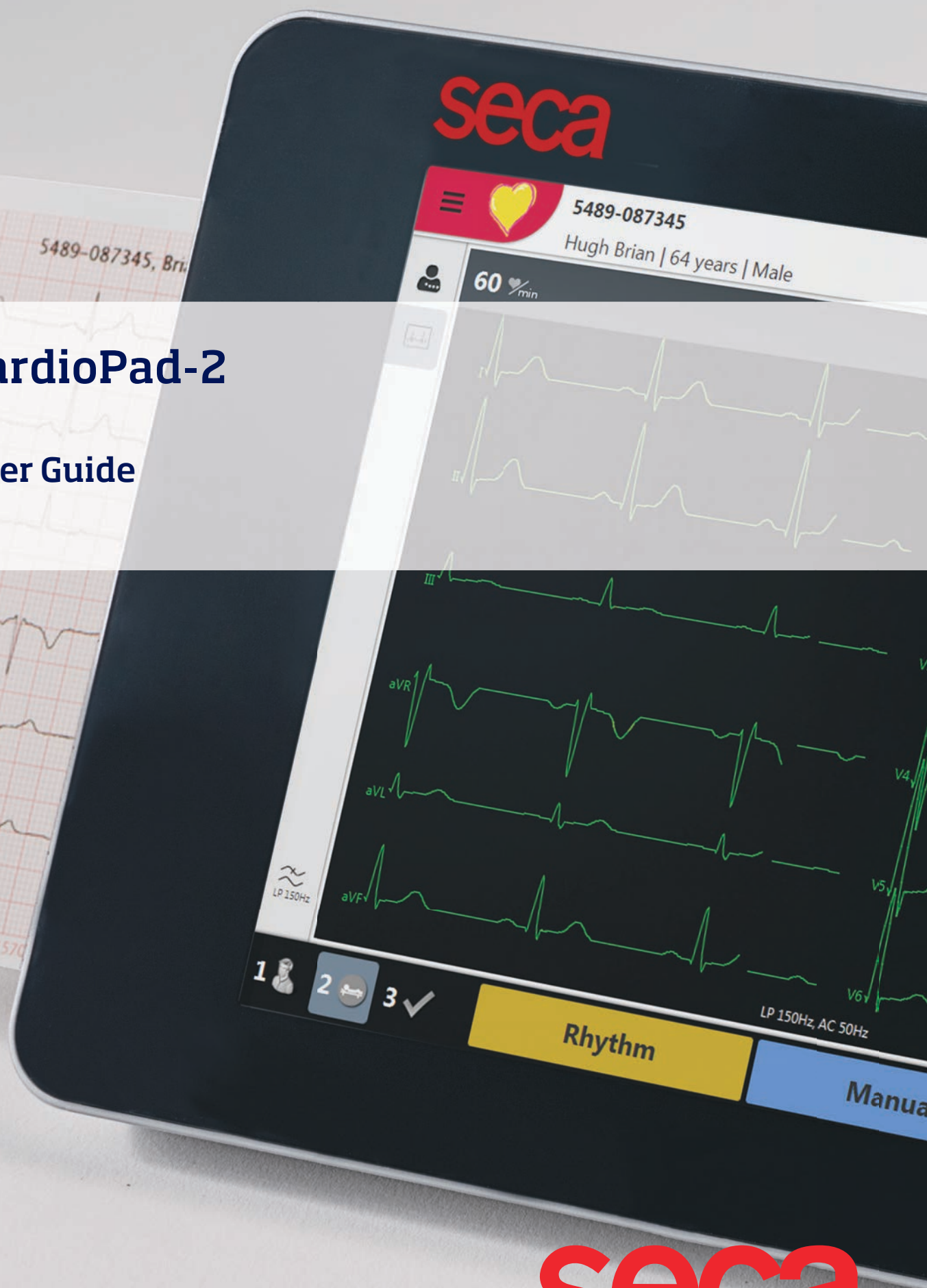


CardioPad-2

User Guide



Art. no.: 2.511405 Rev.: a

seca

Precision for health



Sales and Service Information

The seca sales and service centre network is world-wide. Contact your nearest seca subsidiary to obtain the address of your local distributor. In case of difficulty, a complete list of all distributors and subsidiaries is provided on our internet site:

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SCHILLER AG

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CH-6341 Baar, Switzerland



The CardioPad-2 (CARDIOVIT FT-1) bears the CE-0123 mark (Notified Body TÜV-SÜD Produkte Service GmbH, Ridlerstr. 65, 80339 Munich, Germany), indicating its compliance with the essential requirements of the Annex I of the Medical Device Directive 93/42/EE regarding safety, functionality and labelling. The requirements apply to patients, users and third persons who come into contact with this device within the scope of its intended use.

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1 Safety Notes

1.1 Responsibility of the User

- ▲ The CardioPad-2 must only be used by qualified physicians or trained medical personnel.
- ▲ The numerical and graphical results as well as any interpretation suggested by the device must be examined with respect to the patient's overall clinical condition and the quality of the recorded data.
- ▲ The responsibilities of the personnel for the operation and maintenance of the device must be specified.
- ▲ Ensure that the personnel have read and understood this user guide, in particular this section **Safety Notes**.
- ▲ Damaged or missing components must be replaced immediately.
- ▲ The safety, reliability and performance of the device can only be guaranteed when the maintenance intervals as stated in the section [Maintenance](#) are observed.

1.2 Organisational Measures



- ▲ Before using the device, ensure that a medical product representative has explained its functions as well as the safety requirements.
- ▲ Keep this user guide in an accessible place for reference purposes. Make sure that it is always complete and legible.
- ▲ Observe the operating and maintenance instructions.
- ▲ In addition to this user guide, legal and other binding regulations for the prevention of accidents and for environment protection must be observed.

1.3 Intended Use



- ▲ The CardioPad-2 is a 12-channel ECG unit used for the recording, analysis, viewing, storage and transmission of ECGs.
- ▲ The CardioPad-2 is designed for indoor use and can be used for all patients of both sexes, all ethnicities and all ages.
- ▲ The CardioPad-2 is used to diagnose cardiac abnormalities, detect acute myocardial ischaemia and infarctions in chest pain patients, etc.
- ▲ The CardioPad-2 is intended for indoor use in hospitals, cardiological units, outpatient clinical units and general physicians' offices.


1.4 Contra-indication



- ▲ The device is not designed for sterile use.
- ▲ Do not use this unit in areas where there is any danger of explosion or in the presence of flammable gases such as anaesthetic agents.
- ▲ The device is not designed for direct cardiac application.
- ▲ The device is not designed for use in an MRI suite.

1.5 Safety-Conscious Operation



- ▲ Make sure that the staff have read and understood the operating instructions, in particular this section Safety Notes.
- ▲ Only operate the device in accordance with the specified technical data.
- ▲  The device is CF classified. It is defibrillation protected only when the seca original patient cable is used. However, as a safety precaution, remove the electrodes before defibrillation, if possible.
- ▲ Do not touch the unit casing during defibrillation.
- ▲ To ensure patient safety, none of the electrodes, including the neutral electrode, nor the patient or any person with simultaneous patient contact, must come in contact with conductive parts, even when these are earthed.
- ▲ Immediately report any changes that impair safety (including operating behaviour) to the person responsible.
- ▲ Do not place any liquids on the unit. If liquid is spilled on the device, immediately disconnect the device from the mains and wipe it. The device must be serviced before reusing.
- ▲ Only connect the original seca patient cable to the patient socket.
- ▲ If the patient cable should become defective after defibrillation, an electrode becomes displaced, or an electrode resistance is too high, a lead-off indication is displayed in the upper right part of the screen.
- ▲ Only use accessories and disposables recommended or supplied by seca. Use of other than recommended or supplied parts may result in injury, inaccurate information and/or damage to the unit.
- ▲ To prevent pacemaker malfunction, a distance of at least 20 cm must be observed between the device and the pacemaker as soon as the Wi-Fi (wireless LAN) module is switched on.


1.6 Safety facilities



- ▲ Operating the device without the correctly rated fuse or with defective cables constitutes a danger to life! Therefore:
 - Do not operate the unit if the earth connection is suspect or if the mains lead, the power supply unit or the device is damaged or suspected of being damaged.
 - Damaged cable connections and connectors must be replaced immediately.
 - The electrical safety devices, such as fuses, must not be altered.
 - Ruptured fuses must only be replaced with the same type and rating as the original.

1.7 Operation with other Devices



- ▲ Accessory equipment connected to the analogue and digital interfaces must be certified according to the respective IEC standards (e.g. IEC/EN 60950 for data processing equipment and IEC/EN 60601-1 for medical equipment). Furthermore, all configurations shall comply with the valid version of IEC/EN 60601-1. Everybody who connects additional equipment to the signal input part or signal output part configures a medical system and is therefore responsible that the system complies with the requirements of the valid version of IEC/EN 60601-1. If in doubt, contact the technical service department or your local representative.
- ▲ Any other equipment used with the patient must use the same common earth as the CardioPad-2.
- ▲ Special care must be exercised when the unit is used with high-frequency equipment. Use the special high-frequency seca patient cable to avoid possible signal interference during ECG acquisition and to reduce the risk of burns in case of a lack of potential equalisation. However, the stimulation units should only be used at a sufficient distance from the electrodes and both devices must be connected to the same potential equalisation. If in doubt, the patient should be disconnected from the device.
- ▲ This device can safely be used with pacemaker patients.
- ▲ There is no danger when using this device simultaneously with electrical stimulation equipment.
- ▲ If the device is part of a medical system, only the original seca patient cable must be used with, and connected to, the CardioPad-2.
- ▲ If the patient cable should become defective after defibrillation, a lead-off indication is displayed on the screen (see Page 38).
- ▲ Portable communication devices, HF radios and devices labelled with the  symbol (non-ionic electromagnetic radiation) can affect the operation of this device (Page 104).

1.8 Network safety



- ▲ When the CardioPad-2 is part of a *network* (LAN, WLAN, HIS, etc.), the operator of the network/data coupling must take appropriate security measures to protect the transmission of data. Networks that are not protected and maintained can lead to failure of the data transmission or to incorrect transmission of data, which in turn can result in danger to the patient. For further safety notes, see chapter 10.

1.9 Maintenance



- ▲ Danger of electric shock! Do not open the device. There are no serviceable parts inside. Refer servicing to qualified technicians authorised by seca only.
- ▲ Before cleaning and to isolate the mains power supply, switch the unit off and disconnect it from the mains by removing the plug.
- ▲ Do not use high-temperature sterilisation processes (such as autoclaving). Do not use E-beam or gamma radiation sterilisation.
- ▲ Do not use aggressive or abrasive cleaners.
- ▲ Do not, under any circumstances, immerse the device or cable assemblies in liquid.

1.10 Terms of Warranty

Your seca CardioPad-2 is warranted against defects in material and manufacture, as stated in the Terms and Conditions. Excluded from this warranty is damage caused by an accident or as a result of improper handling. The warranty entitles to free replacement of the defective part. Any liability for subsequent damage is excluded. The warranty is void if unauthorised or unqualified persons attempt to make repairs.

In case the device is defective, send it to your local seca representative or directly to the manufacturer. The manufacturer can only be held responsible for the safety, reliability and performance of the device if:

- assembly operations, extensions, readjustments, modifications or repairs are carried out by persons authorised by him, and
- the seca device and approved attached equipment is used in accordance with the manufacturer's instructions, and.
- the maintenance intervals as stated in the section [Maintenance](#) are observed.



There are no express or implied warranties which extend beyond the warranties hereinabove set forth. seca makes no warranty of merchantability or fitness for a particular purpose with respect to the product or parts thereof.

seca assumes no liability for the loss of data saved on the computer or on the device. The owner is solely responsible for the data backup.

1.11 Safety Symbols and Pictograms

1.11.1 Symbols used in this document

The safety level is classified according to ISO 3864-2. The following overview shows the safety symbols and pictograms used in this manual.



For a direct danger which could lead to severe personal injury or to death.



For a possibly dangerous situation which could lead to severe personal injury or to death.



For a possibly dangerous situation which could lead to personal injury. This symbol is also used to indicate possible damage to property.



For general safety notes as listed in this chapter.



For electrical hazards, warnings or precautionary measures when dealing with electricity.



Note For possibly dangerous situations which could lead to damages to property or system failure. **Important** or helpful user information.

Reference to other instructions.

Touch-sensitive areas

This symbol is used to designate touch-sensitive areas that might not be self-evident.



Touch (to open/close menus and perform functions)



Move up or down.



Move to the right or left



Scroll up or down using two fingers

1.11.2 Symbols used on the device



Potential equalisation.



CF symbol. The device is classified safe for internal and external use. However, it is only defibrillation protected when used with the original seca patient cable.



Manufacturer symbol, manufacturing date.



Keep dry.



Symbol for the recognition of electrical and electronic equipment
Equipment/components and accessories no longer required must be disposed of in a municipally approved collection point or recycling centre. Alternatively, you can return the equipment to your supplier or the manufacturer for disposal. Improper disposal can harm the environment and human health.



The unit/component can be recycled



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Attention: consult accompanying documents.



Consult the user guide.



Attention: non ionising electromagnetic radiation. The device contains an HF transmitter (Wi-Fi).

The CardioPad-2 radiates high-frequency electromagnetic energy and can disturb other devices if not installed and operated in accordance with the user guide. CardioPad-2 However, there is no guarantee that no interference can occur in certain installations. If the CardioPad-2 causes interferences, these can be determined by switching the device off/on or by transmitting/not transmitting ECG data. The user can take the following measures to solve this problem:

- Increase the distance between the disturbed device and the CardioPad-2. A minimum distance of 20 cm must be kept between the device and a pacemaker.
- Turn the device to change the angle of radiation.
- Connect the device to a different mains connector.

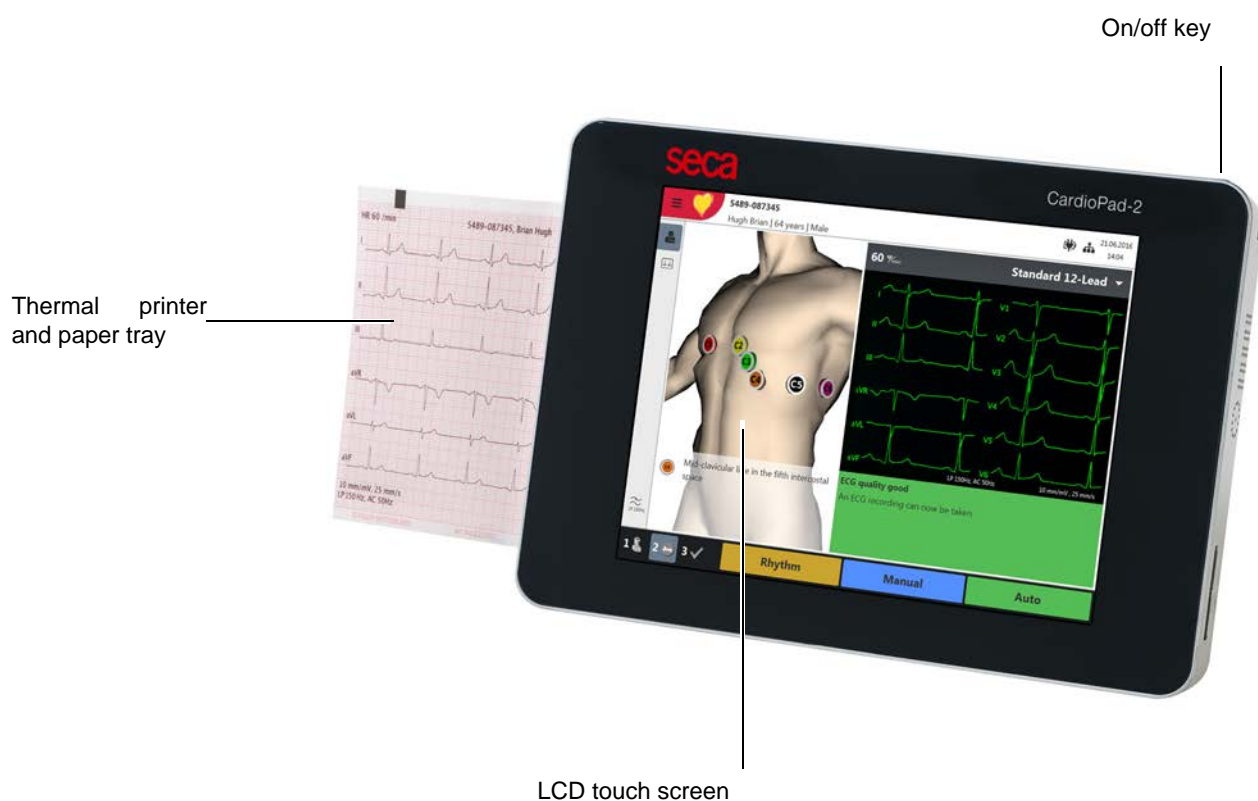
For more details, see [Page 102](#).

2 Introduction

The seca CardioPad-2 is a 12-channel ECG unit designed to record, display, and measure resting ECGs. The multi-touch screen allows easy and intuitive operation to efficiently enter patient data, record ECGs and adjust device settings.

