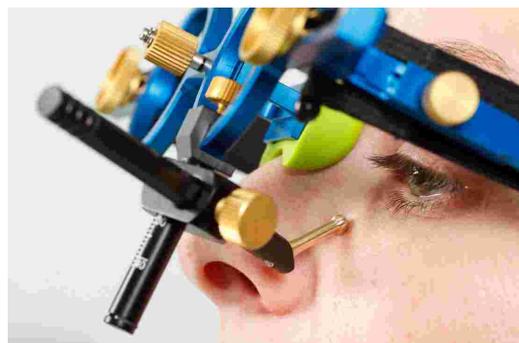
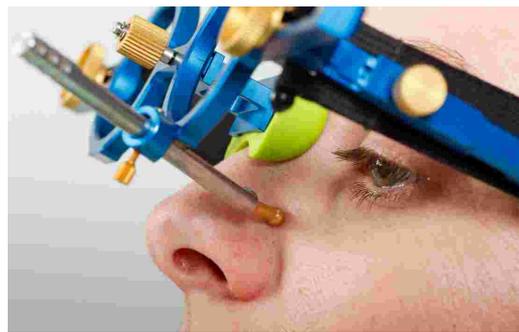
Also here, asymmetries could be caused by a flawed mounting of the bow.



Loosen and remove the porus knobs.



Attach the orbital pointer on the cross bar of the face bow and adjust it to the orbital.



To indicate the position of the orbital point with a lead mark in a subsequent x-ray, you can now mark the point on the skin.

Afterwards, fixate the orbital pointer and remove it from the face bow.



3.5.3 Preparing the lower face bow

Move the side arms of the lower face bow into their center position.



Slightly loosen the screws, so that the side arms and the double clamp on the crossbar are movable.



Adjust the two axis needles so that they protrude 2 cm from the axis pin jack.



The writing bow is now ready to be mounted.

3.5.4 Mounting the writing bow

The two axis locators are inserted into the holes for the left and right stylus and clamped firmly.



The side arms of the lower face bow are pushed completely outwards, then slightly fixated. The patient holds the lower jaw closed and in centric (retral) position. The double clamp is pushed onto the clutch.



Make sure not to loosen the clutch and check once more that it fits correctly.

The side arms are moved, so that the tips of the axis locators slide into the bores on the flag adapters of the extension set, which mark the anatomical axis point. This fixes the positions of the styli on the anatomical axis, and also guarantees a correct distance to the flag.

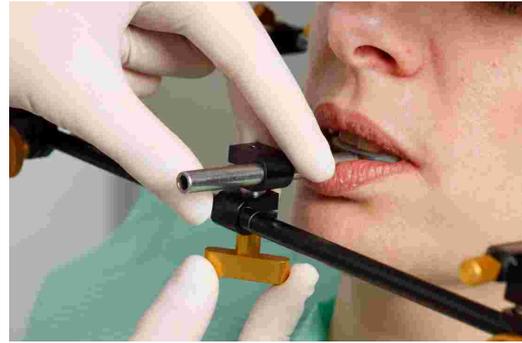


The patient or an assistant lightly presses both guides inwards.

The writing bow is now adjusted so that it is parallel to the upper face bow. Both fixing clamps of the side arms are now carefully clamped firmly.



Tighten the clamp on the lower cross bar. In doing so, support the lower face bow with your second hand to avoid too much force being transferred to the clutch. Strong force can cause pain or loosen the clutch.



It is important that the double clamp is tightened after the clamps of the side arms!

The axis locators for setting the anatomical axis can now be removed. Make sure that the positions of the side arms don't change when doing so.



If there is a change in position, this means that the system is not mounted tension-free, or that one of the clamps is not fixed properly. The mounting procedure for the lower face bow must then be repeated.

An improperly mounted lower face bow can lead to false registrations!

The mounted lower face bow, set at the anatomical hinge axis point.



3.5.5 Determining the joint axis

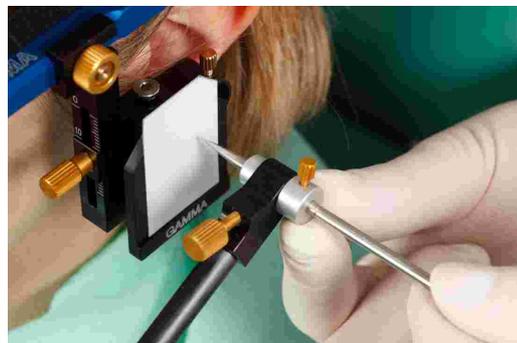
Assemble the mechanical writing flags with writing paper.



Subsequently, mount the flags on the flag adapters of the extension set using the accompanying screws.



Insert the axis needles in the corresponding holes on the end of the side arm and push them in until they are in contact with the writing flag. Fixate the needles in this position.



Start in retral joint position and guide the lower jaw of the patient with the chin in retral open-close movements.



Adjust the setscrews of the side arm in a way that the axis needle solely rotates without drawing a translatory movement on the flag.

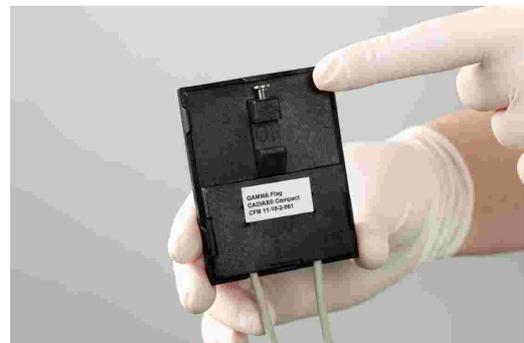


3.5.6 Attaching the sensors



Only touch the flags on their borders. Avoid touching the black measuring surface to prevent it from being soiled or scratched. Also make sure that recording mode is turned off while you mount the flags and styli.

Insert the hexagon socket screws that are contained in the extension set into the threads of the measuring flags.



Fixate the flags on the designated sockets of the upper face bow. Avoid jamming anything between the side arms and the flags in this process.



Fixate the styli with the respective screws in the retainers of the lower face bow. The cable of the stylus should hang downwards after it is fixated.

If the system is mounted properly and the lower jaw is in centric position, the stylus tip should be located in the area of the upper back quarter of the flag.



 The styli should be positioned in a way that their axis protrude by about 1 cm to the outside. This range of movement is, among other things, required for mediotrusive movements.

 The circuit between stylus and flag should always remain closed, even when the system is dismantled after use and the individual parts are stored in their packages. Improperly, jerkily breaking the circuit could lead to faults or disturbances in the system, e.g., broken cables.

 Avoid touching the measuring surface of the flags and the stylus pins during the measurement procedure and preparatory work. This also applies to the patient.

3.6 Setting up the CADIAX system

Plug the connector of the foot switch into the designated jack at the backside of the device.



Connect the device to a free USB-port of your PC.



Subsequently, connect the sensors to the device according to the labeling on the casing.



3.7 Face bow parameter input

In order to recalculate the recordings according to the mounting of the upper face bow, it is necessary to enter the face bow parameters. To do so, activate the recording mode by clicking the button *Recording*. Confirm the entered parameters by pressing the foot switch.



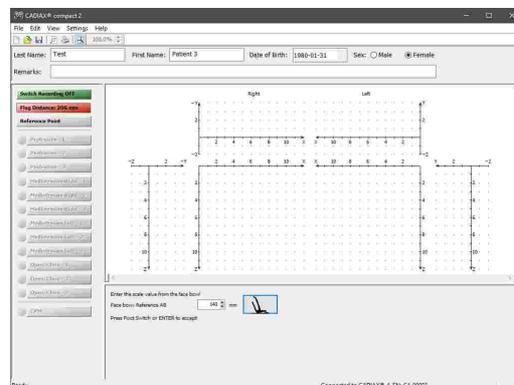
Refer to chapter "Setting the face bow" ²⁷ for instructions regarding the selection of the used face bow.



Note that the terms "left" and "right" always refer to the corresponding side from the patient's point of view. All values have to be entered in millimeters.

3.7.1 Anatomic face bow

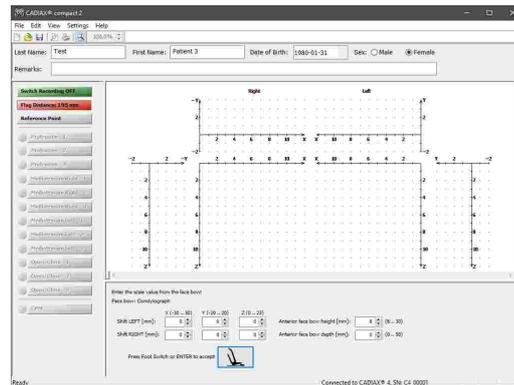
The following parameters have to be entered when using an anatomic face bow.



Scale value describes the distance between left and right side arm. It can be read from the scale on the front of the face bow.

3.7.2 Condylgraph

The following parameters have to be entered when using the Condylgraph face bow.



X-Shift is the shift of either side arm of the upper bow in anterior or posterior direction. It can be read from the scale on the respective side arm. Values that are located towards posterior, relative to the zero point of the scale, are entered as negative values.

Y-Shift is the shift of either side arm of the upper bow to left or right side. It can be read from the scales on the front of the face bow's cross bar. Values that are located towards the inner side, relative to the zero point of the scale, are entered as negative values.

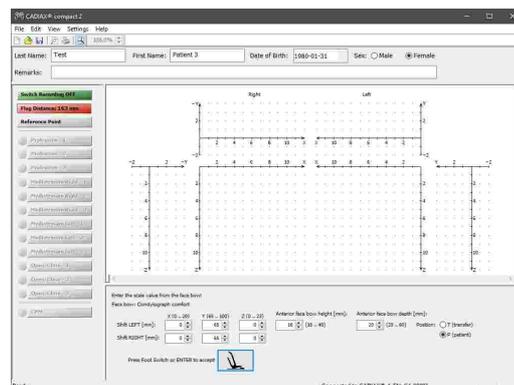
Z-Shift is the shift of the flag holders on the extension set in upwards or downwards direction. It can be read from the scale on the respective side arm extension.

The **anterior face bow height** is the difference in height between the marked orbital point and the upper face bow. The value can be read from the vertical scale of the reference point indicator.

The **anterior face bow depth** is the difference in depth between the marked orbital point and the upper face bow. The value can be read from the horizontal scale of the reference point indicator.

3.7.3 Condylgraph comfort

The following parameters have to be entered when using the Condylgraph face bow.



Y-Shift is the shift of either side arm of the upper bow to left or right side. It can be read from the scales on the top side of the face bow's cross bar.

X-Shift is the shift of either side arm of the upper bow in anterior or posterior direction. It can be read from the scale on the respective side arm.

Z-Shift is the shift of the flag holders on the extension set in upwards or downwards direction. It can be read from the scale on the respective side arm extension.

The **anterior face bow height** is the difference in height between the marked orbital point and the upper face bow. The value can be read from the vertical scale of the reference point indicator.

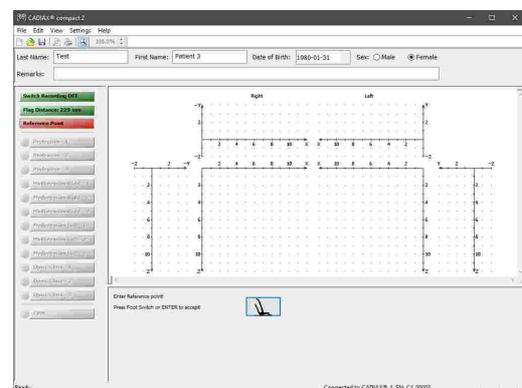
When using the fixed reference point indicators, the value cannot be changed and is fixed to their mounting height of 22 mm.

The **anterior face bow depth** is the difference in depth between the marked orbital point and the upper face bow. The value can be read from the horizontal scale of the reference point indicator.

When using the individual reference point indicator, it is additionally required to specify the position, in which this value is measured. In **position T (transfer)**, the pointer is oriented parallel to the side arms of the face bow, and in **position P (patient)**, it is inclined by 30° towards the patient's nose.

3.8 Setting the reference position

Guide the patient into the retral reference position and press the foot switch. The position set here will be used as zero point for the following recordings.

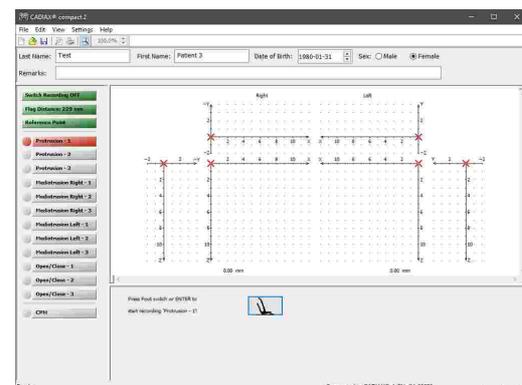


You can also re-set the reference position between recordings by pressing the button again.

3.9 Recording joint movements

3.9.1 Joint track curves

After entering the face bow parameters and setting the reference position, the application will automatically select the first item to be recorded. You can change this selection by clicking the buttons on the left border of the window at any time.

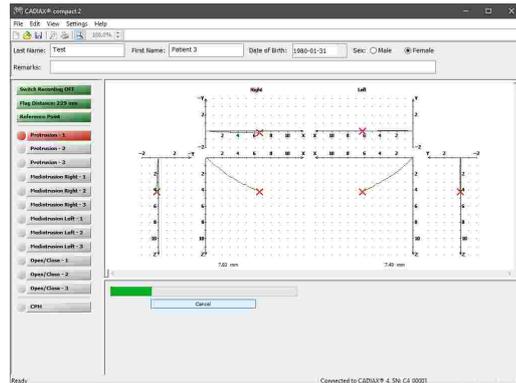


Before starting a recording, ensure that the patient is in reference position. In the ideal case, the red cross of the real-time cursor is positioned exactly in the origin of the coordinate system. If this position is difficult to reproduce, you can re-set the software's reference position via the button of the same name (refer to chapter "Setting the reference position" ⁵⁵)

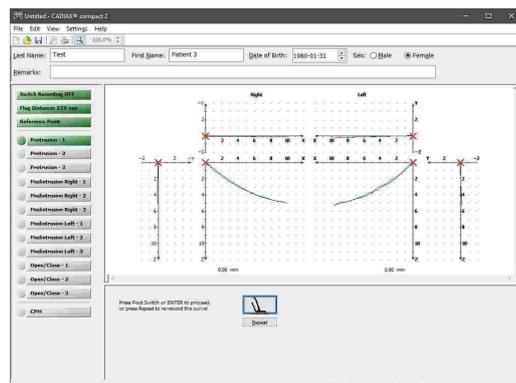
Press the foot switch to start recording the selected movement and have the patient carry it out within the following 4.5 seconds.



The start and the end of the recording are signaled acoustically. During the recording, the progress will be displayed and the curve will be drawn in real-time.



Once the recording is finished, it will be displayed in the recording window and you can proceed with the next one.



! Check a curve for its quality immediately after the recording. To do so, check the starting point of the movement track relative to the reference position (i.e. the origin of the coordinate system), as well as smoothness of the curve line. Ideally, the movement starts exactly in the zero point and doesn't show any distortion artifacts of any kind.

Registrations with obvious distortions should not be accepted. In such cases, clean the flags and styli thoroughly and repeat the recording. If this doesn't prevent artifacts from appearing, cancel the registration and contact an authorized GAMMA service department.

In addition, movement tracks that differ from the expected shape should be treated skeptically and have to be verified with further registrations.