The CardioPad-2 has the following features:

2.1 Main components of the CardioPad-2



2.1.1 Standard

- Pacemaker detection
- Manual rhythm printout in real time (leads, speed and amplitude can be changed)
- Auto mode recording (10 seconds) with user-defined layout
- Rhythm
- Measurements
- Full disclosure of all 12 channels
- Display of reversed electrodes
- Recording review
- Connectivity
 - Wi-Fi
 - LAN
- Schiller Link
- PDF export to USB

2.1.2 Options

- Interpretation with ETM Sport
- Barcode reader - to read a patient's ID and retrieve patient data from a database
- Culprit Coronary Artery Algorithm (CCAA)
- Worklist

2.2 Connections

- RJ-45 Ethernet connector (network)
- 2 USB interfaces for software updates with a USB stick and connection of a barcode reader.
- 1 USB connection type B for streaming to CS-104 application
- Kensington lock

2.3 Display

The display will vary according to the task being carried out. In all screens, however, the top, bottom and right areas always display the same category of information. Example for a typical patient data view:

Access to the main menu

- Worklist
- Recorder
- Memory
- Settings
- Maintenance

Entering Patient Data

Display of patient data

Patient ID / Visit ID

Hugh Brian I 53 years I Male

Network/WLAN status

Battery/mains status

Export status

Printer jobs

Worklist item

Storing capacity

Date and time

05.04.2019 08:40

Sub-menu

- Patient data
- Recording data

1 Enter patient data

2 Apply electrodes, check and record resting ECG, CCAA or ETM Sport

3 Check and save recording

Record ECG

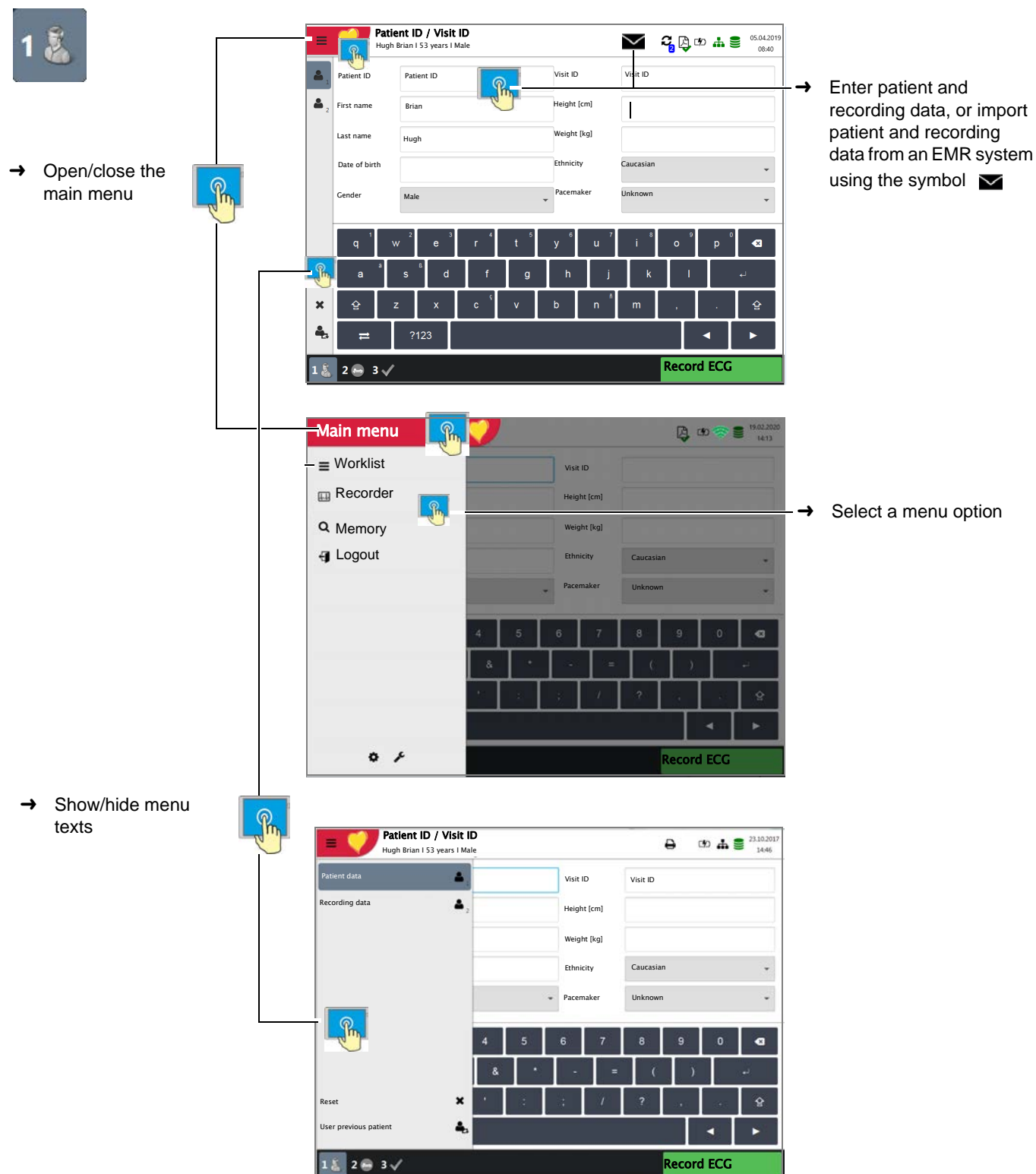
Review

Function key, go to the next step. The function keys change their function depending on the selected view.

Function key to return to the review screen; this is only available when the recording has not yet been accepted.

2.4 Multi-touch screen operation

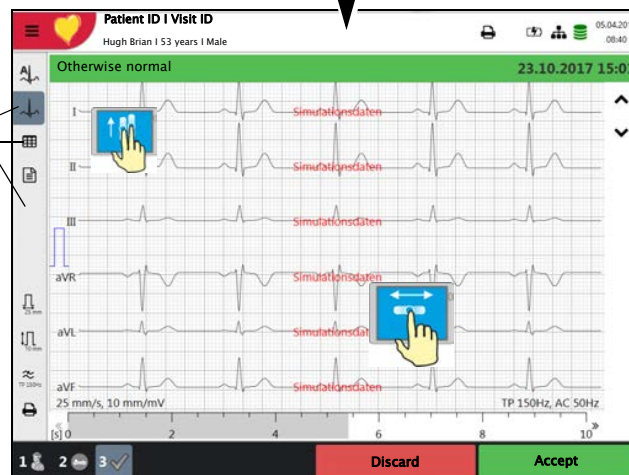
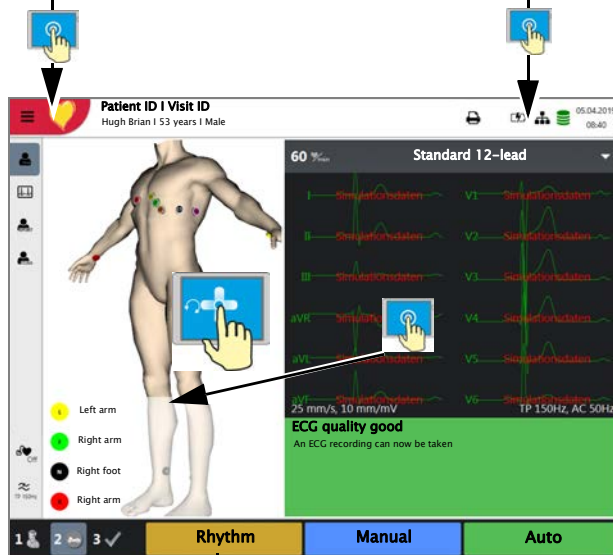
The touch-sensitive areas of the screen are located as follows:





→ Prepare ECG recording

- Determine electrode positions and apply electrodes
- Check the signal quality
- Select Auto, ETM Sport or CCAA



→ To edit patient data or record an emergency ECG, press the key **1** before accepting the recording, and edit/enter the patient data. Press **Review** to return to the review screen.

- The recorded ECG is displayed and can be reviewed.
- Rotate leads I...V6: scroll up or down and along the time axis.
- Display average values, results and measurements.
- Set the speed with , and the amplitude with .
- Set filter for display to 25/40/150 Hz or Off.
- Accept the ECG (i.e. save), print, or discard.

Rhythm ECG

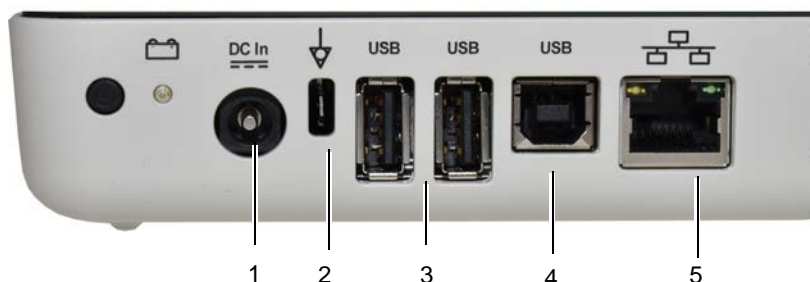
→ Press to set the amplitude, press to select the lead and to move along the time axis.

2.5 Connection panel

CAUTION

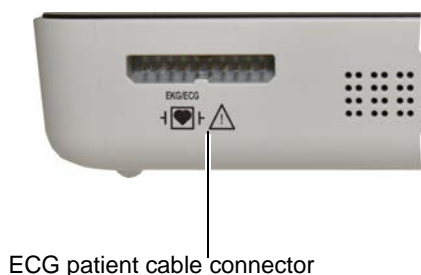
- ▲ All externally connected hardware must be approved by seca. Connection of any hardware not approved by seca is at the owner's risk. Moreover, the unit's warranty may become invalid.

2.5.1 Back panel




- (1) Power input 15 VDC
- (2) Potential equalisation stud. The potential equalisation stud is used to equalise the ground potential of the unit to that of any nearby mains-powered equipment. Use the hospital or building common ground for all mains-powered units.
- (3) 2x USB interfaces for the barcode scanner and USB sticks.
- (4) 1x USB interfaces type B for ECG streaming to CS-104 application
- (5) RJ-45 Ethernet LAN connection (Local Area Network)

2.5.2 Right hand side panel



ECG patient cable connector

CAUTION

- ▲ The patient cable as well as the connector comply with the safety standard CF , e.g. they are fully floating and isolated and defibrillation protected.
- ▲ The unit is only CF rated and defibrillation protected if used with the original SCHILER patient cable.

3 Operation

3.1 Start-up and Preparation



- ▲ Danger of electrical shock. Do not operate the unit if the earth connection is suspect or if the power supply unit/mains lead is damaged or suspected of being damaged.

3.1.1 Location

- Do not keep or operate the unit in a wet, moist or dusty environment. Avoid exposure to direct sunlight or heat from other sources.
- Do not allow the unit to come into contact with acidic vapours or liquids.
- The CardioPad-2 must not be placed in the vicinity of X-ray or diathermy units, large transformers or electric motors.

3.1.2 Connection of external cable assemblies and ancillary equipment



1. Connect the external power supply unit to the mains.
2. Connect the external power supply unit's output to the back panel. The mains indicator lamp is lit.
3. Leave the CardioPad-2 connected to the mains for 8 hours to fully charge the battery (see [Page 21](#)).
4. Connect the potential equalisation cable.
5. Connect the patient cable (side panel).
6. Connect any ancillary and optional equipment (see [Page 18](#)). These may include the following:
 - Network cable
 - USB barcode reader

3.1.3 Potential equalisation



The potential equalisation stud at the back of the unit is used to equalise the ground potential of the CardioPad-2 to that of all mains-powered equipment in the vicinity. Use the hospital or building common ground. A yellow/green ground cable is supplied as an option (article number 2.310320).



- ▲ Danger of triggering ventricular fibrillation! If the CardioPad-2 is used together with devices that are designed for direct cardiac application, both devices must be connected to the hospital/building common ground (potential equalisation) to prevent equalising currents between different device potentials.

3.2 Switching on / off



→ The unit is switched on and off with the **On / Off** key.

3.2.1 Login and Logout / Emergency ECG

If Access control is activated, the following dialogues are displayed:

Login

→ Enter the password and press **“Login”** to log in.

In addition, for access control modes “Local” or “Schiller Server”, a user name is required.

Emergency ECG

→ Select **“Emergency ECG”** to bypass the login procedure and to perform an emergency ECG.

→ You are automatically logged off when the ECG recording is accepted.

Logout

→ Open the main menu  and select  Logout .



- In the system settings ([Section Access control, page 86](#)), the following Access control settings are available:
 - None**: no user name or password is required, the program is opened directly when the device is switched on.
 - Basic**: to access levels with a separate password for the device (recording) and/ or the settings.
 - Local**: the user and password are defined locally in the settings. Three different privileges can be defined.
 - SCHILLER Server**: user, password and access privileges are defined on the SCHILLER Server.
- The user roles and privileges are individually assigned to the users, defining access to different workflows and functions. If a function is not available, it means that the logged in user does not have the necessary privileges for this function. Individual users and their user groups and privileges are defined on the **SCHILLER Server**, or **locally** if the system is not networked
- If **Emergency ECG** is selected, the login procedure is bypassed and the patient data view is displayed directly. Once the emergency ECG has been accepted, the login dialogue is displayed again. Access to other functions is not possible.



3.3 Power supply

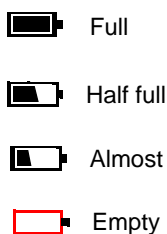
3.3.1 Mains and battery indicators



The unit can either be operated from the mains supply or from the built-in rechargeable battery. Battery charging is indicated by the LED below the battery symbol.

The current power source is displayed in the top right corner of the screen when the unit is switched on:

- Mains via external power supply unit  , battery is being charged
- Internal rechargeable battery ()
- When running on battery power and the battery capacity is limited, the battery symbol is flashing.
- When mains is connected and the battery is charging, the battery symbol is displayed 'filling'.




Battery capacity

The internal battery provides power for up to four hours. When the unit is running on battery power (mains not connected), the battery symbol indicates the battery status. When the battery is full, the symbol is solid.

When running on battery power and the battery capacity is low, the battery symbol turns red.

Battery charging

The battery is charged when the unit is connected to the mains supply. The unit can remain connected to the mains supply without damage to either the battery or the unit.

When the battery is not fully charged and the mains supply is connected, the battery LED  is blinking, indicating that the battery is being charged.

3.3.2 Isolating the device from the mains supply

To isolate the device from the mains supply, remove the mains plug from the external power supply unit.

3.4 System and ECG settings



- The system settings (time, date, device ID etc.) and other general settings are described on [Page 76](#).
- Resting ECG settings (auto format, user defined leads, print options, interpretation, rhythm lead definition, etc.) are described on [Page 51](#).

Overview **Menu > Settings**

Menu Settings	Sub-menu
ECG (Page 76)	<ul style="list-style-type: none"> • Leads & cable • Filters & formulas • Views & layouts • Additional leads • Interpretation • Rhythm ECG
Reports (Page 79)	<ul style="list-style-type: none"> • General • Manual printout • Resting ECG • Rhythm ECG • EMR integration
Connectivity (Page 82)	<ul style="list-style-type: none"> • Update server • Ethernet • WLAN
Regional (Page 83)	<ul style="list-style-type: none"> • Date & time • Keyboard • Language • Units • Patient ID system
General (Page 84)	<ul style="list-style-type: none"> • Info • Power management • Station • Update • Manage licenses • Mandatory fields • Workflow • Access control • Printer

3.5 Changing the printing paper



Important

The device is delivered without printing paper inserted. The thermal paper is sensitive to heat, humidity and chemical vapours. The following points apply to both paper storage and archiving of recordings:

- Before use, keep the paper in its original cardboard cover. Do not remove the cardboard cover until the paper is to be used.
- Store the paper in a cool, dark and dry location.
- Do not store near chemicals, e.g. sterilisation liquids.
- Do not store in a plastic cover.
- Certain glues can react with the paper. Therefore, do not use glue to attach the printout onto a mounting sheet.

seca can only guarantee perfect printouts when original seca chart paper or chart paper of the same quality is used.

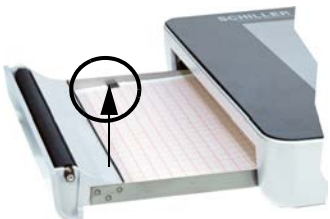
1. Pull out the paper tray.



2. Remove the remaining paper.



3. Place a new paper pack into the paper tray with the printed (grid) side facing upwards and the black paper mark facing the top of the unit.

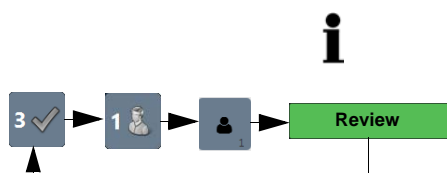


4. Pull out the first page as shown on the left.
5. Push the paper tray home until it locks into place.




3.6 Patient / recording data

In the patient data screen, new patients can be entered and previously stored patient data can be edited.



If a recording is performed without having entered a patient or visit ID, a UUID is generated instead of a patient ID, "Emergency ECG" is given instead of a last name, and the date and time are given instead of a first name. If you want to enter patient data once the recording has been performed (and before it has been accepted), you can jump to the Patient data screen, enter the data and use the Review key to jump back to Step 3 to accept (save) the recording.

With the data of the current patient, you can:

- edit it directly in the entry fields
- obtain the data from the server by entering the Patient or Visit ID (configuration: see page 82)
- press **X** to reset the data and enter a new patient
- press  to use the previous patient data
- read the Patient ID with a barcode scanner.
 - Use the alphanumeric keyboard (shown) to enter the patient data.
 - For numeric entry fields, only the numeric keypad is displayed.
 - Press the key **?123/ABC** to display special characters.
 - Use the **Shift** key to switch the keyboard to capitals.
 - To select special characters from the keyboard, **press and hold the key and select the special character.**





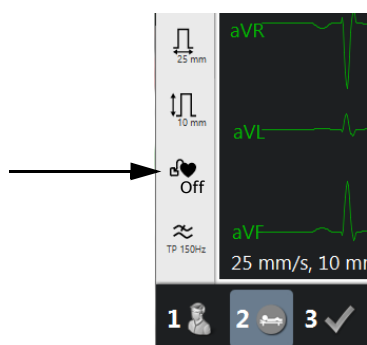
Patient data - left entry fields

Patient ID	Enter the patient's identification number.
Last name	Enter patient's name (maximum 50 characters).
First name	Enter patient's first name (maximum 50 characters).
Date of birth	Enter the patient's date of birth in the format dd-mm-yyyy or yyyy.mm.dd.
Gender	Enter the patient's gender - Male or Female or Undefined.

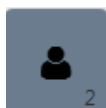
Patient data - right entry fields

Visit ID	An additional field for visit ID, patient reference no., hospital no., etc., can be entered if required. The maximum number of characters is 50.
Height	Enter the patient's height.
Weight	Enter the patient's weight.
Ethnicity	Select one of the following: <ul style="list-style-type: none"> – Undefined – Caucasian – Asian – Black / African American – American Indian / Alaska Native – Native Hawaiian / Pacific Islander – Hispanic – Oriental – Other

Pacemaker	Select if the patient has a pacemaker (Yes/No/Unknown).
------------------	---



Regardless of this setting, detected pacemaker pulses are indicated in blue and the interpretation states that it is a pacemaker ECG. Visual indication of pacemaker pulses is switched off and needs to be manually activated in the ECG preview.



Recording data - left side

Room

Examination room

Medication

☐ Digitalis

Indication

Reason for medication

Recording data - right side

Referring physician

Referring physician

Attending physician

Attending physician

Remark

Remarks about the patient/recording



Deleting entered patient data.



The previous patient data is entered again.



All fields (except for Medication) can be set as Mandatory fields: **Menu > Settings > General > Mandatory fields**, see [Section 9.5 General, page 84](#). For worklist recordings, defined mandatory fields are not taken into account.

3.6.1 Patient data query (PDQ)

When the unit is connected to SEMA or another hospital patient database (via network or WLAN), patient data can be filled in automatically when the **Patient ID** or **Visit ID** is entered. This is called **Patient Data Query** or **PDQ**.

Patient data query is possible as follows:

- The patient data is filled in automatically after the Pat ID/visit ID has been entered by the user or read with a barcode reader (confirm by pressing Enter) (see following).

The PDQ settings are defined in **Menu > Settings > General > Workflow** - the following options are available:

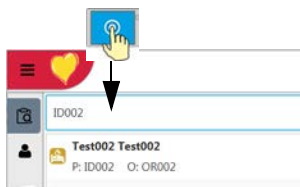
- **Patient data query (PDQ mode)** - select one of the following:
 - Patient ID
 - Visit ID

These settings along with other transmission settings are detailed in the system settings (see [Page 73](#)).

PDQ with barcode reader

If a barcode reader is attached (see next page), scan the barcode to enter the **Patient ID** / **Visit ID**. Patient data is filled in automatically when the **Patient ID/Visit ID** is read with a barcode reader.

3.6.2 PDQ in the worklist



If you use the "Worklist" workflow, you can search/enter patient data in the same way (see [Page 68](#)).

Tap the Search field and read the **Patient ID** or **Visit ID** using the barcode reader. The corresponding work item is shown in the worklist.

3.6.3 Barcode reader



Barcode scanner configuration: see document 2.510721.

Country-specific character sets can be defined in **Menu > Settings > Regional > Keyboard > External keyboard layout**.



A barcode reader can be attached to the USB port on the back panel to read the Patient ID / Visit ID. seca has tested the following barcode reader:

→ Symbol Model LS 2208, from Symbol Tech N.Y.

When a barcode reader is connected, the patient data is read from the barcode (generated by the hospital system). If an external hospital patient database is available, all patient data is entered in the patient data fields of the CardioPad-2 as described on the previous page.



A worklist can also be downloaded from a hospital patient database giving patient data and specifying the type of recording to be carried out. The worklist is described on [Page 68](#).

4 Placing the electrodes



- ▲ Ensure that neither the patient nor the leading parts of the patient connection nor the electrodes (including the neutral electrodes) come in contact with other persons or conductive objects, even when these are earthed.

4.1 Basics

Careful application of the electrodes and good electrode contact is important for a good recording (see electrode positioning on pages [31](#) - [38](#)).

A minimal resistance between skin and electrode is required to obtain the best ECG signal and ensure the highest quality ECG recording. Therefore, please note the following points:

1. Only use electrodes that are recommended by seca AG (see accessories)
2. Before using disposable electrodes, check that the expiration date has not yet passed.
3. To increase the electrode's conductivity and adherence:
 - Shave the areas where the electrodes are to be placed, if necessary.
 - Thoroughly clean the areas with alcohol or soapy water.
 - Let the skin dry before applying the electrodes.
 - ¹When applying the electrodes, ensure that a layer of gel is between the electrode and the skin.
4. Check the electrode resistance as described in the section [4.10](#).
5. If the electrode resistance is higher than the acceptable level:
 - Remove the electrode and use an abrasive cleaning pad or abrasive cleaning gel ² to remove the uppermost layer of epidermis.
 - Apply the electrode. Always use a new disposable electrode.
6. Ensure that the patient is warm and relaxed before you start the recording.
7. After the recording, remove the electrodes. Clean the suction or vacuum electrodes according to the manufacturer's instructions.

1. Electrode gel is integral with single-use electrodes and extra gel does not need to be applied when single-use electrodes are used. For biotab electrodes, solid conductive gel is incorporated in the adhesive.
2. Dedicated abrasive cleaning gel gives very good results in reducing the skin-electrode resistance.

4.2 Electrode Identification and Colour Code

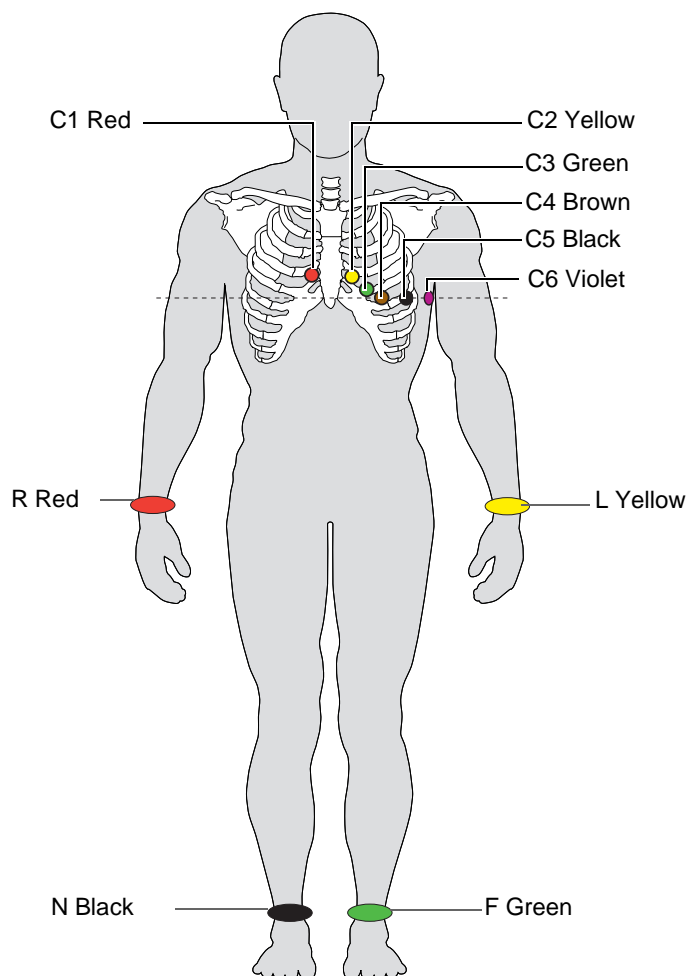
The electrode colour codes in the following sections correspond to Code 1 (IEC) for the graphics and to Code 2 (AHA) in the tables

	IEC		AHA	
	IEC label	Colour	AHA label	Colour
Limb	R	Red	RA	Caucasian
	L	Yellow	LA	Black
	F	Green	LL	Red
Chest according to Wilson	C1	White/red	V1	Brown/red
	C2	White/yellow	V2	Brown/yellow
	C3	White/green	V3	Brown/green
	C4	White/brown	V4	Brown/blue
	C5	White/black	V5	Brown/orange
	C6	White/violet	V6	Brown/violet
Neutral	N	Black	RL	Green



The patient cable (type IEC or AHA) is set in the menu [Leads & cable, see chapter 5.6.1](#).

4.3 Standard 10-lead resting ECG

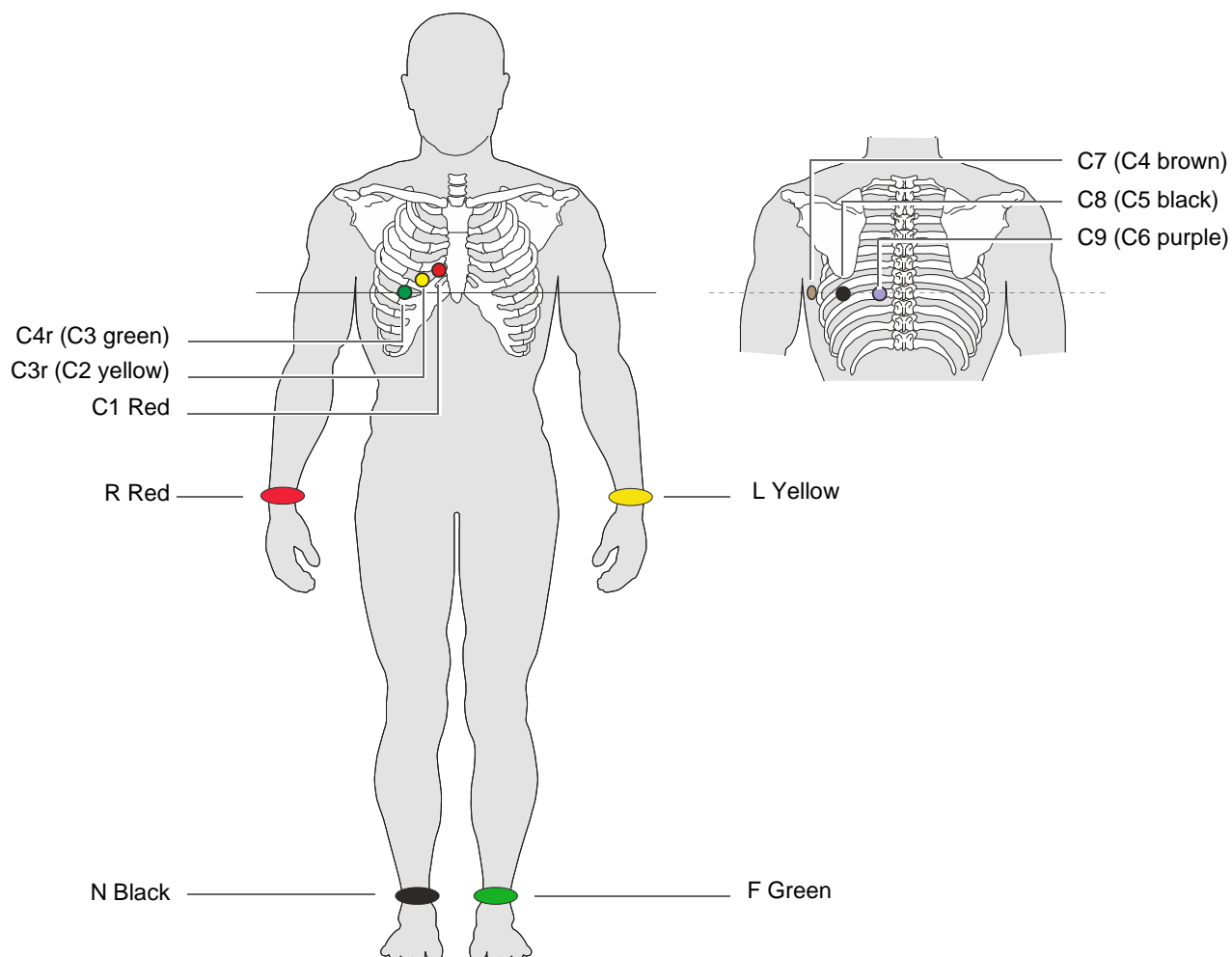


4.3.1 Electrode placement for standard leads

IEC label	AHA label	Electrode placement
C1 red	V1 red	→ Fourth intercostal space at the right sternal border
C2 yellow	V2 yellow	→ Fourth intercostal space at the left sternal border
C3 green	V3 green	→ Midway between C2 and C4
C4 brown	V4 blue	→ Fifth intercostal space on the mid-clavicular line
C5 black	V5 orange	→ Anterior axillary line on the same horizontal level as C4
C6 purple	V6 purple	→ Mid-axillary line on the same horizontal level as C4
L yellow	LA black	→ Left arm (resting ECG)
R red	RA white	→ Right arm (resting ECG)
F green	LL red	→ Left foot (resting ECG)
N black	RL green	→ Right foot (resting ECG)

The electrode resistance can be checked in the electrode test screen ([see Page 38](#)).

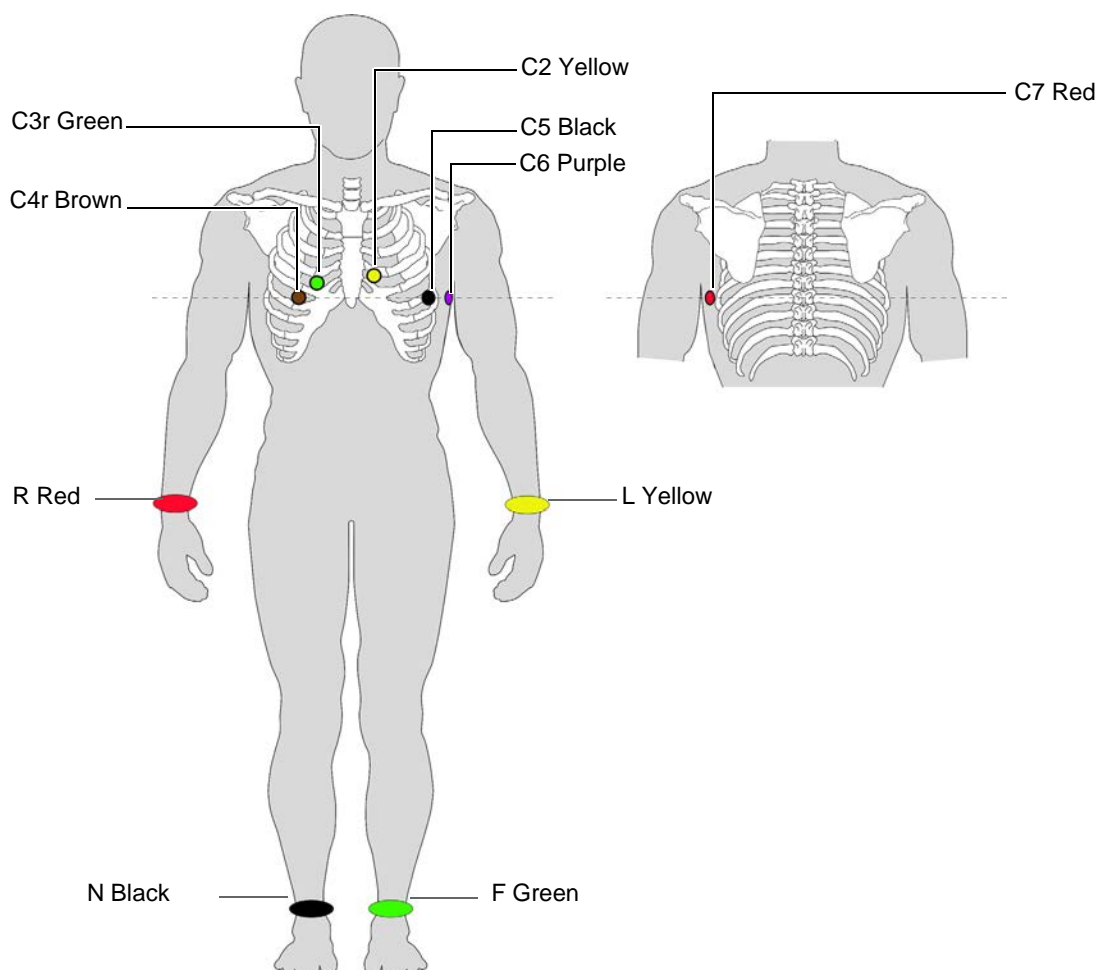
4.4 Balanced



Balanced, 10-wire cable

IEC label	AHA label	Electrode placement
C1 white / red	V1 brown / red	→ Fourth intercostal space at the right sternal border.
C3r white / yellow	V3r brown / yellow	→ Left of the mid-scapular line at the level of C3
C4r white / green	V4r brown / green	→ Left of the mid-scapular line at the level of C4
C7 white / brown	V7 brown / blue	→ Left axillary line at the level of C4.
C8 white / black	V8 brown / orange	→ left posterior axillary line opposite C4
C9 white /violet	V9 brown / violet	→ Left axillary line at the level of C4, opposite C3
L Yellow	LA Black	→ Left arm
R Red	RA White	→ Right arm
F Green	LL Red	→ Left foot
N Black	RL Green	→ Right foot