! Please note that the designations mediotrusion right and mediotrusion left always refer to the condyle of the patient that is carrying out the mediotrusive movement. Mediotrusion right therefore means a mandibular (i.e., of the chin) movement to the left side and vice versa.

i You can specify the curves to be recorded and the order of the recording sequence via the menu *Settings* → *Recording*. There, you can also specify if the reference position shall be set anew before certain items.

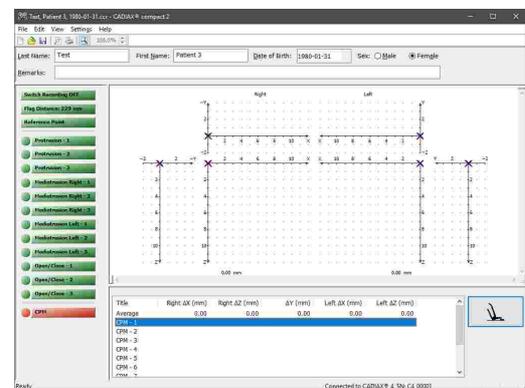
3.9.2 Condyle position measurement (CPM)

A condyle position measurement (CPM) describes the measurement of the 3-dimensional offset in the joint between a reference position and any another joint position (e.g. maximum intercuspation ICP).

! Naturally, measurements of a position relative to the occlusion (e.g. ICP) only make sense if the registration clutch is fixed to the lower jaw teeth in para-occlusal method.

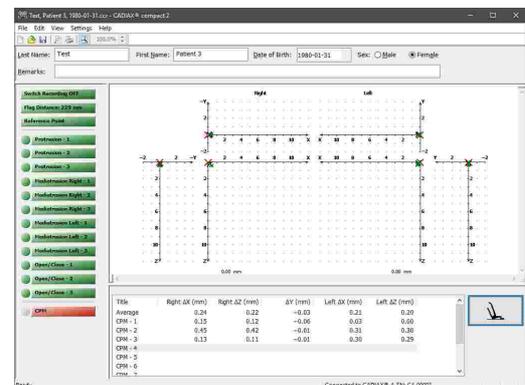
! Before performing a measurement, ensure that the patient is in reference position. In the ideal case, the red cross of the real-time cursor is positioned exactly in the origin of the coordinate system. If this position is difficult to reproduce, you can re-set the software's reference position via the button of the same name (refer to chapter "Setting the reference position" ⁵⁵).

To start a CPM registration, press the corresponding button on the left border of the window.



Guide the patient into reference position (re-set it, if necessary) and have them move to the second position to be measured. Press the foot switch to measure this position.

Each measurement is signaled acoustically. The system allows performing up to ten measurements.



To delete a measurement, right-click the item in the list to bring up the context menu and choose *Delete*.

i You can rename the individual measurements by right-clicking them in the list and choosing *Rename*.

3.10 Finishing the registration

To finish the registration, leave the recording mode by pressing the button *Switch Recording OFF*.

Subsequently, save the recorded data via the menu *File* → *Save*. CADIAX compact 2 Recorder can save the data of every patient as an individual file. As file name, it hereby suggests a composite of patient name and date of birth, which can be changed arbitrarily.



If CADIAX compact 2 Recorder was started from GAMMA Dental Software, the recorded data can be transferred to the invoking application via the entry *Save and Exit* in the tool bar.



To prevent data loss due to issues occurring while saving the recordings, those are saved in the sub-directory *GDSW/Temp* of the user's documents folder. To recover such a file with the extension **.ccr*, use the corresponding menu item in the *Data* menu.



Make sure to switch off the recording mode before starting to dismantle the system!

Disassemble the system in reverse mounting order. First, loosen the measuring styli and flags from the face bow and subsequently remove the lower face bow from the clutch. Afterwards, remove the upper face bow and eventually remove the clutch.



To loosen the clutch, move its shaft carefully up and down. When removing the clutch, take care to not have it hit against the teeth of the upper jaw due to jerky movements. If necessary, protect them, e.g. by putting a wax plate in between the teeth.

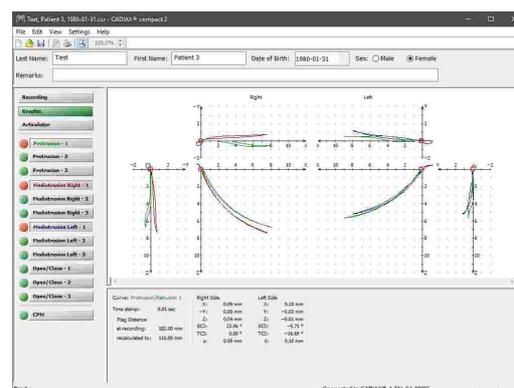
4 Data evaluation

After the registration, the gathered data can be evaluated, for which purpose the graphical display allows measuring and overlaying the curves. It is also possible to use these curves for calculation of the best matching value settings for various articulators.

4.1 Retrieval and analysis of recordings

Recorded curves can be analyzed immediately after recording or at a later occasion. To open previously recorded patient data, choose the menu entry *File* → *Open*.

After having loaded the data, you can select the curves to be displayed via the buttons on the left border of the window. These are displayed in the axis-orbital reference coordinate system (refer to chapter "The reference coordinate system [71]").

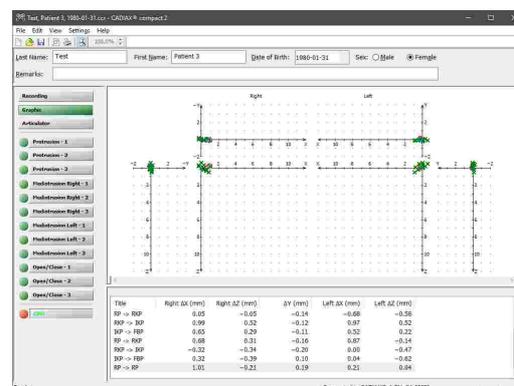


For easier distinction when overlaid, each type of curve is displayed in a different color. You can change the display style of individual curves via the menu entry *Settings* → *Curve Color & Pen Width*.

By clicking an arbitrary point on a curve, the values for this position will be shown in the lower part of the screen:

- X, Y, Z** The spatial coordinates of the selected position.
- SCI** The sagittal condyle inclination at the selected position.
- TCI** The transversal condyle inclination at the selected position.
- s** The distance of the selected position from the zero point.

To analyze CPM recordings, click the corresponding button after the data has been loaded or recorded. A table with the coordinates of the individual measurements appears in the lower part of the screen. These values are relative to the reference position.



The calculated average value of all measurements is displayed in the graphic with a distinct color.

4.2 Calculating articulator settings

 The calculation of articulator settings is not available when the application has been started from GAMMA Dental Software. In that case, the settings can be calculated in the accompanying analysis application.

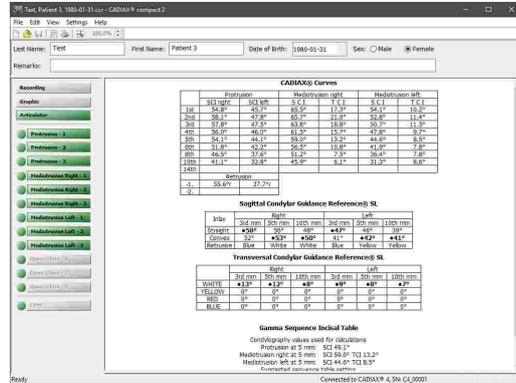
Semi- or fully adjustable articulators can have their simulated movements adapted to the actual movements of the lower jaw. For this purpose, such articulators allow the user to set the angle of the guidance tracks in the two spatial planes that define the movement (sagittal and transverse plane). These are referred to as sagittal condyle inclination (SCI, formally HCI) and transversal condyle inclination (TCI, also Bennett) respectively. Some articulators also allow the shape of the recorded curve to be approximated with differently curved inserts that are based on naturally occurring curve shapes, all with the goal to achieve the best possible reproduction of the actual recordings.