4.5 Paediatric



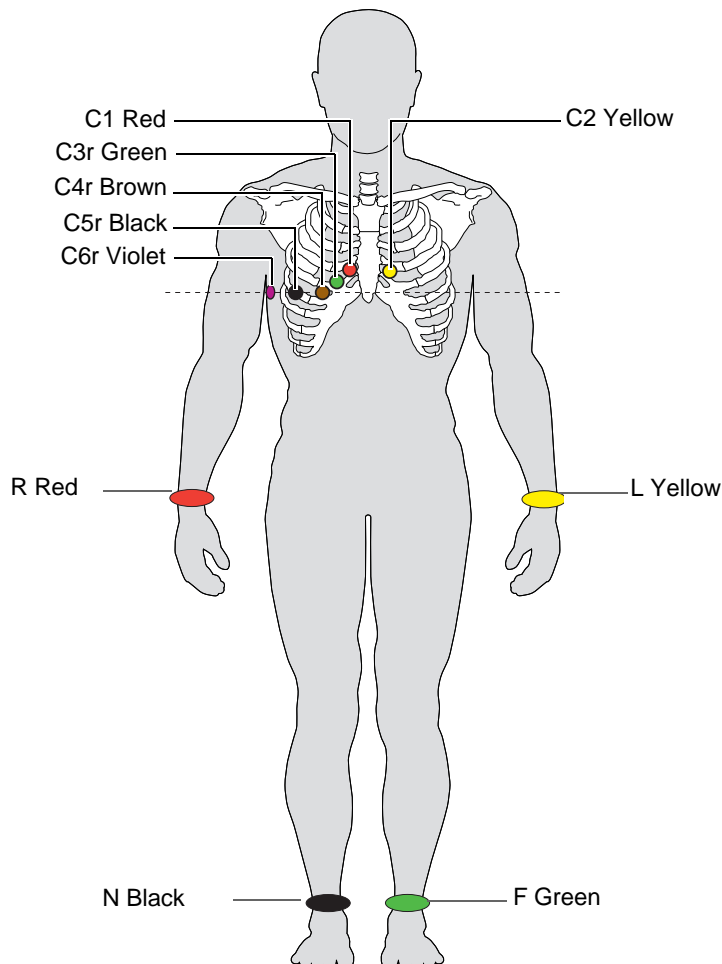
IEC label	AHA label	Electrode placement
C4r white / brown	V4 brown / blue	→ Fifth intercostal space on the mid-clavicular line.
C3r white / green	V3 brown / green	→ Fourth intercostal space, above C4r
C2 white / yellow	V2 brown / yellow	→ Fourth intercostal space at the left sternal border
C5 white / black	V5 brown / orange	→ Anterior axillary line on the same horizontal level as C4
C6 white /violet	V6 brown / violet	→ Mid-axillary line on the same horizontal level as C4
C7 (C1 white /red)	V7 (V1 brown / red)	→ Left posterior axillary line at the level of C4.
L yellow	LA black	→ Left arm (resting ECG)
R red	RA white	→ Right arm (resting ECG)
F green	LL red	→ Left foot (resting ECG)
N black	RL green	→ Right foot (resting ECG)



For paediatric patients, we recommend setting the myogram filter to Off = 250 Hz.

4.6 Right precordials (C3r-C6r)

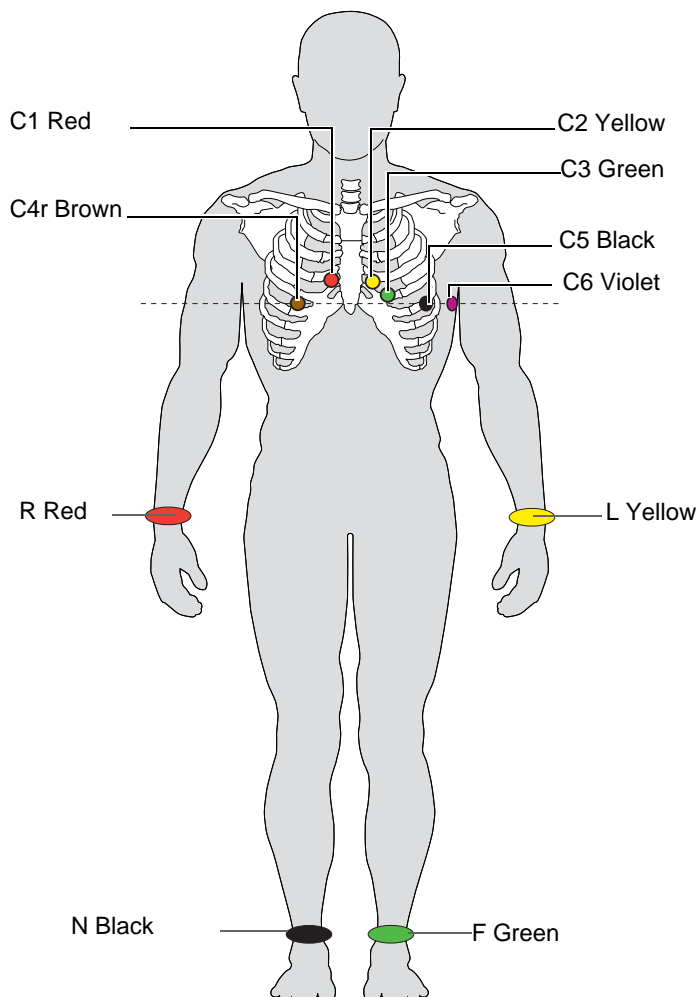
Since the treatment of an infarction might depend on the influence of the right ventricle, it is suggested to perform additional recordings with right precordial leads in the case of an acute infarction of the right ventricle's inferior wall (Circulation 2007).



IEC label	AHA label	Positioning
C1 white / red	V1 brown / red	→ Fourth intercostal space at the right sternal border.
C2 white / yellow	V2 brown / yellow	→ Fourth intercostal space at the left sternal border.
C3r white / green	V3 brown / green	→ Designated point halfway between C1 and C4r.
C4r white / brown	V4 brown / blue	→ Fifth intercostal space on the mid-clavicular line.
C5r white / black	V5 brown / orange	→ Anterior axillary line on the same horizontal level as C4r.
C6r white / violet	V6 brown / violet	→ Mid-axillary line on the same horizontal level as C4r.
L Yellow	LA Black	→ Left arm
R Red	RA White	→ Right arm
F Green	LL Red	→ Left foot
N Black	RL Green	→ Right foot

4.7 Standard with C4r

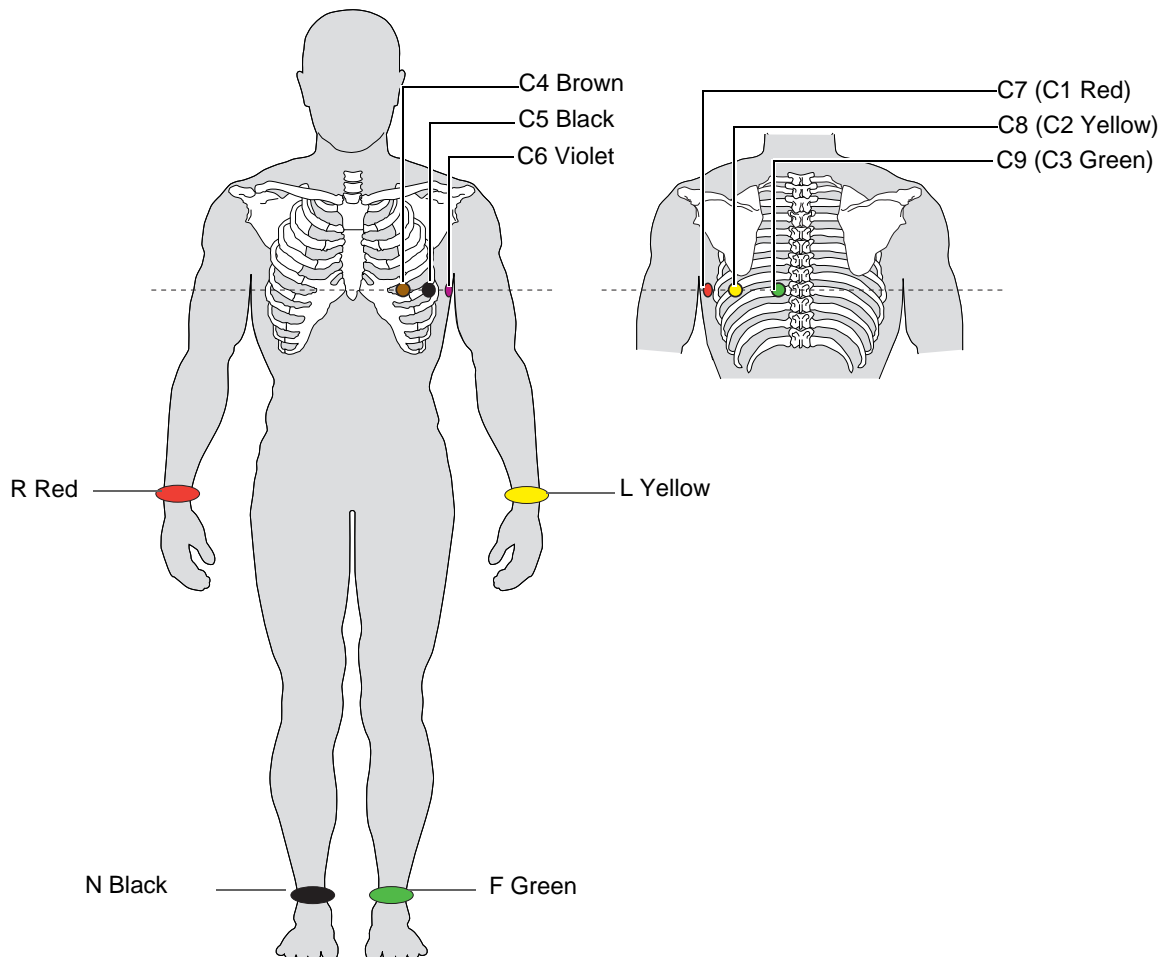
ACC/AHA guidelines recommend examining patients suffering from a myocardial infarction with inferior ST elevation for possible RV ischaemia or RV infarction; this examination should be performed with a right precordial C4r lead.



IEC Label	AHA Label	Electrode placement
C1 white / red	V1 brown / red	→ Fourth intercostal space at the right sternal border.
C2 white / yellow	V2 brown / yellow	→ Fourth intercostal space at the left sternal border.
C3 white / green	V3 brown / green	→ Midway between C2 and C4.
C4r white / brown	V4 brown / blue	→ Fifth intercostal space on the mid-clavicular line.
C5 white / black	V5 brown / orange	→ Anterior axillary line on the same horizontal level as C4.
C6 white /violet	V6 brown / violet	→ Mid-axillary line on the same horizontal level as C4.
L Yellow	LA Black	→ Left arm
R Red	RA White	→ Right arm
F Green	LL Red	→ Left foot
N Black	RL Green	→ Right foot

4.8 Left posterior C7-C9

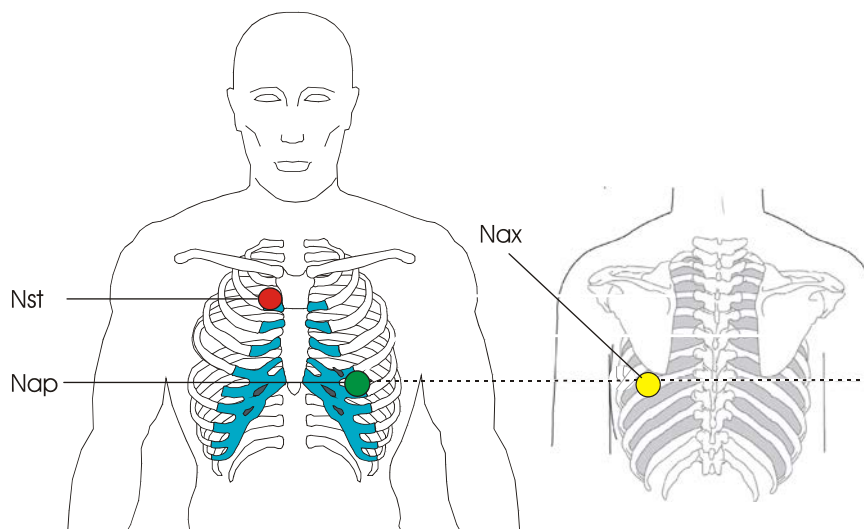
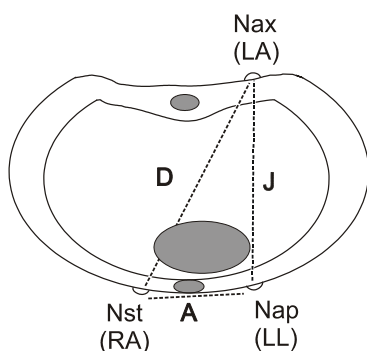
If an acute coronary occlusion is strongly suspected, it is recommended to also register posterior chest wall leads (C7–C9)



IEC label	AHA label	Positioning
C7 (C1 white /red)	V7 (V1 brown / red)	→ Left posterior axillary line at the level of C4.
C8 (C2 white /yellow)	V8 (V2 brown / yellow)	→ Left of the mid-scapular line at the level of C4.
C9 (C3 white /green)	V9 (V3 brown / green)	→ Left paravertebral line at the level of C4.
C4 white / brown	V4 brown / blue	→ Fifth intercostal space on the mid-clavicular line.
C5 white / black	V5 brown / orange	→ Anterior axillary line on the same horizontal level as C4.
C6 white /violet	V6 brown / violet	→ Mid-axillary line on the same horizontal level as C4.
L Yellow	LA Black	→ Left arm
R Red	RA White	→ Right arm
F Green	LL Red	→ Left foot
N Black	RL Green	→ Right foot

4.9 Nehb leads

The Nehb leads are bipolar chest leads. They are of special interest for the diagnosis of changes in the posterior ventricle wall. Three leads are arranged in the form of a triangle, also called the “small cardiac triangle”. Nehb dorsal (D) is measured between the electrode positions Nax and Nst; Nehb anterior (A) between Nap and Nst, and Nehb inferior (J) between Nap and Nax.



Place the electrodes as follows:

IEC label	AHA label	Electrode placement
C1 white / red	V1 brown / red	→ Nst : 2nd rib at the right sternal border.
C2 white / yellow	V2 brown / yellow	→ Nax : left posterior axillary line (on the back), directly opposite Nap.
C4 white / brown	V4 brown / blue	→ Nap : 5th intercostal space, midclavicular line (cardiac apex).

Place all other electrodes in the normal positions ([Page 31](#)).

4.10 Skin/Electrode Resistance

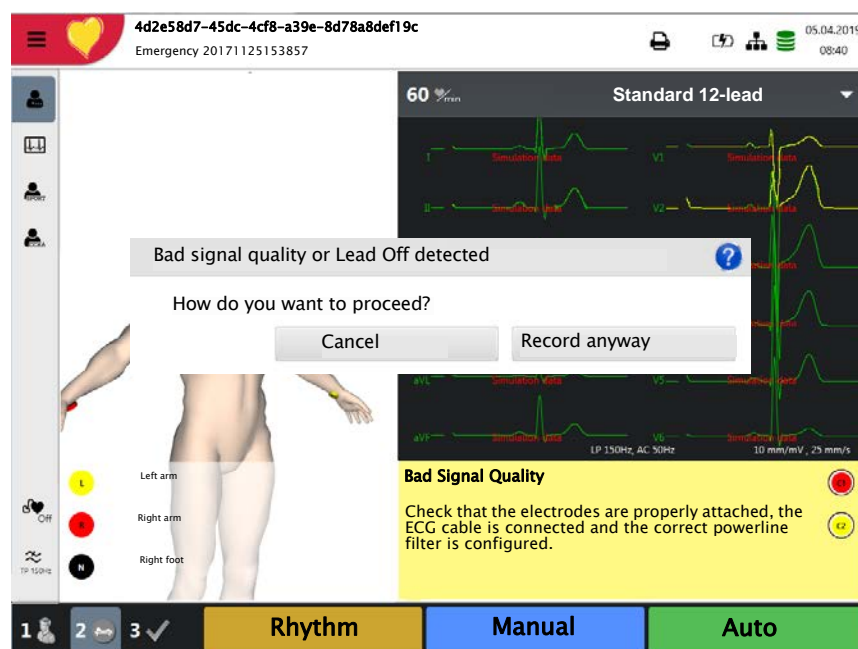
4.10.1 Electrode and patient cable check

The electrode check is part of step 2 before the start of an ECG recording. The following is checked and displayed:

- Excessive noise (signal noise too high)
 - Due to poor electrode contact
 - Mains interferences (mains filter not activated)
- Electrodes reversed
- Electrodes have come off

The electrode status is shown in the bottom right information field of the screen. If an electrode is displayed red, the suspected cause is displayed. Reapply the electrode.

- If F (LL) or N is not connected or has come off, the electrode resistance cannot be measured and all leads are marked red.