To be able to calculate these articulator settings, the software recalculates the recorded curves from the actual flag distance to the intercondylar distance of the articulator beforehand. The recordings displayed by the application are always in already recalculated form.

Before calculating the articulator settings, make sure that you have selected the correct type of articulator (refer to chapter "Setting the articulator"²⁸). You can display the calculated settings by clicking the button *Articulator* on the left border of the window.

By default, all available protrusion and mediotrusion curves will be used for calculation. You can exclude individual curves by clicking the buttons on the left border of the window. If multiple curves of one type are selected, an average of these curves will be used. If certain values cannot be calculated, the corresponding field in the table of results will be empty.

As an alternative to the tabular display of articulator settings, a graphical display is provided for certain types of articulators. You can change between the display style via the menu *Settings* → *Articulator*.

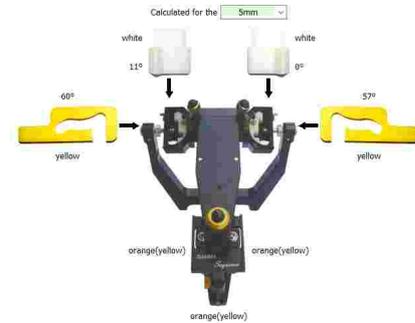


The screenshot shows the software interface with patient information: Patient 3, Date of Birth: 1980-01-31, Sex: Male. The main window displays several tables for articulator settings:

Protrusion	Mediotrusion right	Mediotrusion left
50	10.0	10.0
100	10.0	10.0
150	10.0	10.0
200	10.0	10.0
250	10.0	10.0
300	10.0	10.0
350	10.0	10.0
400	10.0	10.0
450	10.0	10.0
500	10.0	10.0
550	10.0	10.0
600	10.0	10.0
650	10.0	10.0
700	10.0	10.0
750	10.0	10.0
800	10.0	10.0
850	10.0	10.0
900	10.0	10.0
950	10.0	10.0
1000	10.0	10.0

Right	Left
300 mm	300 mm
350 mm	350 mm
400 mm	400 mm
450 mm	450 mm
500 mm	500 mm
550 mm	550 mm
600 mm	600 mm
650 mm	650 mm
700 mm	700 mm
750 mm	750 mm
800 mm	800 mm
850 mm	850 mm
900 mm	900 mm
950 mm	950 mm
1000 mm	1000 mm

Right	Left
300 mm	300 mm
350 mm	350 mm
400 mm	400 mm
450 mm	450 mm
500 mm	500 mm
550 mm	550 mm
600 mm	600 mm
650 mm	650 mm
700 mm	700 mm
750 mm	750 mm
800 mm	800 mm
850 mm	850 mm
900 mm	900 mm
950 mm	950 mm
1000 mm	1000 mm



4.2.1 Condylar settings

The tabular view of articulator settings is usually comprised of the following tables, all of which concern the settings of the condylar elements of the articulator:

- The **average angle values** of the curves that have been selected for articulator calculation. The retrusive angles are measured on the rotating working side of the mediotrusion curves. The suffix character denotes the quadrant of the coordinate system in which the retrusion movement takes place (refer to chapter "Retrusion direction" ⁶¹).

CADIAX® Curves

	Protrusion		Mediotrusion right		Mediotrusion left	
	S C I right	S C I left	S C I	T C I	S C I	T C I
1st	67.0°	72.2°	71.9°	19.6°	57.1°	-9.2°
2nd	67.2°	68.0°	69.8°	19.7°	59.3°	-4.7°
3rd	65.9°	62.8°	69.5°	17.4°	57.7°	-4.1°
4th	63.4°	59.4°	65.8°	15.9°	55.8°	-3.2°
5th	61.1°	53.6°	63.7°	14.3°	52.9°	-2.7°
6th	58.6°	49.7°	61.0°	10.7°	49.9°	-2.3°
8th	51.9°	42.1°	54.8°	8.8°	42.8°	-1.7°
10th	44.8°	35.2°	48.1°	7.2°	36.4°	-1.2°
14th			35.4°	6.5°		
	Retrusion					
-1.	46.4°r	46.3°r				
-2.	41.9°r	32.9°r				

- The recommended settings for programming the **sagittal condylar inclination** (SCI) on the articulator.

Sagittal Condylar Guidance Reference® SL

Inlay	Right			Left		
	3rd mm	5th mm	10th mm	3rd mm	5th mm	10th mm
Straight	●67°	64°	53°	67°	60°	45°
Convex	61°	●60°	●56°	●61°	●57°	●47°
Retrusive	Blue	Yellow	Yellow	Yellow	Yellow	Yellow

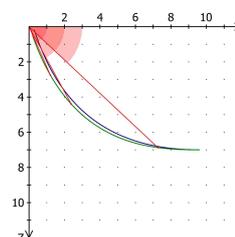
- The recommended settings for programming the **transversal condylar inclination** (TCI, also referred to as "Bennett") on the articulator.

Transversal Condylar Guidance Reference® SL

	Right			Left		
	3rd mm	5th mm	10th mm	3rd mm	5th mm	10th mm
WHITE	●13°	●11°	●8°	●0°	●0°	●0°
YELLOW	0°	0°	0°	0°	0°	0°
RED	0°	0°	0°	0°	0°	0°
BLUE	0°	0°	0°	0°	0°	0°

Please note that the different types of articulators provide a varying degree of adjustability, meaning that the number of tables as well as their content is dependent on the selected type of articulator. Most articulators are adjustable at least in regards to the inclination of the sagittal and transversal condylar guidance. Some fully-adjustable articulators, such as the Reference SL, additionally provide multiple inserts for adapting the shape of the condylar guidance path to the patient's actual movement. Further, some articulators allow programming the immediate side shift of the Bennett movement (ISS; refer to chapter "Immediate side shift (ISS)" ⁷³). The ISS threshold used for this purpose can be configured in the calculation options.

All settings are calculated starting at the origin of the coordinate system and up to the **3rd, 5th, and 10th** millimeter of condylography excursion. Depending on which part of the movement is to be reproduced in the articulator, the condylar elements have to be programmed with the appropriate values. This is especially important for the wax-up procedure, as a condylography curve's initial curvature can differ significantly from its entire curvature and an incorrect setting can therefore lead to entirely different movement paths of the dental cusps.

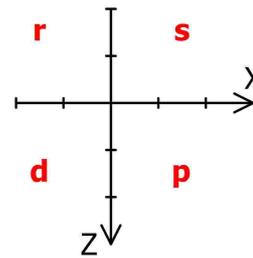


If multiple inserts for altering the shape of the condylar path are available for selection, the application will calculate the settings for each of them and indicate the best-fitting insert using bold font and a pre-fixed dot, for example: ●67°. All displayed angle values are generally limited to the mechanical adjustment range of the selected articulator.

4.2.1.1 Retrusion direction

Depending on the quadrant of the coordinate system in which a retrusion movement takes place, the following designations are used:

- **r** A **retrusive** movement in the posterior, upper quadrant (-X/-Z).
- **s** A **surtrusive** movement in the anterior, upper quadrant (+X/-Z).
- **d** A **detrusive** movement in the posterior, lower quadrant (-X/+Z).
- **p** A **protrusive** movement in the anterior, lower quadrant (+X/+Z).



The designations for the four quadrants of the coordinate system in a retrusion movement, illustrated for the right patient side.

i Refer to chapter "The reference coordinate system" for a detailed description of the coordinate system used by the software.

4.2.2 Sequence incisal table settings

The Sequence incisal table (order number 04-000013) is an accessory part for the Reference SL articulator, which allows for a convenient adjustment of the protrusive and mediotrusive guidance inclinations. The flexible concept of exchangeable inserts makes it easy to wax-up the desired occlusion concept while taking into consideration the patient's individual condylar inclination. The basis is always the natural morphological sequence in the human masticatory organ.