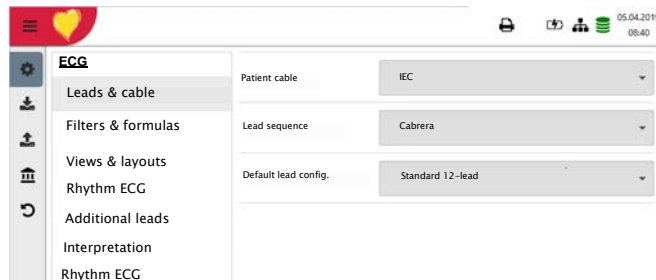
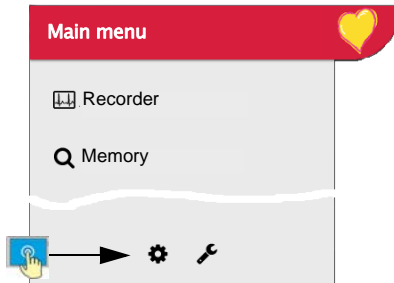
Lead Reversal

Some of the electrodes seem to be interchanged. Please check that all electrodes are placed in the correct position.

4.11 Lead sequence/lead view

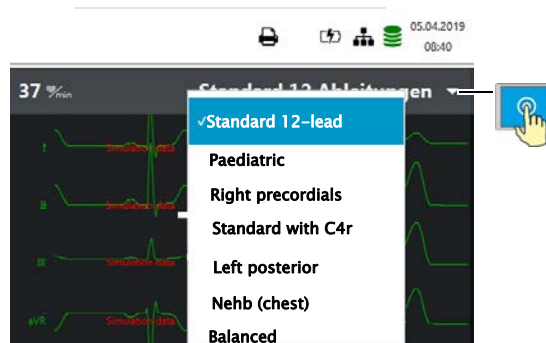
4.11.1 Setting Standard or Cabrera lead sequence

- The lead sequence is defined in the settings.
(Menu > Settings > ECG > Leads & cable).
- In the Lead menu, select between Standard and Cabrera.



4.11.2 Select the lead view (Standard or other settings)

The lead display can be set directly in the electrode screen in Step 2.



The lead labels on the display and on printouts change accordingly.



Important

Automatic interpretation is only possible when **Standard 12 lead** is set.

For ETM Sport recordings, lead configuration Standard 12 lead is selected automatically.


For CCAA recordings, lead configuration Standard with C4r is selected automatically.

5 Resting ECG

WARNING

- ▲ After heavy artefacts or lead off, the displayed heart rate may not be reliable.

CAUTION

- ▲ The safety notes at the beginning of this book must be read and fully understood before taking an ECG recording.
- ▲ The CardioPad-2 device is CF classified . The patient connection is fully isolated. During the ECG recording, ensure that neither the patient nor the leading parts of the patient connection nor the electrodes (including the neutral electrodes) come in contact with other persons or conductive objects, even when these are earthed.
- ▲ Do not operate the unit if the earth connection is suspect or if the mains lead is damaged or suspected of being damaged.
- ▲ If an external electronic device (e.g. a PC) is connected to the CardioPad-2, use the potential equalisation stud for earth protection.



If another format than the default format is set for the automatic printout, the printout can differ from the format displayed on the screen.

The displayed lead sequence (Standard or Cabrera) can be selected (see [5.6.1 Leads & cable Page 51](#)). Amplitude and speed can be defined in the menu [5.6.3 Views & layouts, Page 53](#).

For the preview, the following parameters can be freely programmed (before start of the recording):

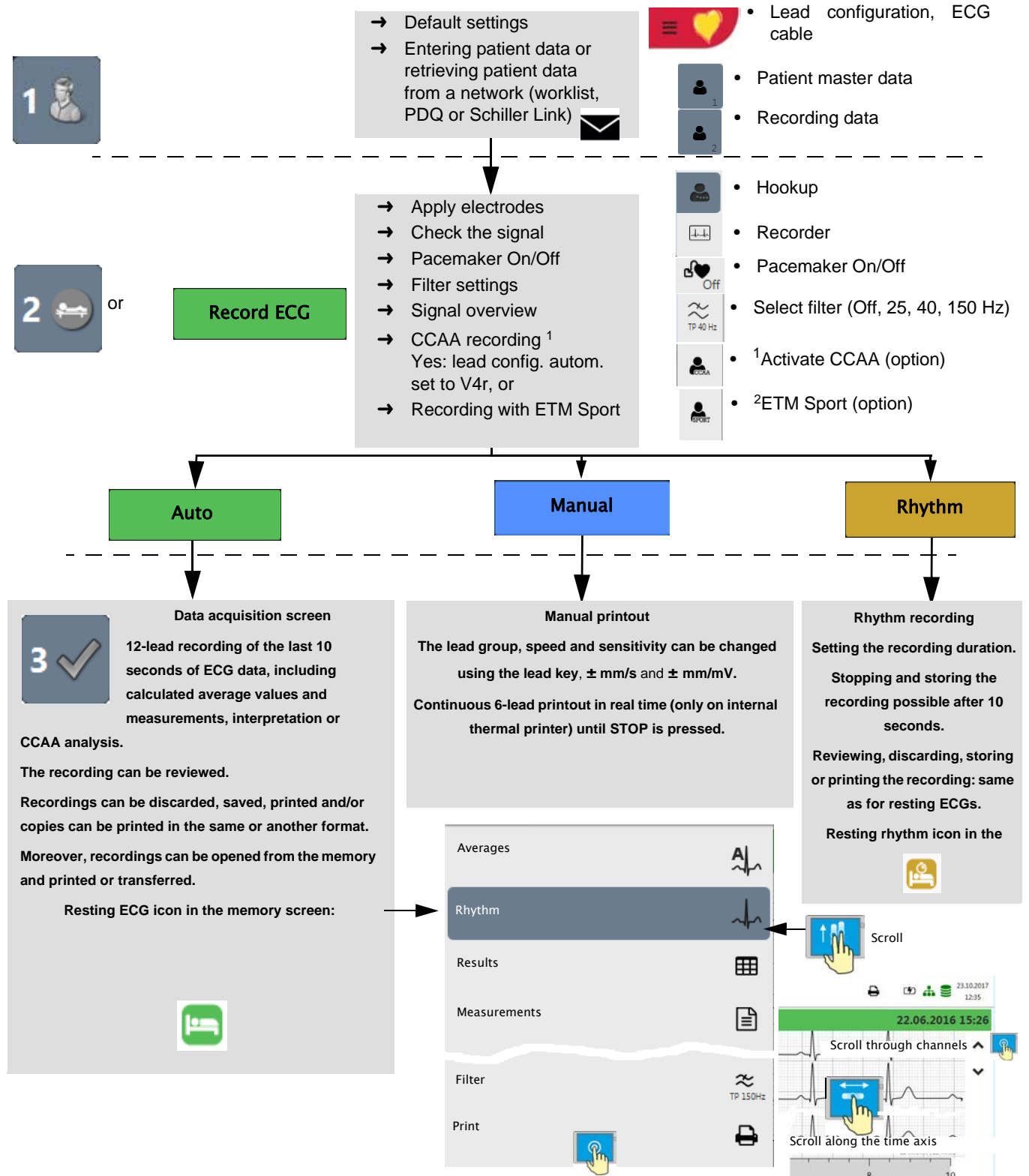
- Lead configuration
- Filter

Saved recordings can be displayed and printed in another format at any time. For further information on how to define the format, see [5.6.7 Reports Page 57](#).

CAUTION

- ▲ When using the 25 Hz or 40 Hz filter, the displayed or printed ECG may not always fulfil the requirements for a diagnostic ECG.

5.1 Resting ECG - procedural flow diagram



1. The dialogue CCAA is only displayed if this option is installed ([Section 6.1.2 Starting the CCAA analysis, page 63](#)).
2. The dialogue ETM Sport is only displayed if the Interpretation option is installed.

5.1.1 Printing, saving and transferring automatically

Menu > Settings > General > Workflow

Activate **Print after acquisition**, **Transmit after acquisition** and **Delete after transmission** to automatically print and transmit a saved recording or to delete recordings after transmission.



- The transmission settings are detailed in the section Settings (see [Page 82](#)).
- Further ECG settings are described later in this section (see [Page 51](#)).
- Printing and transfer from the memory is described in the section Memory (see [Page 65](#)).
- The settings are saved automatically. The settings can be exported (see [Page 75](#)).

5.2 Automatic resting ECG recording

To take an automatic ECG recording, press the **Auto** key. After approx. 10 seconds, the recording is analysed and the result displayed. The recording can be checked and saved and further printouts can be obtained in different formats. Depending on the setting, the recording is deleted automatically as soon as it has been transmitted, or it remains stored in the memory.

Auto



Amplitude settings (5/10/20 mm/mV) and speed (12.5/25/50 mm/s)




Pacemaker On/Off

Remaining recording duration

Depending on the settings (see section 5.6.3), only some or none of these pages are displayed.

The grey bar shows the position on the time axis.

Check the recording using  (time axis) and  (select channels).

- Select the amplitude and speed for the display .
- Select filter (Off = 250 Hz, 25, 40 or 150 Hz) .
- **Accept** the recording.
- Print the recording .
- Press **Discard** to exit the preview without storing the ECG.
- Select a recording for review and printout via the **Memory** menu.
- Open the menu **Memory** to delete a recording from memory.

5.2.1 ETM Sport

When ETM Sport interpretation is selected before the start of a recording, the additional criteria for an athlete's ECG are analysed and displayed.



Activate ETM Sport

4d2e58d7-45dc-4cf8-a39e-8d78a8def19c
Emergency 20171125153857

02.04.2019 15:38

Abnormal ECG in athletes
02.04.2019 15:38

ETM Sport Results

☒ Left axis deviation
☐ Left atrial enlargement
☐ Right axis deviation
☐ Right atrial enlargement
☐ Complete right bundle branch block
☐ T-wave inversion
☒ ST segment depression
☐ Pathological Q waves
☐ Complete left bundle branch block
☐ Profound intraventricular conduction delay
☐ Epsilon wave

☐ Ventricular pre-excitation
☐ Prolonged QT interval
☐ Brugada-like ECG pattern
☐ Profound sinus bradycardia
☐ Profound 1° AV block
☐ Mobitz Type 2° AV block
☐ 3° AV block
☐ Atrial tachyarrhythmia
☐ Premature ventricular contractions
☐ Ventricular arrhythmias
☐ Other abnormality

1
2
3
Discard
Accept

Example of an ECG rated normal for athletes, but rated abnormal when the standard interpretation is used.

4d2e58d7-45dc-4cf8-a39e-8d78a8def19c
Emergency 20171125153857

02.04.2019 15:57

Normal ECG in athletes
02.04.2019 15:38

HR
60

Intervals

RR 1.000 ms	QRS 94 ms
P 116 ms	QT 416 ms
PR 172 ms	QTcB 416 ms

Axis

P axis 46 °
QRS axis 47 °
T axis 36 °

LVH Criteria

Sokolow-Lyon	3.73 mV
Cornell	1.44 mV
Lewis	0.28 mV
Romhilt-Estes	1

Interpretation

Sinus rhythm
Left atrial abnormality
Normal electrical axis
Non specific ST abnormality (elevation)
Abnormal ECG
Normal ECG in athletes

1
2
3
Discard
Accept

5.2.2 Automatic printout

The printout gives the following:

- Heart rate
- Patient ID or Visit ID
- Time and date
- Speed
- Sensitivity
- Filter
- Device ID
- Serial number
- Software version
- Technician

And any combination of the following (for printout settings, see [Page 57](#)):

- | | |
|---------------------|--|
| Patient data | <ul style="list-style-type: none"> • All patient data according to Section 3.6 Patient / recording data, page 24 |
| Result | <ul style="list-style-type: none"> • Interpretation (can be deactivated in Menu > Settings > ECG > Interpretation , see Section 5.6.5 Interpretation, page 56). • Intervals & axis |
| Measurements | <ul style="list-style-type: none"> • Detailed measurement table |
| Rhythm | <ul style="list-style-type: none"> • ECG recording of all 12 leads in either Standard or Cabrera format (according to selection) |
| Averages | <ul style="list-style-type: none"> • Averaged cycles with markings |

5.3 Manual rhythm printout

Use this function to print a real-time ECG. The print parameters such as lead sequence, print speed and sensitivity can be changed by the user during the printout.



The real-time ECG is not saved. The chosen settings only apply to the printout.

5.3.1 Starting manual printout



→ To start a manual real-time printout, press the **Manual** key.

The default printout settings are **25 mm/s** and **10 mm/mV**. These settings can be changed, see [Section 5.6.7 Reports, page 57](#)



Select lead sequence

→ To change the lead sequence for the printout (Standard I, II, III, aVR, aVL, aVF), press the key **- I - aVF +**.

The Standard and Cabrera lead sequences are as follows:

Lead sequence	Lead group 1	Lead group 2
Standard	I, II, III, aVR, aVL, aVF	V1, V2, V3, V4, V5, V6
Cabrera	aVL, I, -aVR, II, aVF, III	V1, V2, V3, V4, V5, V6

The lead group is selected in the ECG settings ([see Page 51](#)).

Select speed

→ To change the printout speed (5, 12.5, **25** and 50 mm/s), press the key **- mm/s +**.

Select sensitivity

→ To change the printout sensitivity (5, **10** and 20 mm/mV), press the key **- mm/mV +**.

Stopping the printout

→ To stop the manual recording (printout), press the **Stop** key.

The printout provides the following information:

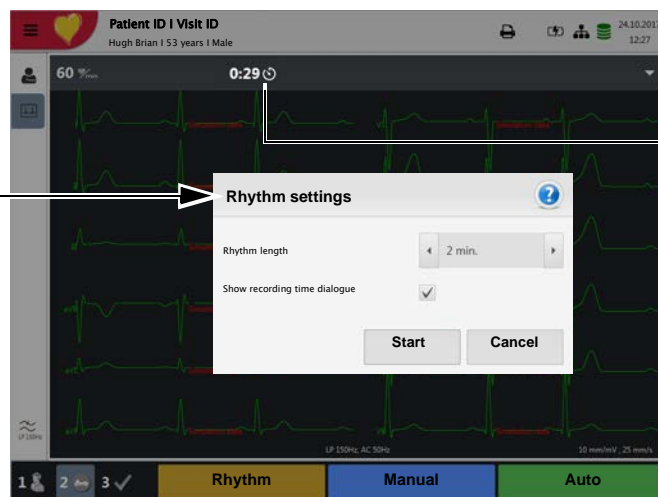
- Selected leads
- Heart rate, averaged over four beats
- Patient ID or Visit ID
- Time and date
- Speed
- Sensitivity
- Filter
- Device ID
- Serial number
- Software version

5.4 Rhythm recording

Press **Rhythm** to perform a rhythm recording. Select the recording duration in the dialogue that pops up. If a recording is cancelled after more than 10 seconds, it can still be stored. The recording can be checked and saved and further printouts can be obtained in different formats. Depending on the setting, the recording is deleted automatically as soon as it has been transmitted, or it remains stored in the memory.

Rhythm

The dialogue "Rhythm settings" can be deactivated in the Settings menu or directly in the dialogue. To reactivate the dialogue, tick the option in the Rhythm ECG menu, see chapter 9.2.7.



Once Start is pressed, the remaining recording duration is displayed

After 10 s of recording, the icon Cancel changes to Stop. Press Stop to end and store the recording.

Stop

Time intervals



Set the amplitude and select the channel, I..V6

For recordings with a duration of 3 or 4 minutes, the time interval is displayed

Check the recording using (select channel) and (time axis).

- Select filter (Off = 250 Hz, 25, 40 or 150 Hz)
- **Accept** the recording
- Print the recording
- Press **Discard** to exit the preview without storing the ECG
- Select a recording for review and printout via the **Memory** menu .
- Open the menu **Memory** to delete a recording from memory.

5.4.1 Automatic printout

The printout gives the following:

- Heart rate
- Patient ID or Visit ID
- Time and date
- Speed
- Sensitivity
- Filter
- Device ID
- Serial number
- Software version
- Technician
- Resting rhythm curves, see [Page 60](#).

5.5 Changing the ECG preview layout



The ECG preview is optimised for 2 columns with 6 leads each, or for 3 columns with 4 leads each. The amplitude and speed can be set to 5, **10** or 20 mm/mV, and to 12.5, **25** or 50 mm/s. For the settings, see [Section 5.6.3 Views & layouts, page 53](#).

The hookup preview layout is always set to 2 columns with 6 leads each.

5.5.1 Display

Leads

→ The following presentation can be selected in **Menu > Settings > ECG > Leads & cable**:

The Standard and Cabrera lead sequences are as follows:

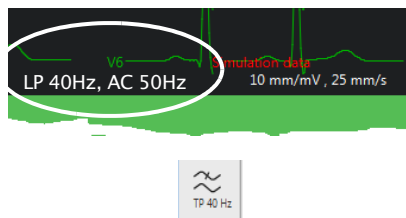
Lead sequence	Lead group 1	Lead group 2
Standard	I, II, III, aVR, aVL, aVF	V1, V2, V3, V4, V5, V6
Cabrera	aVL, I, -aVR, II, aVF, III	V1, V2, V3, V4, V5, V6

The factory setting for the Default lead configuration is Standard 12 lead. The following settings can be made:

- Standard 12-lead
- Paediatric
- Right precordials
- Standard C4r
- Left posterior
- Nebh (chest)
- Balanced

5.5.2 Myogram filter

The myogram filter suppresses disturbances caused by strong muscle tremor. In **Menu > Settings > ECG > Filters & formulas**, the **myogram filter** is defined.



In the information field, **LP 25 Hz**, **LP 40 Hz** or **LP 150 Hz** is displayed.