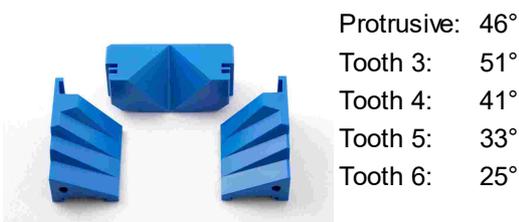
Gamma Sequence Incisal Table

Condylography values used for calculations
 Protrusion at 5 mm: SCI 57.4°
 Mediotrusion right at 5 mm: SCI 63.7° TCI 14.5°
 Mediotrusion left at 5 mm: SCI 52.9° TCI -2.7°
 Suggested sequence table setting
 Protrusion element: ORANGE(YELLOW)
 Right lateral element: ORANGE(YELLOW)
 Left lateral element: ORANGE(YELLOW)

The articulator settings view displays the recommended settings for the Sequence incisal table as well as the condylar inclinations used for their calculation below the condylar settings. The Sequence incisal table settings are provided in both the graphical and in the tabular view.

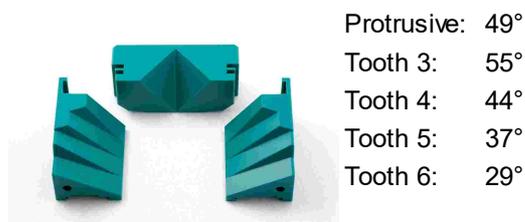
The differently-colored guidance elements can be combined as needed and possess the following inclinations to the axis-orbital plane:

Blue guidance elements

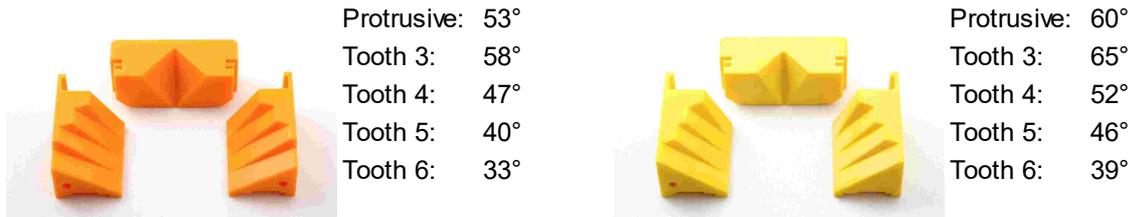


Orange guidance elements

Green guidance elements



Yellow guidance elements



i The yellow guidance elements are not part of the standard set and can be purchased separately (order number 04-000013Y). If this color allows for the best possible reproduction of the calculated guidance track, it will be denoted in brackets.

The recommended protrusive guidance inclination of the Sequence incisal table is calculated from the cusp tips coordinates of the two central mandibular incisors. The mediotrusive guidance sequence is calculated based on the canine coordinates of the respective patient side.

If no data set of measured cusp tips coordinates has been selected, the following empirically determined coordinates will be used for the incisors:

X: 70.5 mm
Y: 0.0 mm
Z: 48.0 mm

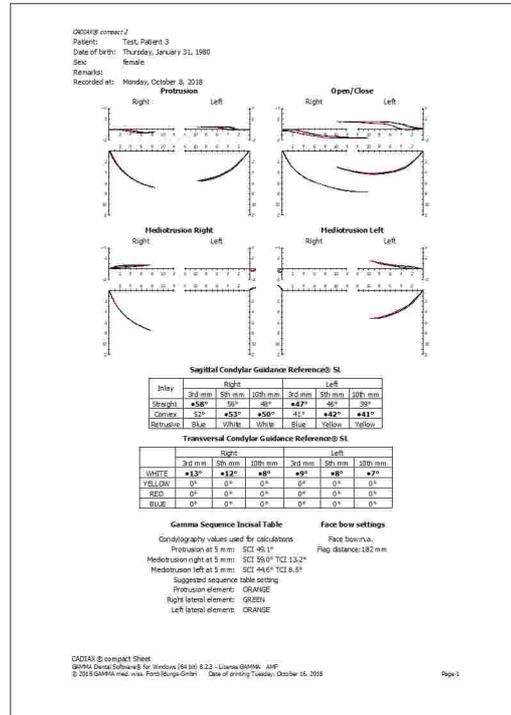
The default coordinates used for the canines are as follows:

X: 66.0 mm
Y: 13.5 mm
Z: 50.0 mm

4.3 Data printout

 The printing of data is not available when the application has been started from GAMMA Dental Software. In that case, this functionality is provided by the accompanying analysis application.

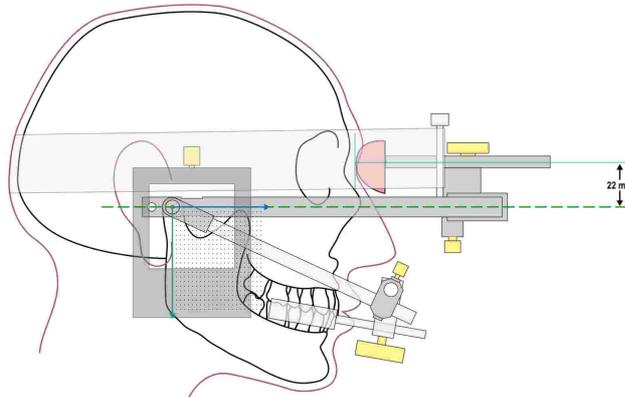
CADIAX compact 2 Recorder allows to create a standard printout, which shows patient information, recordings in graphical form and articulator settings among other things. This printout can be carried out via the menu *File* → *Print*.



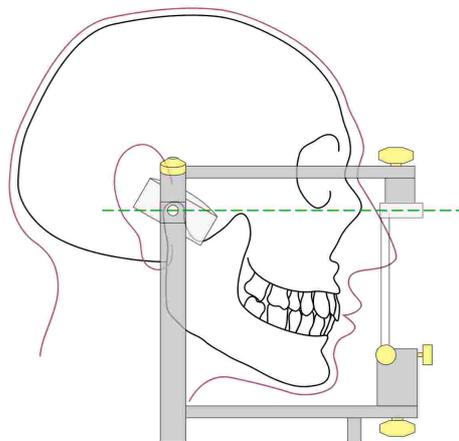
 You can adjust the layout of the printed document via the menu item *File* → *Print Setup*. The *Print Preview* functionality allows a preview of the printout to be displayed on the screen.

5 Mounting the articulator

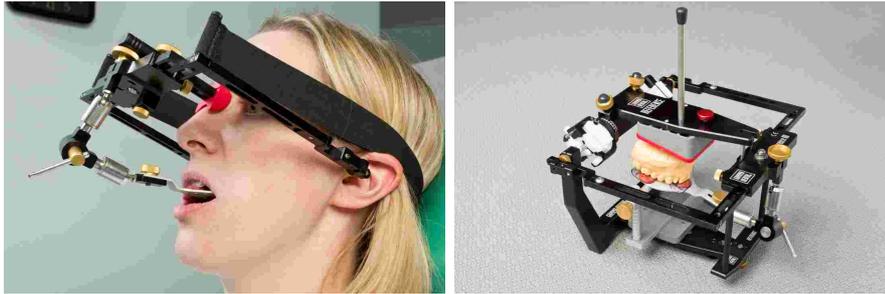
The CADIAX system uses the axis-orbital-plane as reference plane for recordings and for transferring the jaw position into the articulator (refer to chapter "The reference coordinate system [71]"). For reasons related to construction, the side arms of the face bows will be parallel to that plane when the anterior face bow height is 22 mm. The side arms of the anatomical face bows are always congruent to that plane.



In the articulator, the plane is described by the right and left hinge axis point and the contact plane of the incisal table.