- The **default** cut-off frequency is user-defined at LP 25 Hz or LP 40 **150** or 250 Hz (Filter Off) ([see chapter 5.5.2, page 52](#)).
- An ECG recorded in auto mode is stored unfiltered. It is therefore possible to print the stored ECG either with or without applying the myogram filter.
- For paediatric patients, we recommend setting the myogram filter to Off = 250 Hz.



- ▲ When using the 25 Hz or 40 Hz filter, the displayed or printed ECG may not always fulfil the requirements for a diagnostic ECG.

5.5.3 Other filters

The following additional filters are available:

Baseline filter

The cut-off frequency for the baseline filter is based on IEC 60601-2-25 and cannot be changed.



Notch filter

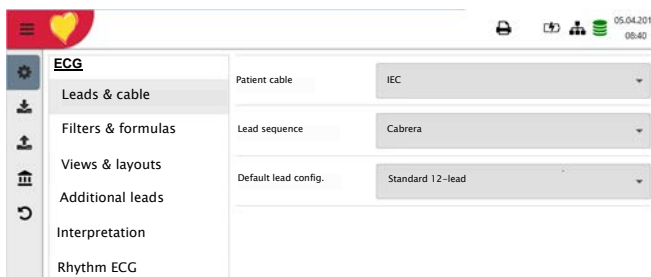
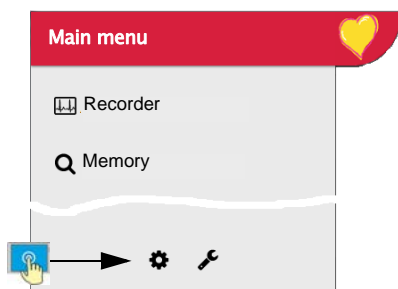
This filter prevents recording interference due to mains frequency oscillation. If the filter is active, "AC 50 Hz" or "AC 60 Hz" is displayed.



- The filters are activated/deactivated or changed in the ECG settings ([see following description](#)).

5.6 ECG settings

When pressing the Menu key , the option **Settings**  is displayed. The following table gives an overview of all the settings concerning the ECG acquisition:



Overview **Menu > Settings**

Menu Settings	Sub-menu
ECG (Page 51)	• Leads & cable
	• Filters & formulas
	• Views & layouts
	• Additional leads
	• Interpretation
	• Rhythm ECG



Changed settings are saved automatically. In **Menu > Import**, settings from another device can be imported, or a backup of the settings can be restored (see [Page 75](#)).

5.6.1 Leads & cable

Menu	Parameter	Description / selection
Leads & cable	Patient cable	IEC or AHA
	Lead sequence	Standard or Cabrera <ul style="list-style-type: none"> • Standard 12-lead • Paediatric • Right precordials
	Default lead config.	<ul style="list-style-type: none"> • Standard C4r • Left posterior • Nebh (chest) • Balanced

5.6.2 Filters & formulas

Menu	Parameter	Description / selection
Filters & formulas	Notch filter	Off/ AC 50/AC 60 Hz
	Myogram filter	Off = 250 Hz/LP25/LP40/LP150 Hz
	Default QTc calculation	Bazett, Fridericia, Framingham, Hodges

5.6.3 Views & layouts

In this menu, the views and layouts for the **Preview**, **RECG review** and **Resting rhythms** are defined.



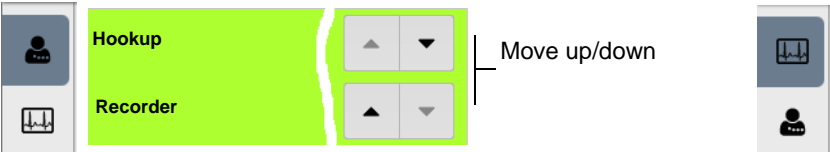
Preview

Menu	Parameter	Description
Preview	Preview view order	Select whether Hookup or Recorder is shown at the top
	9 lead layout	6/3 for Nebh Chest
	12 lead layout	2x6 / 4x3
	Speed/Amplitude	Speed 12.5/ 25 /50 mm/s Amplitude 5/ 10 /20 mm/mV

Order of preview views in Step 2



View in Step 2: either Hookup or Recorder is shown at the top



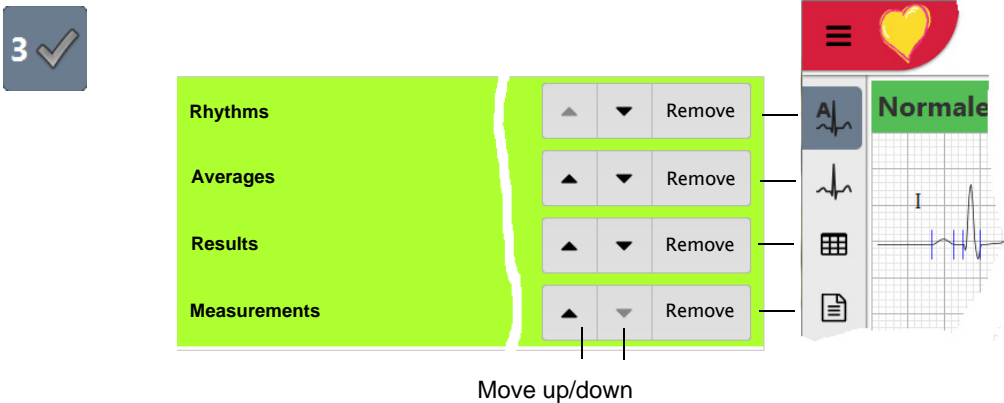
RECG review

These settings apply to current resting ECG recordings and recordings from the memory. Therefore, saved ECGs can be displayed with different settings at any time.



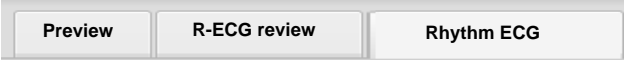
Menu	Parameter	Description
RECG Review	Review views and order	Adding/removing views, and defining their order: rhythms, averages, results and measurements. Settings see below.
	Rhythm 12 lead layout	1x6 / 1x12
	Rhythm Speed/Amplitude	Speed 12.5/25/50 mm/s Amplitude 5/10/20 mm/mV
	Avg. Speed/Amplitude	Speed 25/50 mm/s Amplitude 10/20 mm/mV

View and order in Step 3 of the Review



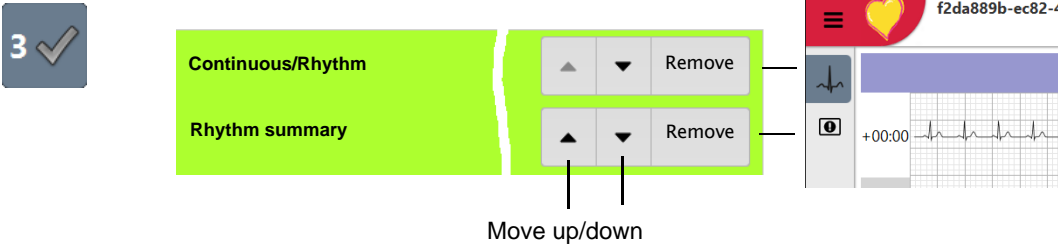
Rhythm ECG

These settings apply to current resting rhythm recordings and recordings from the memory. Therefore, saved ECGs can be displayed with different settings at any time.



Menu	Parameter	Description
Rhythm ECG	Review views and order	Adding/removing views, and defining their order: Continuous/Rhythm and Rhythm summary. Settings see below.
	Amplitude	2.5/5 mm/mV
	Speed	Speed 6.25/12.5mm/s

View and order in Step 3 of the Review



5.6.4 Additional leads

Default leads per lead configuration

These settings apply to the current resting rhythm recording, recordings from the memory, and the printout. Therefore, saved ECGs can be displayed or printed with different settings at any time.

Menu	Parameter	Description / selection
Additional leads	Standard 12-lead	I / II / III aVR / aVL / aVF / V1 / V2 / V3 / V4 / V5 / V6 / -aVR Rhythm 1 II , Rhythm 2 V2 , Rhythm 3 V5
	Paediatric	I / II / III aVR / aVL / aVF / V7 / V2 / V3r / V4r / V5 / V6 / -aVR Rhythm 1 V7 , Rhythm 2 V4r , Rhythm 3 II
	Right precordials	I / II / III aVR / aVL / aVF / V1 / V2 / V3r / V4r / V5r / V6r / -aVR Rhythm 1 V3r , Rhythm 2 V5r , Rhythm 3 II
	Standard C4r	I / II / III aVR / aVL / aVF / V1 / V2 / V3 / V4r / V5 / V6 / -aVR Rhythm 1 V4r , Rhythm 2 V2 , Rhythm 3 II
	Left posterior	I / II / III aVR / aVL / aVF / V4 / V5 / V6 / V7 / V8 / V9 / -aVR Rhythm 1 V8 , Rhythm 2 V5 , Rhythm 3 II
	Nehb (chest)	I / II / III / aVR / aVL / aVF / D / A / J / -aVR Rhythm 1 D , Rhythm 2 A , Rhythm 3 J
	Balanced	I / II / III aVR / aVL / aVF / V4r / V3r / V1 / V7 / V8 / V9 / -aVR Rhythm 1 V7 , Rhythm 2 V4r , Rhythm 3 II

5.6.5 Interpretation

Menu	Parameter	Description / selection
Interpretation	Print interpretation	Yes/No
	Display interpretation	Yes/No

5.6.6 Resting rhythm

Parameter	Description / selection
Rhythm length	30 s , 1, 2, 3 or 4 minutes Setting the recording duration.
Show recording time dialogue	<input checked="" type="checkbox"/> Yes. The dialogue can be deactivated during the recording and can be activated here again.
Predefined event texts	Enter (delete) predefined event texts which can be selected during the recording. → Press +, enter text and confirm with Enter

HR > 180

B

+

⌫

⬅

5.6.7 Reports

In this menu, the **Print layout** is defined.

General

Parameter	Description
Rhythm mode	Sequential or Simultaneous. When Sequential is selected, the individual lead groups show consecutive time segments (applies to the printout). When Simultaneous is selected, all lead groups show the same time segment (applies to the printout). If a format including a rhythm lead is defined for printout, Sequential is always used, even if you have selected Simultaneous.
PDF paper format	A4 or Letter
PDF conformance	None , PDF/A-1a, PDF/A-1b
Company info 1, 2, 3	Enter company information on PDF rows 1, 2 and 3.

Manual printout

In this menu, the default settings for manual printouts are defined.

Parameter	Description
Lead group	Select the lead group Limb or Precordials
Speed [mm/s]	5, 12.5, 25 or 50 mm/s
Amplitude [mm/mV]	5, 10 , 50 mm/mV

Resting ECG

These settings apply to current resting ECG recordings and recordings from the memory. Therefore, saved ECGs can be printed with different settings at any time.



- The order listed below can vary.

Menu	Description / selection
	Selection and order of the following printout formats:
	<ul style="list-style-type: none"> • Patient data • Rhythm 2x6, 25 mm/s, 1 page • Averages 4x3+1, 50/25 mm/s, 1 page • Results
12 Lead	<ul style="list-style-type: none"> • Rhythm 2x6, 25 mm/s, 2 page • Rhythm 2x6, 50 mm/s, 2 page • Rhythm 4x3+1, 25 mm/s, 1 page • Averages 4x3+1, 25/25 mm/s, 1 page • Averages 6x2+2, 50/25 mm/s, 1 page • Measurement Table
12 Lead (PDF)	<ul style="list-style-type: none"> • Rhythms 10s, 25 mm/s, 2p • Measurements • Averages Grid, 25/25 mm/s • Averages Grid, 50/25 mm/s • Averages Wide, 25/25 mm/s • Panorama • Rhythms 10s, 25 mm/s • Rhythms 5s, 25 mm/s • Rhythms 5s, 50 mm/s, 2p • Rhythms Grid, 25 mm/s
9 Lead	<ul style="list-style-type: none"> • Patient data • Rhythm 6/3, 25 mm/s, 1 page • Averages 3x3+1, 50/25 mm/s, 1 page • Results • Rhythm 6/3, 50 mm/s, 2 pages • Rhythm 6/3, 50 mm/s, 2 pages • Averages 6/3+2, 50/25 mm/s, 1 page • Measurement Table
9 Lead (PDF)	<ul style="list-style-type: none"> • Rhythms 10s, 25 mm/s, 2p • Measurements • Averages Grid, 50/25 mm/s • Averages Wide, 50/25 mm/s • Rhythms 5s, 25 mm/s • Rhythms 5s, 50 mm/s, 2p

Printout formats highlighted in green are printed.

12 lead	12 lead (PDF)	9 lead	9 lead (PDF)
Patient data			
Rhythm 2x6, 25 mm/s, 1 page			
Averages 4x3+1, 50/25 mm/s, 1 page			
Results			
Rhythm 2x6, 25 mm/s, 2 page			
Rhythm 2x6, 50 mm/s, 2 page			

Change the order by moving the items up/down using the arrow keys.

Add/remove print formats by pressing Append or Remove.

Rhythm ECG

These settings apply to current resting rhythm recordings, resting rhythm recordings from the memory (Internal, display and printout), as well as PDF. Therefore, saved resting rhythm ECGs can be printed with different settings at any time.

Menu	Description / selection
	<ul style="list-style-type: none"> Amplitude 5 or 2.5 mm/mV Patient data
Internal	<ul style="list-style-type: none"> Continuous x1, 6.25 mm/s Event list HR trend
PDF	<ul style="list-style-type: none"> Rhythm summary Continuous 25 mm/s, 2:00 min Rhythm 5, 10, 20 mm/mV All events 2x10s, 6 pages Rhythm 5, 10, 20 mm/mV All events 2x5s, 6 pages Rhythm 5, 10, 20 mm/mV Continuous 12.5 mm/s, 5:20 min Rhythm 5, 10, 20 mm/mV Continuous 6.25 mm/s, 10:40 min Rhythm 5, 10, 20 mm/mV Manual events 10s, 1/2 page Rhythm 5, 10, 20 mm/mV Manual events 10s, 1 page Rhythm 5, 10, 20 mm/mV Rhythm 10s/page Rhythm 5, 10, 20 mm/mV Rhythm 20s/page Rhythm 5, 10, 20 mm/mV

Internal PDF

Amplitude 5 mm/mV

Patient data

Continuous x1, 6.25 mm/s

Event list

HR Trend

Internal PDF

Rhythm summary

Continuous, 25 mm/s, 2:00 min

Rhythm 10 mm/mV

All Events 2x10s 4/p

All Events 2x5s 6/p

Append

Append

Setting the rhythm amplitude
5, 10, 20 mm/mV

6 Culprit Coronary Artery Algorithm

6.1 Introduction

The Culprit Coronary Artery Algorithm developed by Professor Hein Wellens is designed to determine the size of the cardiac area at risk by localising the occlusion site in the coronary artery and to provide clinical data to shorten the time interval between the onset of chest pain and restoration of myocardial blood flow, as well as to ensure that the patient is assigned to the most suitable hospital. The algorithm uses the ST segment deviation of 12 ECG leads to indicate the site of occlusion in the culprit artery.

The closer the occlusion site to the origin of the coronary artery, the larger the size of the area at risk. The algorithm indicates the location of the occlusion site and issues a recommendation based on the ECG data and patient history. The recommendation is based on the following:

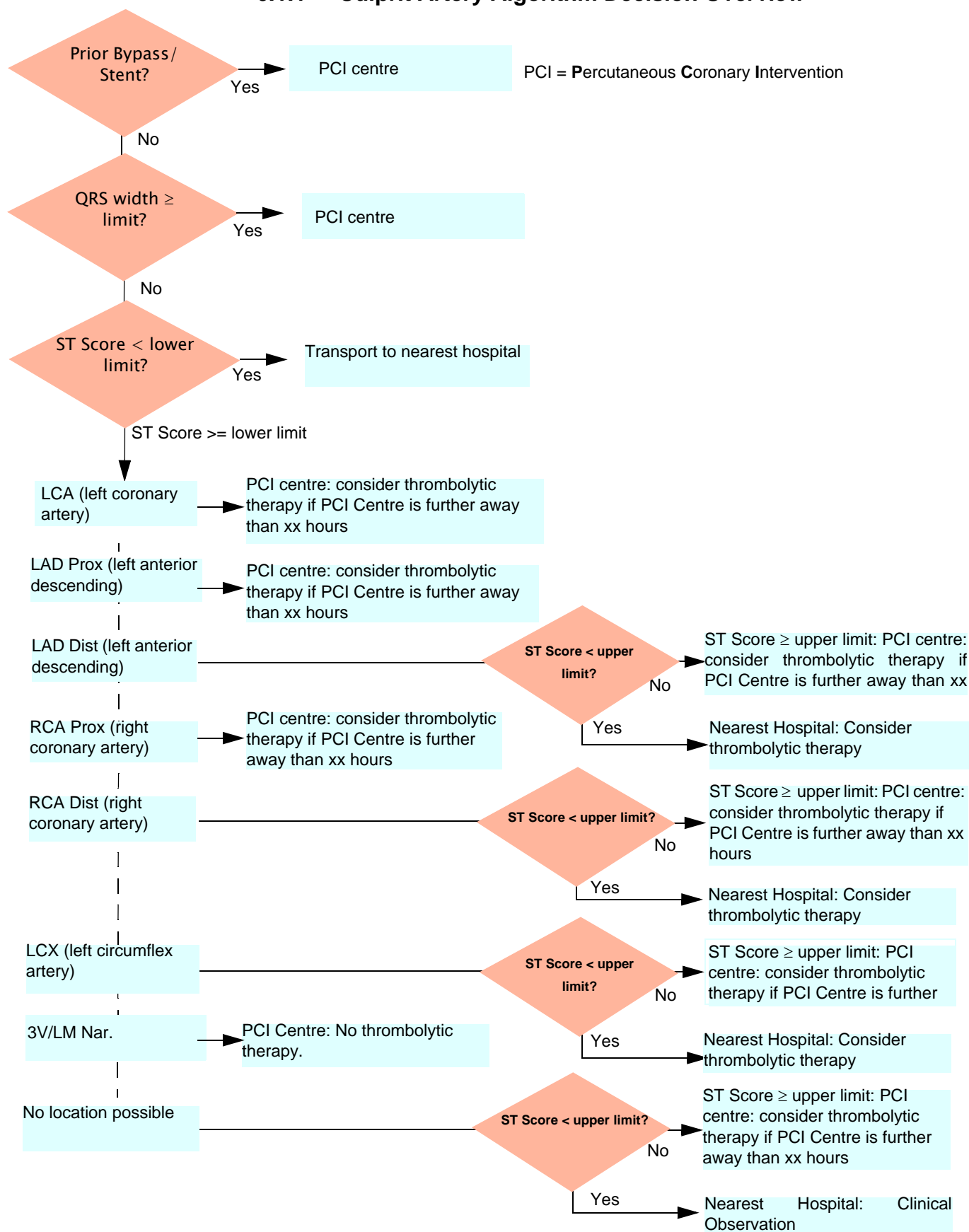
- **Prior Bypass/ Stent.** This data is entered before the ECG recording is taken (see [Section 5.1 Resting ECG - procedural flow diagram, page 41](#)). If the patient has had prior bypass or stent, the ECG is not analysed further and the advice **Go to PCI centre (Percutaneous Coronary Intervention)** is given.
- **ST Score.** The sum of the absolute ST deviations in mm in 12 leads (excluding V4r). That is the total ST deviation (mm) of all leads (I, II, III, aVR, aVL, aVF, and all leads V1 to V6).
- **Occlusion Site.** The calculated occlusion site.