This ensures that, when the upper jaw model is transferred into the articulator using the face bow, the calculated values will match the actual settings of the articulator's condylar housings. For transferring the model position, a bite fork is attached to the face bow via a freely movable 3D joint support. An impression of the upper jaw teeth is taken and replicated with the plaster models in a transfer stand or directly in the articulator.



If a different face bow is used for transfer, make sure that the face bow is set to use the same reference points. Only then is it guaranteed that the values calculated by the CADIAX system match the model situation in the articulator.

Model transfer with an exact transfer bow:

Basically, the transfer can be carried out as follows:

The reference points of the GAMMA bow (right and left hinge axis points, plus the anterior reference point) are marked on the skin of the patient. Then, using the face bow corresponding to the articulator system, the transfer of the upper jaw is carried out relative to these marks on the patient's skin.

Marking the anterior reference point is only done on one side (patient's left side), at the side of the bridge of the nose, or under the eye. Measure a distance of 22 mm from the deepest depression of the nasion and mark this position. Transfer of the hinge axis point is best carried out after the registration, using the still mounted writing bow, whereby the upper bow is dismantled and the skin is marked with a pen (axis locator pin) through the bore (stylus holder).

Model transfer with the anatomic transfer bow:

The anatomic transfer bows from various manufacturers partially differ in their measurements as well as in their used methods in mounting models. The limitations and characteristics of their construction necessitate using different methods of transferring the reference plane, but also different locations of the reference plane, relative to the nasion point. If assumed that the statistically accepted hinge axis points hold the same position or that the difference lies within a tolerably small range, the following table of mounting and/or conversion recommendations, for using the various anatomic face bows, results:

Articulator	Anatomic Bow	TCI	SCI
Artex	Direct mounting in the Artex Articulator, Reference face bow upgrade with axis pins (order number 06-230491).	Calculations are set directly.	Calculations are set directly.
Denar	Mounting with Denar Slidematic face bow, adjustment of the bow to the anterior mark on the skin with the orbital pointer.	Calculations are set directly.	Calculations are set directly.
Hanau	Mounting with Hanau Slidematic face bow, adjustment of the bow to the anterior mark on the skin with the orbital pointer.	Calculations are set directly.	Calculations are set directly.
Ivoclar	Mounting using Ivoclar UTS (Universal Transfer bow System), Reference plane determined by means of anterior mark on skin and orbital pointer.	Calculations are set directly.	Calculations are set directly.

KaVo	Direct mounting in KaVo Articulator, Reference face bow upgrade with axis pins (order number 06-230491). Required accessory: KaVo extraneous bow reference.	Calculations are set directly.	Calculations are set directly. Scale: Frankfurt horizontal.
Panadent	Mounting using Panadent face bow.	Calculations are set directly.	Calculations are set directly.
Reference	Direct mounting in the Artex Articulator, Reference face bow upgrade with axis pins (order number 06-230491).	Calculations are set directly.	Calculations are set directly.
SAM	Mounting with SAM ATB face bow.	Calculations are set directly.	Subtract 2° from the given SCI table values, the calculation of the fossa characteristic remains unchanged.
Whip Mix	Mounting with Whip Mix anatomic face bow.	Calculations are set directly.	Calculations are set directly.

For detailed information regarding the face bow transfer and the mounting of models in the articulator, please refer to the instruction manual "Reference SL Articulator and Face Bow Systems".

6 Troubleshooting

There are always two steps involved in correcting errors in the CADIAX system: first, determine the problem and then carry out the recommended solution to eliminate the error.

If errors occur that are not covered in this chapter, contact an authorized GAMMA service center to resolve the problem.

The device is not detected by the recording software and the green LED on the front of the device is unlit.

Possible cause of error	Solution
The device is not connected to the computer.	Connect the device with an USB port of your computer.
The USB connection between device and computer is defective.	Use another USB port or another USB cable.
The CADIAX device is defective.	Contact an authorized GAMMA service center.

The device is not detected by the recording software but the green LED on the front of the device is lit.

Possible cause of error	Solution
The USB connection between device and computer is defective.	Use another USB port or another USB cable.
The CADIAX device is defective.	Contact an authorized GAMMA service center.
The driver software has not been installed correctly or has not been installed at all.	Disconnect the CADIAX device from the computer. Start the setup routine of the software and perform a repair. Restart the computer and reconnect the device after a short waiting period. Start the recording software only when the operating system has finished configuration of the device. If the computer is connected to the internet, you can also have the drivers installed by Windows Update automatically.
Other software-related issue.	Contact an authorized GAMMA service center.

The green LED on the device front blinks slowly and/or the recording software notifies that a hardware defect has been encountered.

Possible cause of error	Solution
The CADIAX device is defective.	Contact an authorized GAMMA service center.

After mounting, the position of the styli is outside the black measuring surface areas of the flags.

Possible cause of error	Solution
The patient's lower jaw was not in reference position when the writing bow was set to the hinge axis	Repeat the procedure of adjusting the writing bow. Make sure that the patient keeps their lower jaw

point.	closed in centric position.
The holding clamps of the writing bow are not firmly tightened.	Make sure that the holding clamps of the bow are firmly fixated both on the shaft of the clutch and on the side arms. Otherwise, additional stress caused by the mounted styli can cause certain displacements.
The writing bow was not properly adjusted to be free of tension.	Repeat the procedure of adjusting the writing bow. Make sure to keep the system free of tension. The writing bow must not be allowed to move, especially when removing the axis locators.

After mounting, the system indicates that there is no contact between stylus and flag of either side.

Possible cause of error	Solution
A stylus is not connected.	Plug the stylus into the CADIAX device.
A flag is not connected.	Plug the flag into the CADIAX device.
The right and left measuring sensors are erroneously interchanged.	Insert the plugs correctly.
A stylus is outside the allowed measuring area of the flag due to incorrect mounting.	Repeat mounting the face bow. Make sure that both styli are positioned to stay on the black measuring surface of the flag, also during medio-trusive movements.
A measuring flag is soiled.	Due to the flag being soiled, there is no continuous electrical contact between the tip of the stylus and the measuring surface of the flag. Clean the flag surface according to the provided cleaning instructions.
A stylus is defective.	Contact an authorized GAMMA service center.
A flag is defective.	Contact an authorized GAMMA service center.
The CADIAX device is defective.	Contact an authorized GAMMA service center.

Recorded curves go "backwards" instead of protrusive.

Possible cause of error	Solution
The right and left measuring sensors are erroneously interchanged.	Insert the plugs correctly.

Recorded curves do not begin in the coordinate origin.

Possible cause of error	Solution
The position of the styli has changed between setting the reference position and starting the recording.	Repeat setting the reference position. If necessary, repeat this procedure before each recording.

Recorded curves show strong artifacts.

Possible cause of error	Solution
A measuring flag is soiled.	Due to the flag being soiled, there is no continuous electrical contact between the tip of the stylus and the measuring surface of the flag. Clean the flag surface according to the provided cleaning instructions.
A stylus is outside the allowed measuring area of the flag due to incorrect mounting.	Repeat mounting the face bow. Make sure that both styli are positioned to stay on the black measuring surface of the flag, also during medio-trusive movements.
"Sliding chair effect" caused by surface friction between stylus and flag.	The movement of the stylus across the flag surface can cause a so called "sliding chair effect" to occur. During such, the tip of the stylus shortly lifts up from the flag surface, causing electrical contact to be lost. During application, this effect is often accompanied by a squeaking sound during movements. To minimize this effect, apply a smallest possible amount of medical petroleum jelly onto the measuring surface of the flag. Make sure to clean the flag after the recording.
A stylus is defective.	Contact an authorized GAMMA service center.
A flag is defective.	Contact an authorized GAMMA service center.
The CADIAX device is defective.	Contact an authorized GAMMA service center.

Recorded curves are too short on one side.	
Possible cause of error	Solution
A measuring flag is soiled.	Due to the flag being soiled, there is no continuous electrical contact between the tip of the stylus and the measuring surface of the flag. Clean the flag surface according to the provided cleaning instructions.
A stylus is outside the allowed measuring area of the flag due to incorrect mounting.	Repeat mounting the face bow. Make sure that both styli are positioned to stay on the black measuring surface of the flag, also during medio-trusive movements.
The right or left measuring sensors are not connected to the device.	Insert the plugs correctly.
A stylus is defective.	Contact an authorized GAMMA service center.
A flag is defective.	Contact an authorized GAMMA service center.
The CADIAX device is defective.	Contact an authorized GAMMA service center.

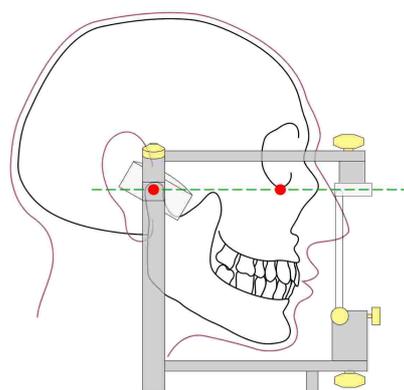
7 Background information

In this chapter you will find explanations regarding the terminology and backgrounds of the GAMMA concept.

7.1 The reference coordinate system

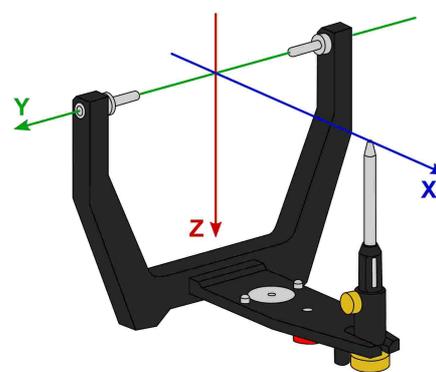
In order to aggregate CADIAX condylography data and CADIAS cephalometry tracings, all GAMMA products use the hinge-axis-orbital coordinate system as reference. This allows the reproducible and standardized transfer of recorded data in the analog or virtual articulator.

The basis for the axis-orbital coordinate system is the axis-orbital-plane (AOP), which is defined by the left and right hinge axis points and the left orbital point (lowest point of the orbit's anterior margin). Before a lateral radiography, usually lead markers are placed on these three points to indicate their location in the x-ray image.



The axis-orbital-plane on the cranium and in the articulator. The visible axis point and the orbital point are marked red.

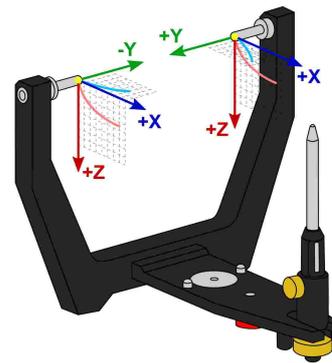
The origin of the coordinate system is located centrally on the hinge axis between right and left condyle. From this origin, the positive X axis extends anterior towards the orbital point, the positive Z axis downwards, and the positive Y axis to the right, from the patient's point of view. The median-sagittal plane coincides with the X and Z axis, the transversal plane with the X and Y axis, and the frontal plane with the Y and Z axis.



The origin of the axis-orbital coordinate system in the articulator.

The movements of the right and left condyle recorded during condylography are visualized in symmetric sub-coordinate systems with identical axis definitions.

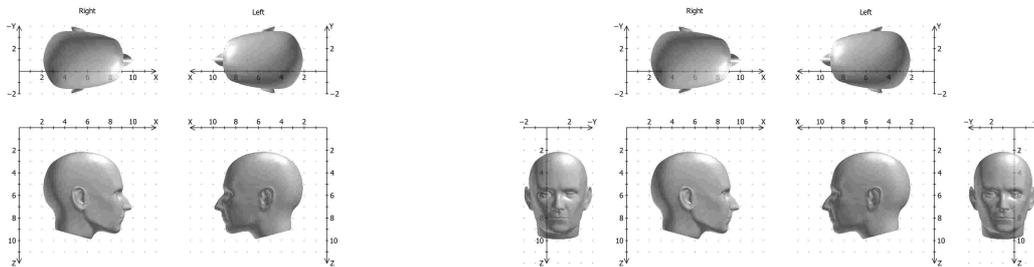
When recording movements on the patient, the distance between left and right measurement electronics is naturally greater than the distance between the right and left condylar guidance elements in the articulator. It is for this reason that recordings have to be recalculated to the smaller distance before the software can calculate articulator settings.



The zero points of right and left condyle used when recording condylography.

i The reference position set during recording represents the zero point of these sub-coordinate systems. Ideally, the reference position is located on the hinge axis and remains fixed for the duration of the recording. However, due to physiological reasons, most patients are unable to return to the precise starting position after a movement. In these cases it can happen that recordings do not start in the zero point, unless the reference position has been re-fixed before each individual recording.

Besides viewing condylographic recordings in sagittal (X/Z) or transversal (X/Y) projection, the CADIAX applications can also display additional coordinate systems for frontal projection (Y/Z):



The coordinate system with sagittal and transversal view.

Extended coordinate system with sagittal, transversal, and frontal view.

7.2 Exact and anatomic hinge axis

A CADIAX condylography recording can be carried out based on either the exact or the anatomic hinge axis of the temporomandibular joint, depending on the used recording system. In both cases, the measurement takes place in close proximity to the joint itself.

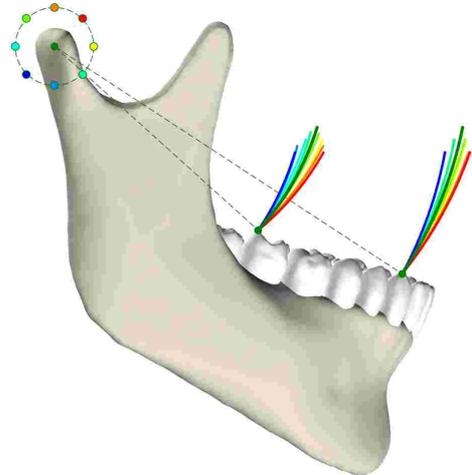
The exact hinge axis (also referred to as kinematic or individual hinge axis) is determined during the recording on the patient. Here, the joint is fixated in retral position and the rotation center of stationary open/close movements is observed. Subsequently, the measurement electronics are adjusted to that position and the reference position is set. For recording on exact hinge axis without limitations, a CADIAX 4 or CADIAX diagnostic device is required.

In contrast to the exact hinge axis, the anatomic hinge axis (also referred to as arbitrary hinge axis) is not ascertained for each individual patient. Rather, its location is given through the empirically determined distance of 10 mm anterior to the ear canal. This position is indicated on the Reference AB face

bow that is usually used for anatomic recordings and therefore easy to find and adjust to. Recordings on the anatomical hinge axis can be carried out with the devices CADIAX compact 2 as well as CADIAX 4.

The advantage of recording on the anatomic hinge axis is in its simple and quick application. While the deviation from the exact hinge axis inevitably leads to a distortion of the curve characteristics, its effects on the movements used for articulator programming, namely protrusion and mediotrusion, are tolerable.

However, when recording condylography for the purpose of functional diagnostics and occlusion analysis, the exact determination of the patient's individual hinge axis is imperative. In this use case, hinge axis deviations of just a few millimeters in combination with the rotational component can cause significantly different movement patterns in the tooth area.