The site of occlusion is determined by the following:

1. The number of leads indicating a occlusion are counted (= sum)
2. The occlusion site with the highest number is chosen as the occluded location.
3. If two locations have an equal value, then the more critical occlusion site (highest in the artery) is selected.

6.1.1 Culprit Artery Algorithm Decision Overview



6.1.2 Starting the CCAA analysis



When CCAA analysis is set, the following applies:

- The lead setting is automatically set to Right Precordial (V4r). Ensure that the C4 electrode is placed in the C4r (precordial) position.

Procedure

1. Enter the patient data.
2. Press Record ECG to proceed to the next dialogue.
3. To take an automatic ECG recording including CCAA analysis, press **CCAA**.
4. Activate the CCAA analysis: parameter Chest pain "✓".



5. Enter the additional parameters Bypass, stenting and time since chest pain started.
6. Check the electrode placement (V4r) and record the ECG.

The data is shown in the print preview. The recording can be checked, accepted and further printouts obtained in different formats.



All other settings and features (saving, printing etc.) are the same as described in [Section 5.2 Automatic resting ECG recording, page 43](#).

6.1.3 CCAA information on print preview/printout



Information on LAD (left anterior descending)

- ▲ For men under the age of 40 showing early repolarisation in the anterior leads, false LAD diagnoses may occur.

The following CCAA information is given on the print preview/printout:

Manual entry before the start of the recording:

- Previous bypass or stenting (Yes/No)
- Time since chest pain started, in hours

Measured values:

- QRS width (averaged) [ms]
- ST score (averaged) [mm]

Assessed area of an occlusion:

- LCA (left coronary artery)
- LAD Prox (left anterior descending)
- LAD Dist (left anterior descending)
- RCA Prox (right coronary artery)
- RCA Dist (right coronary artery)
- LCX (left circumflex artery)
- 3V/LM narrowing (all three vessels or left main is affected)

Advice:

Recommendations based on the ST score and additional information:

- Transport to PCI centre
- Transport to nearest hospital
- Consider thrombolytic therapy if PCI centre is further away than 1.5 hours.
- Consider thrombolytic therapy
- No thrombolytic therapy

7 Memory

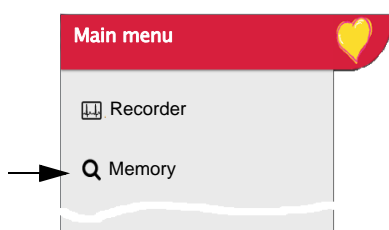
Recordings can be stored locally and transmitted automatically to Schiller Link or SEMA. Recordings stored in the memory can be viewed, printed, transmitted or deleted at any time.

Approx. 350 resting ECGs and 100 resting rhythms can be stored on the CardioPad-2. Recordings are stored manually after completion of the acquisition.



Memory capacity is indicated by the icon . A green icon means Memory OK, a yellow icon means Memory almost full, a red icon means Memory full, no recording possible. Chapter 7.1.2 describes how to delete recordings.

7.1 Editing the memory



- When **Menu > Memory** is selected, stored recordings are displayed
- The recordings are listed by date/time; however, different listing criteria can be selected and recordings can also be searched via the search function.

Double click to open the recording Sort recordings

Search recording

Selecting ☒, transmitting or deleting one or several recordings.

Export selected recordings as PDF to USB.

Transmitting the selected recordings

Deleting the selected recordings


Display selected recordings ☒

View recording


View recording

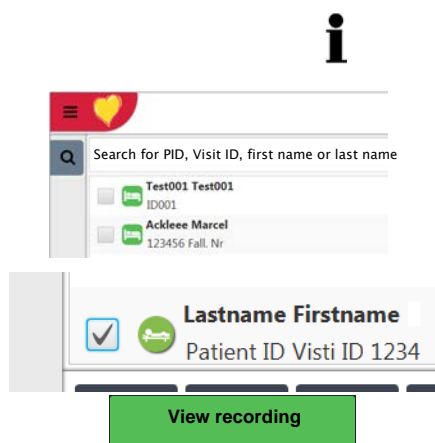
Search for PID, Visit ID, first name or last name	Sort by	Date / time
<input type="checkbox"/> Ackleee Marcel 123456 Fall. Nr		25.10.2017 16:19
<input type="checkbox"/> Name Surname Patient ID Cas nr.		25.10.2017 16:14
<input type="checkbox"/> Emergency 20171025161306 4ab354c5-414e-407e-af77-737271ae6ab1		25.10.2017 16:13
<input type="checkbox"/> Emergency 20171025160953 a80d5d92-d315-4db2-9457-5c7d366d006e		25.10.2017 16:09

7.1.1 Opening the print preview from the memory and printing a recording

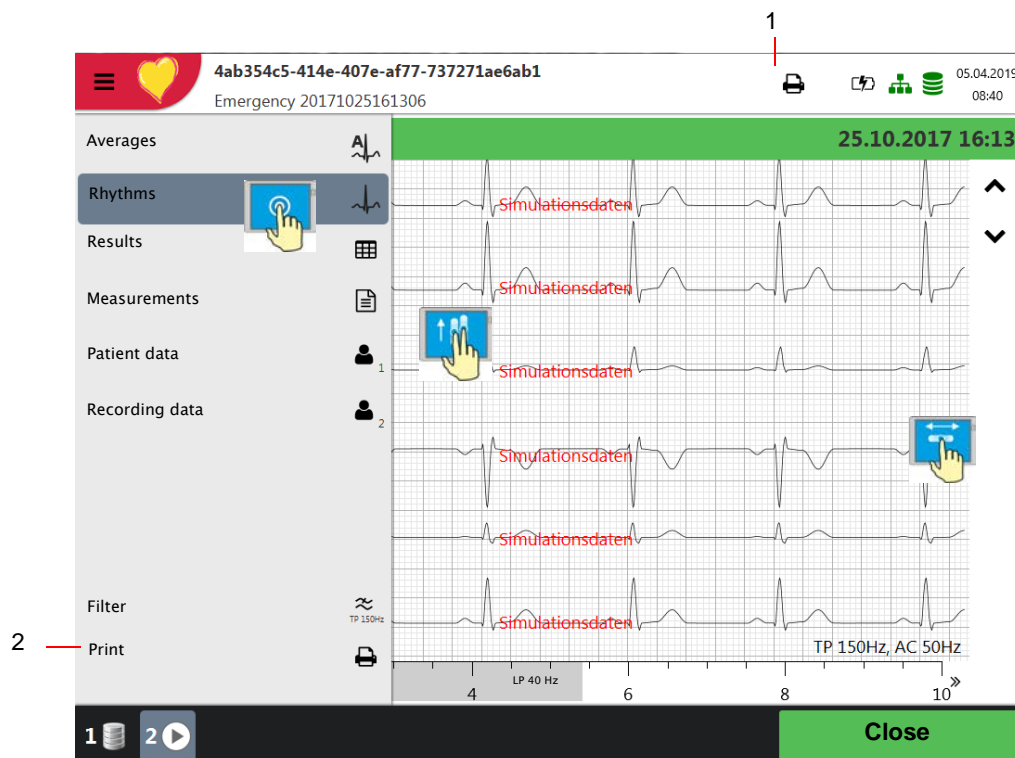
If the recording cannot be printed (e.g. no paper), the printout can be generated again by pressing the icon (1)  Print jobs in the status bar at the top.

Recordings can be searched using the Patient ID, Visit ID or first/last name. Enter the search term via keyboard or via barcode reader.

1. Search and select the desired recording.
2. Press the key View recording.
→ The recording is displayed according to the settings in **Menu > Settings > Resting ECG > Vies & layouts > RECG Review**, and the layout can be changed for the displayed recording at any time.
3. Press (2)  to print the recording in the selected format, see [Section 9.2.7 Reports, page 79](#).

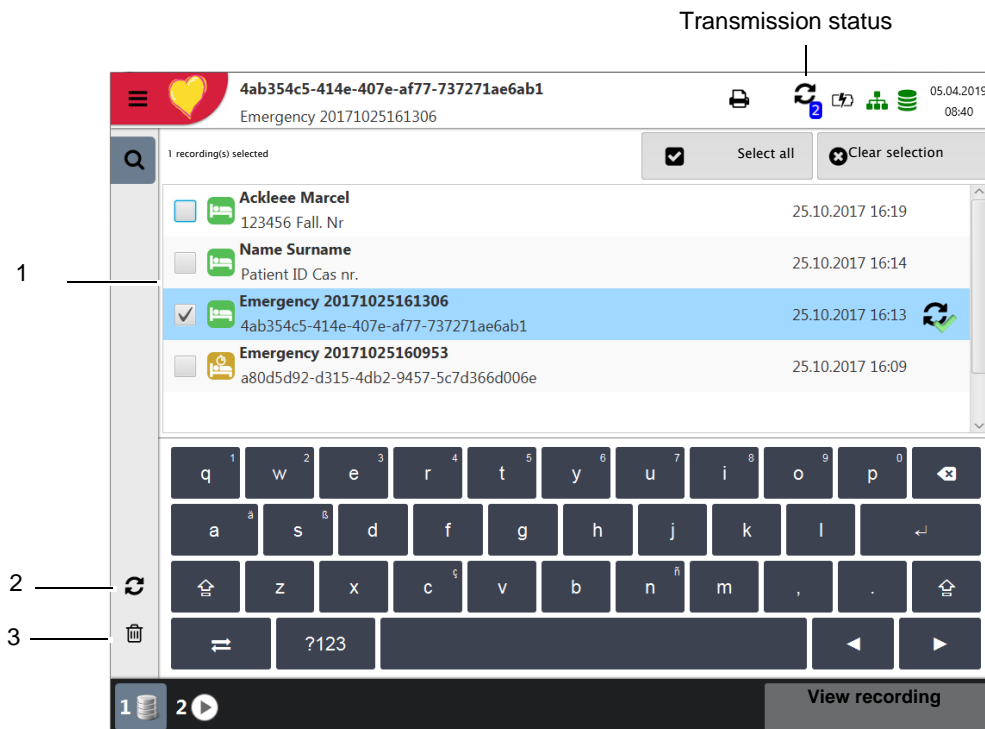


Example: resting ECG



7.1.2 Transmitting and deleting stored recordings

Depending on the settings in **Menu > Settings > General > Workflow**, the recording is transmitted and deleted automatically as soon as it has been recorded. If automatic transmission is not activated, recordings can be transmitted as follows.



1. Select one or more recordings directly on the screen (1).
2. To select all recordings, press the key **Select all**.
3. Select one of the following options:
 - Export (2)
 - Delete (3) (automatic deletion after transmission can be set in **Settings > General > Workflow**).

If the selected operation cannot be carried out due to an error, an error message is issued (see [Page 91](#)) and the following symbols/buttons are displayed for each recording:



Indicates faulty recordings or recordings that have not been transmitted.



Indicates recordings that have not been transmitted.



Exported recordings.



The transmitting options are detailed in the section System settings (see [Page 87](#)).

8 Worklist (Option)

8.1 General information

The Worklist function enables a doctor / administrator to define a worklist of patients that require recordings to be made. The doctor can define the patient, room / department, and specify the type of recording to be made. The worklist is defined directly from the Hospital information system (HIS) (e.g. SEMA or GDT) and after the recording has been made by the CardioPad-2, the recordings are sent back to the HIS for analysis, examination and storage.

Instead of the type of recording, "Undefined" can be set. When this is the case, only the patient demographics are sent to the unit.



- To be able to use the worklist function, the unit must be set up to communicate with SEMA (see [Page 82](#)).
- The SEMA user guides describes how to define worklists from SEMA.



SEMA has options to send a worklist to a specific unit or to all units on the system. To receive a specific worklist from SEMA, the unit identification of the CardioPad-2 (device ID in the system) must be the same as the one defined for SEMA. This is usually set when the unit is first commissioned. The Device ID is shown in **Menu > Settings > General > Station**.

8.1.1 Worklist settings

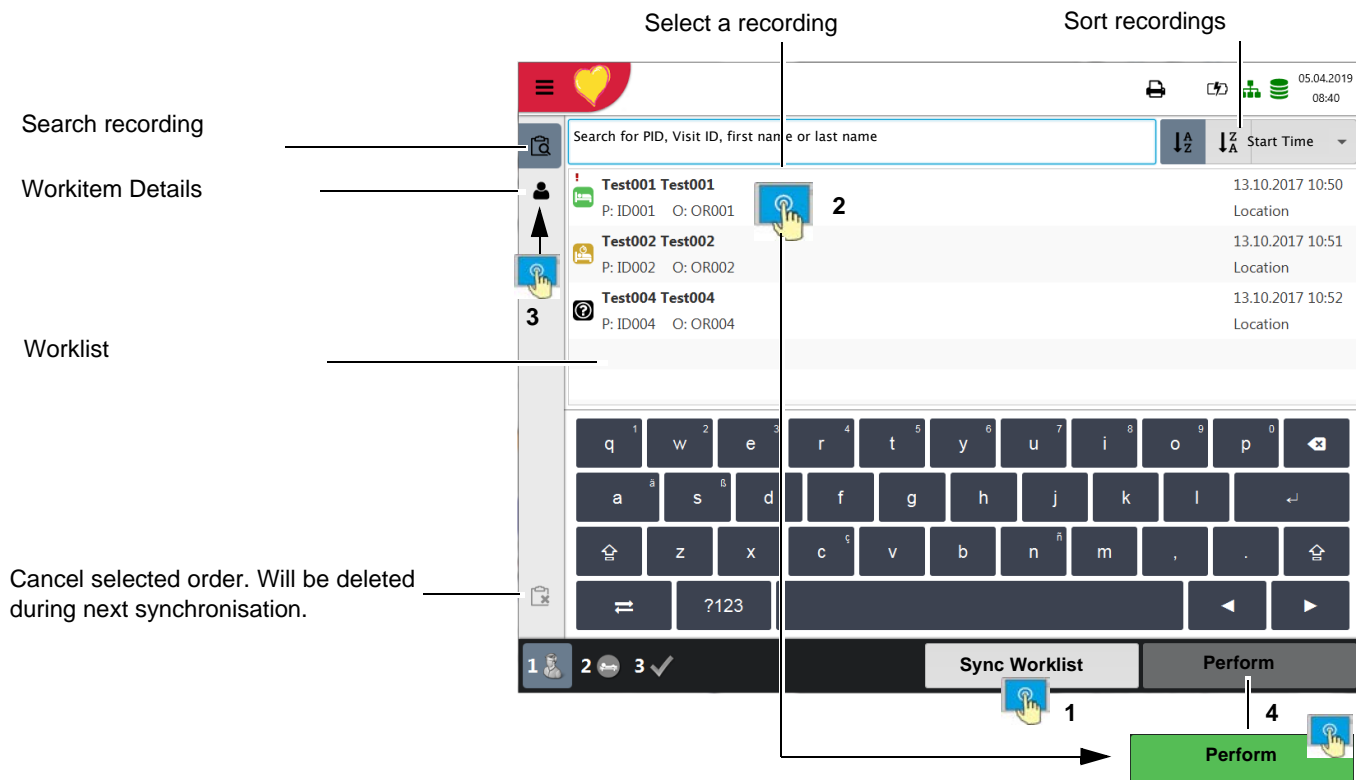
If worklists are to be used, the workflow can be adapted accordingly. To do so, set the Default workflow in **Menu > Settings > General > Workflow** to Record from worklist ([Section 9.5 General, page 84](#)). In this way, the worklist is shown directly after power-up. However, worklist can also be selected manually from the menu.