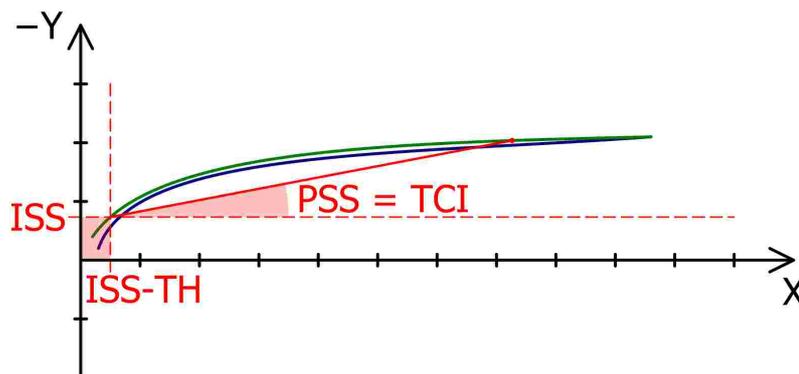


The effects of various deviations from the exact hinge axis onto the movements of dental cusps.

7.3 Immediate side shift (ISS)

Some articulator systems divide the transversal Bennett curve into an immediate and a subsequent progressive side shift movement. These two phases of the movement are referred to as "immediate side shift" (ISS) and "progressive side shift" (PSS), respectively. The separation is made at a particular distance measured in X direction, which is referred to as "ISS threshold" (ISS-TH).

In the articulator settings calculated by the software, the ISS describes the maximum transversal displacement up to the specified threshold distance. The PSS however is an angle value equatable to the transversal condylar inclination (TCI), not including the initial displacement.



The ISS threshold (ISS, here: 0.5 mm) separates the Bennett movement in immediate (ISS) and progressive side shift (PSS).

8 Specifications

8.1 Technical data

ADC resolution:	14 bit (CADIAX compact 2, model A) 16 bit (CADIAX compact 2, model B) 16 bit (CADIAX 4, model A)
Measurement data display:	0.01 mm
Distance accuracy:	± 5 %
Angle accuracy:	± 1.5 °
Supply voltage:	5 V DC (in compliance with USB specifications)
Current input:	max. 0.5 A (in compliance with USB specifications)
Protection class:	B 

8.2 Cleaning

8.2.1 CADIAX device

Make sure that the CADIAX device is disconnected from the computer. Also disconnect the sensors and the foot switch from the device. Remove dust and dirt with a soft cloth.



Do not use liquid, and make sure that no liquid gets inside the device during cleaning. The device must never be cleaned under running water or any other liquid. Do not use stiff brushes or steel wool.



Never clean the device with alcohol, organic solvents, or disinfectants, as these may cause damage to the components and the housing.

8.2.2 Measuring flags

The flag surface must not be damaged (e.g., scratched) or soiled (oil, dust, fingerprints, etc.). Check the condition of the flag surface before every application.

If necessary, the flag surface has to be cleaned. To do so, wipe the measuring area with rubbing alcohol and dapple it dry with a soft, lint-free cloth. Leave it in the open afterwards for it to dry completely. Make sure not to damage the sensitive surface during cleaning.



Never treat or clean the flags with stiff brushes or other abrasive materials.

8.2.3 Measuring styli

Only wipe off the styli with a dry, lint-free cloth. If necessary, clean the tips with rubbing alcohol.



Never treat the sockets and the axes with oil or any other lubricants.

8.2.4 Face bow

Parts of the face bow must only be disinfected by spray or wipe disinfection. Wash off any residues under running water. Only the glabella support may be sterilized in an autoclave (5 minutes at 134 °C; 20 minutes at 120 °C).

8.2.5 Functional occlusal clutch

Disinfect the functional occlusal clutch in a disinfecting tank or use disinfectant spray. Subsequently, clean the registration material off the clutch. Sterilization can be carried out in an autoclave (5 minutes at 134 °C; 20 Minutes at 120 °C).

8.2.6 Occlusal tray clutch

Disinfect the occlusal tray clutch in a disinfecting tank or use disinfectant spray. Subsequently clean the registration material off the clutch. Sterilization can be carried out in an autoclave (5 minutes at 134 °C; 20 Minutes at 120 °C).

8.2.7 Bite fork

Disinfect the bite fork in a disinfecting tank or use disinfectant spray. Subsequently clean off any registration material. If a thermoplastic material has been used, it is advisable to place the bite fork in a refrigerator to make removal of the registration material easier. Sterilization can be carried out in an autoclave (5 minutes at 134 °C; 20 Minutes at 120 °C).

8.2.8 3D joint support

The 3D joint support must only be disinfected by wipe disinfection.



Never treat the joints of the 3D joint support with oil or any other lubricants and do not place the part in an immersion bath.

8.3 Recurrent tests

Like all other electronic devices, also the CADIAX device and its electronic components go through the process of aging. Therefore, the measurement function and security of the device has to be tested at regular intervals. A test interval of one year is recommended.

The security testing has to be carried out in compliance with standard IEC 62353 ("Medical electrical equipment - Recurrent test and test after repair of medical electrical equipment") or the appropriate local derivative.

During the recurrent tests, any differences in potential between the touchable, conductive elements of the connector assembly has to be measured. Any detected difference in potential indicates faulty security technology, which has to be corrected. These measurements are carried out as supplementary to the required standard tests above.

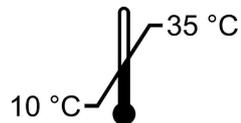
Measurement technology testing are carried out by GAMMA or by a service center authorized by GAMMA.

The measuring flags are subjected to relatively high mechanical stresses, and undergo the results of normal attrition. They should be replaced after approximately 500 examinations.

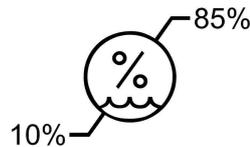
8.4 Operating conditions

The device is designed for operation exclusively in dry areas.

- Temperature: From 10 °C to 35 °C.



- Relative humidity: From 10% to 85%, non-condensing.



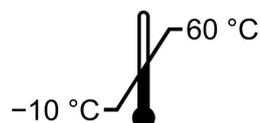
In case of a drastic change in temperature, wait until the device has reached room temperature before beginning operation.

8.5 Storage and transport

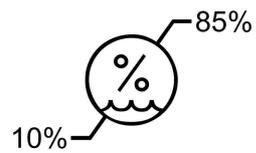
If the device is to be transported over long distances, pack it in its original packaging. Store the flags and styli in the appropriate containers as long as they are not in use.

For storage and transport, make sure to comply with the following environmental conditions:

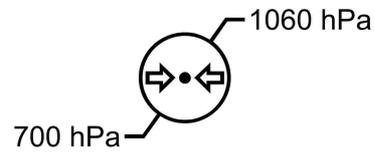
- Temperature: From -10 °C to 60 °C.



- Relative humidity: From 10% to 85%. Store in a dry place!



- Atmospheric pressure: From 700 hPa to 1060 hPa.



8.6 Disposal



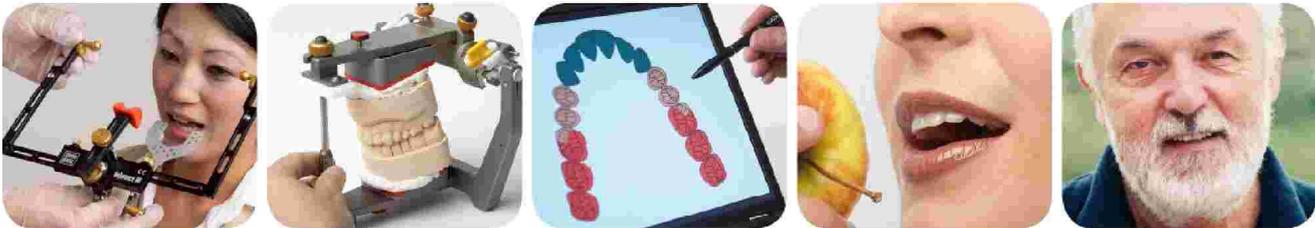
After their product life, the CADIAX device and its components have to be disposed of correctly. Doing so, comply with the regulations that are in effect in your country or city, regarding the disposal of electronic equipment.





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