8.2 Receiving a worklist

To open the worklist proceed as follows:

1. Press **Menu > Worklist**.



If **Menu > Settings > General > Workflow** Auto sync. workflow is activated, the list is updated every minute and the time for the next update is shown on the key.

2. To receive a worklist from a HIS, press the **Sync. worklist (1)** key to download the worklist from the server. Wait (up to a few minutes) for the worklist to be populated. Select a work item **(2)**. You can check the work item by pressing **(3)**, return to the worklist and/or perform the work item **(4)**.
3. All patients given in the worklist are displayed with their last/first name, patient ID, order ID and room number. The following recording types are available:

- Resting ECG
- Resting rhythm
- Undefined recording type. The recording type is assigned when the recording is performed.



Recording status:


- White background = recording to be performed.
- Blue or grey background = selected recording.
- Green background = already performed recording. This work item will be deleted from the device during the next synchronisation.
- Red background = recording was cancelled. Will be deleted during next synchronisation.

Test001 Test001	13.10.2017 10:50
P: ID001 O: OR001	Location
Test002 Test002	13.10.2018 10:51
P: ID002 O: OR001	Location
Test004 Test004	13.10.2017 10:52
P: ID004 O: OR004	Location
Test005 Test005	13.10.2017 10:50
P: ID001 O: OR001	Location


8.2.1 Taking a Worklist Recording



- This procedure corresponds with the worklist mode “Record from worklist”, see setting [Section 9.5 General, page 84, workflow](#).
- Patient data provided by the HIS cannot be edited (except for height and weight).
- If you have selected an incorrect work item, press the key  , but **not** the key  (Cancel order). Select the new work item from the list, or use the Search field.

1. Prepare the patient and select a work item.
2. Select **Work item details**  to check the work order or to complement patient data.
3. Press the Perform key.
4. The corresponding recording acquisition screen (resting ECG or resting rhythm) is opened. If no recording type has been defined, both options are available.





Press  to return to the worklist without performing the recording (last chance to do so).

5. Take the recording:
 - Resting ECG (see [Page 43](#))
 - Resting rhythm (see [Page 47](#))

8.2.2 Performing a recording from work order details




- This procedure corresponds with the worklist mode “Record from work order details”, see setting [Section 9.5 General, page 84, workflow](#).
- Patient data provided by the HIS cannot be edited (except for height and weight).
- If you have selected an incorrect work item, press the key  , but **not** the key  (Cancel order). Select the new work item from the list, or use the Search field.

1. Prepare the patient and select a work item.


Select a recording

Workitem Details

Cancel selected order. Will be deleted during next synchronisation.

2. Select **Details (2)** to check the work order or to complement patient data.
3. Press **Perform (3)** in the “Work item details” view .
4. The corresponding recording acquisition screen (resting ECG or resting rhythm) is opened. If no recording type has been defined, both options are available.



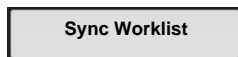
Press  to return to the worklist without performing the recording (last chance to do so).

5. Take the recording:
 - Resting ECG (see [Page 43](#))
 - Resting rhythm (see [Page 47](#))

8.2.3 Sending worklist recordings to the HIS



- It is possible to automatically send performed worklist recordings; alternatively, you can have the unit prompt you to manually send worklist items. This is defined in system settings (**Menu > Settings > General > Workflow** [Page 84](#)).



- In order to manually transmit recordings to SEMA, press **Sync. worklist**. Wait (up to a few minutes) while the recordings are sent - the Worklist will go blank after the files have been sent.



Pending work items are indicated by a white background and selected work items by a blue or grey background. Already performed recordings (green background) can be sent at any time without losing pending work items.

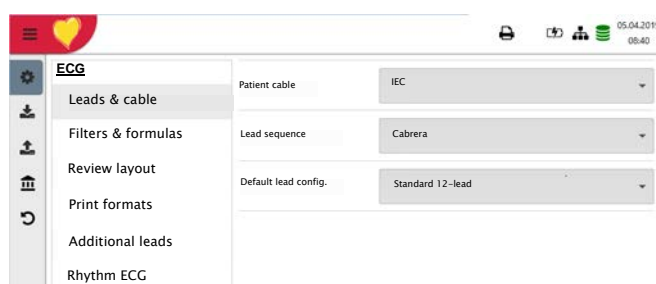
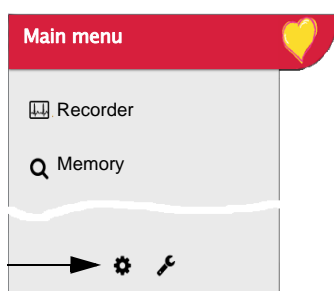
	Test001 Test001	13.10.2017 10:50
	P: ID001 O: OR001	Location
	Test002 Test002	13.10.2018 10:51
	P: ID002 O: OR001	Location
	Test004 Test004	13.10.2017 10:52
	P: ID004 O: OR004	Location
	Test005 Test005	13.10.2017 10:50
	P: ID001 O: OR001	Location

Cancelled work items (red background) are deleted from the worklist during the next synchronisation.

9 General and system settings

9.1 System settings

When pressing the Menu key, the options Settings and Memory are displayed. The following table gives an overview of all the settings available.



Overview **Menu > Settings**

Menu Settings	Sub-menu
ECG (Page 76)	• Leads & cable
	• Filters & formulas
	• Views & layouts
	• Additional leads
	• Interpretation
	• Rhythm ECG
	• General
Reports (Page 79)	• Manual printout
	• Resting ECG
	• Rhythm ECG
Connectivity (Page 82)	• EMR integration
	• Update server
	• Ethernet
	• WLAN
Regional (Page 83)	• Date & time
	• Keyboard
	• Language
	• Units
	• Patient ID system

Menu Settings	Sub-menu
General (Page 84)	• Info
	• Power management
	• Station
	• Update
	• Manage licenses
	• Mandatory fields
	• Workflow
	• Access control
	• Printer

9.1.1 Saving and restoring settings



The settings are saved automatically.

Import settings



Select Import and Import target USB and enter the desired file name to load the stored settings (e.g. default settings) from the USB to the device.

Export settings



Select Export and Export target USB and enter a file name to save the settings.

Export audit log



Select Export target and enter the file name to export the Audit Log

**Reset to factory
settings**



set-

All settings are reset to the factory defaults. If the network settings are to be reset as well, untick the check box.

9.2 ECG

The default settings are printed **bold**

9.2.1 Leads & cable

Menu	Parameter	Description / selection
Leads & cable	Patient cable	IEC or AHA
	Lead sequence	Standard or Cabrera <ul style="list-style-type: none"> • Standard 12-lead • Paediatric • Right precordials
	Default lead config.	<ul style="list-style-type: none"> • Standard C4r • Left posterior • Nebh (chest) • Balanced

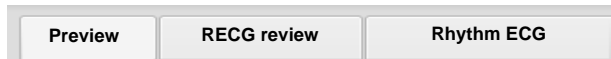
9.2.2 Filters & formulas

Menu	Parameter	Description / selection
Filters & formulas	Notch filter	Off/ AC 50/AC 60 Hz
	Myogram filter	Off = 250 Hz/LP25/LP40/LP150 Hz
	Default QTc calculation	Bazett, Fridericia, Framingham, Hodges

9.2.3 Views & layouts

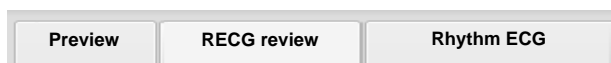
In this menu, the views and layouts for the **Preview**, **RECG review** and **Resting rhythms** are defined.

Preview



Menu	Parameter	Description
Preview	Preview view order	Select whether Hookup or Recorder is shown at the top
	9 lead layout	6/3 for Nebh Chest
	12 lead layout	2x6 / 4x3
	Speed/Amplitude	Speed 12.5/ 25 /50 mm/s Amplitude 5/ 10 /20 mm/mV

RECG Review

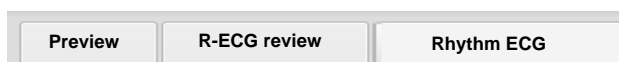


These settings apply to current resting ECG recordings and recordings from the memory. Therefore, saved ECGs can be displayed with different settings at any time.

Menu	Parameter	Description
RECG Review	Review views and order	Adding/removing views, and defining their order: rhythms, averages, results and measurements.
	Rhythm 12 lead layout	1x6 / 1x12
	Rhythm Speed/Amplitude	Speed 12.5/ 25 /50 mm/s Amplitude 5/ 10 /20 mm/mV
	Avg. Speed/Amplitude	Speed 25 /50 mm/s Amplitude 10 /20 mm/mV

Rhythm ECG

These settings apply to current resting rhythm recordings and recordings from the memory. Therefore, saved ECGs can be displayed with different settings at any time.



Menu	Parameter	Description
Rhythm ECG	Review views and order	Adding/removing views, and defining their order: Continuous/Rhythm and Rhythm summary. Settings see below.
	Amplitude	2.5/ 5 mm/mV
	Speed	Speed 6.25 /12.5mm/s

9.2.4 Additional leads

Default leads per lead configuration

These settings apply to the current resting rhythm recording, recordings from the memory, and the printout. Therefore, saved ECGs can be displayed or printed with different settings at any time.

Menu	Parameter	Description / selection
Additional leads	Standard 12-lead	I / II / III aVR / aVL / aVF / V1 / V2 / V3 / V4 / V5 / V6 / -aVR Rhythm 1 II , Rhythm 2 V2 , Rhythm 3 V5
	Paediatric	I / II / III aVR / aVL / aVF / V7 / V2 / V3r / V4r / V5 / V6 / -aVR Rhythm 1 V7 , Rhythm 2 V4r , Rhythm 3 II
	Right precordials	I / II / III aVR / aVL / aVF / V1 / V2 / V3r / V4r / V5r / V6r / -aVR Rhythm 1 V3r , Rhythm 2 V5r , Rhythm 3 II
	Standard C4r	I / II / III aVR / aVL / aVF / V1 / V2 / V3 / V4r / V5 / V6 / -aVR Rhythm 1 V4r , Rhythm 2 V2 , Rhythm 3 II
	Left posterior	I / II / III aVR / aVL / aVF / V4 / V5 / V6 / V7 / V8 / V9 / -aVR Rhythm 1 V8 , Rhythm 2 V5 , Rhythm 3 II
	Nehb (chest)	I / II / III / aVR / aVL / aVF / D / A / J / -aVR Rhythm 1 D , Rhythm 2 A , Rhythm 3 J
	Balanced	I / II / III aVR / aVL / aVF / V4r / V3r / V1 / V7 / V8 / V9 / -aVR Rhythm 1 V7 , Rhythm 2 V4r , Rhythm 3 II

9.2.5 Interpretation

Menu	Parameter	Description / selection
Interpretation	Print interpretation	Yes/No
	Display interpretation	Yes/No

9.2.6 Resting rhythm

Parameter	Description / selection
Rhythm length	30 s , 1, 2, 3 or 4 minutes Setting the recording duration.
Show recording time dialogue	<input checked="" type="checkbox"/> Yes. The dialogue can be deactivated during the recording and can be activated here again.
Predefined event texts	Enter (delete) predefined event texts which can be selected during the recording. → Press +, enter text and confirm with Enter.

HR > 180

B

←

9.2.7 Reports

In this menu, the **Print layout** is defined.

General

Parameter	Description
Rhythm mode	Sequential or Simultaneous. When Sequential is selected, the individual lead groups show consecutive time segments (applies to the printout). When Simultaneous is selected, all lead groups show the same time segment (applies to the printout). If a format including a rhythm lead is defined for printout, Sequential is always used, even if you have selected Simultaneous.
PDF paper format	A4 or Letter
PDF conformance	None , PDF/A-1a, PDF/A-1b
Company info 1, 2, 3	Enter company information on PDF rows 1, 2 and 3.

Manual printout

In this menu, the default settings for manual printouts are defined.

Parameter	Description
Lead group	Select the lead group Limb or Precordials
Speed [mm/s]	5, 12.5, 25 or 50 mm/s
Amplitude [mm/mV]	5, 10 , 50 mm/mV

Resting ECG

These settings apply to current resting ECG recordings and recordings from the memory. Therefore, saved ECGs can be printed with different settings at any time.



- The order listed below can vary.

Menu	Description / selection
	Selection and order of the following printout formats:
	<ul style="list-style-type: none"> • Patient data • Rhythm 2x6, 25 mm/s, 1 page • Averages 4x3+1, 50/25 mm/s, 1 page • Results
12 Lead	<ul style="list-style-type: none"> • Rhythm 2x6, 25 mm/s, 2 page • Rhythm 2x6, 50 mm/s, 2 page • Rhythm 4x3+1, 25 mm/s, 1 page • Averages 4x3+1, 25/25 mm/s, 1 page • Averages 6x2+2, 50/25 mm/s, 1 page • Measurement Table
12 Lead (PDF)	<ul style="list-style-type: none"> • Rhythms 10s, 25 mm/s, 2p • Measurements • Averages Grid, 25/25 mm/s • Averages Grid, 50/25 mm/s • Averages Wide, 25/25 mm/s • Panorama • Rhythms 10s, 25 mm/s • Rhythms 5s, 25 mm/s • Rhythms 5s, 50 mm/s, 2p • Rhythms Grid, 25 mm/s
9 Lead	<ul style="list-style-type: none"> • Patient data • Rhythm 6/3, 25 mm/s, 1 page • Averages 3x3+1, 50/25 mm/s, 1 page • Results • Rhythm 6/3, 50 mm/s, 2 pages • Rhythm 6/3, 50 mm/s, 2 pages • Averages 6/3+2, 50/25 mm/s, 1 page • Measurement Table
9 Lead (PDF)	<ul style="list-style-type: none"> • Rhythms 10s, 25 mm/s, 2p • Measurements • Averages Grid, 50/25 mm/s • Averages Wide, 50/25 mm/s • Rhythms 5s, 25 mm/s • Rhythms 5s, 50 mm/s, 2p

Rhythm ECG

These settings apply to current resting rhythm recordings, resting rhythm recordings from the memory (Internal, display and printout), as well as PDF. Therefore, saved resting rhythm ECGs can be printed with different settings at any time.

Menu	Description / selection
	<ul style="list-style-type: none"> Amplitude 5 or 2.5 mm/mV Patient data
Internal	<ul style="list-style-type: none"> Continuous x1, 6.25 mm/s Event list HR trend
PDF	<ul style="list-style-type: none"> Rhythm summary Continuous 25 mm/s, 2:00 min Rhythm 5, 10, 20 mm/mV All events 2x10s, 6 pages Rhythm 5, 10, 20 mm/mV All events 2x5s, 6 pages Rhythm 5, 10, 20 mm/mV Continuous 12.5 mm/s, 5:20 min Rhythm 5, 10, 20 mm/mV Continuous 6.25 mm/s, 10:40 min Rhythm 5, 10, 20 mm/mV Manual events 10s, 1/2 page Rhythm 5, 10, 20 mm/mV Manual events 10s, 1 page Rhythm 5, 10, 20 mm/mV Rhythm 10s/page Rhythm 5, 10, 20 mm/mV Rhythm 20s/page Rhythm 5, 10, 20 mm/mV

Internal
PDF

Amplitude
5 mm/mV

Patient data
Remove

Continuous x1, 6.25 mm/s
Remove

Event list
Append

HR Trend
Append

Internal
PDF

Rhythm summary
Remove

Continuous, 25 mm/s, 2:00 min
Remove

Rhythm 10 mm/mV


All Events 2x10s 4/p
Append

All Events 2x5s 6/p
Append

Setting the rhythm amplitude
5, 10, 20 mm/mV

9.3 Connectivity

Menu	Parameter	Description / selection
EMR integration Server settings		None <ul style="list-style-type: none"> – No input field displayed Schiller Link <ul style="list-style-type: none"> – Device ID is displayed Schiller Server <ul style="list-style-type: none"> – Host, port, user and password input fields are displayed. (See following)
	Host	Name of the server
	SSL cert. validation	No/Yes <input checked="" type="checkbox"/>
	Port	Port address
	User	User name
	Password	Password
Update server	Host	Schiller Update server
	Port	Port address and key Test connection
Ethernet	Use DHCP	<input checked="" type="checkbox"/> Active or <input type="checkbox"/> Not active. If this is not activated, the following parameters need to be entered:
	IP address	Identifier address of the device in the TCP/IP network.
	Subnet mask	E.g.: 255.255.255.0
	Standard Gateway	Gateway IP address.
	DNS server	Domain name of the server
WLAN general	Wi-Fi enabled	<input checked="" type="checkbox"/> Active <input type="checkbox"/> Not active
	SSID..... <input type="checkbox"/> Hidden	SSID = Enter network name. Check box "Hidden" = if the SSID is configured as hidden in the Wi-Fi network, the check box "SSID Hidden" needs to be activated.
	Wi-Fi security	Selection of the encryption protocol <ul style="list-style-type: none"> • WPA/WPA2 personal SSID + key + (encryption = AES + authentication) • WPA2 enterprise / ieee802.1 (<i>additional settings see *</i>) SSID + certificate + (encryption = AES + authentication) SSID + user name & password + (encryption = AES + authentication)
WLAN security (for WPA/WPA2 personal)	Password	Enter password for WPA/WAP2 protocol


Menu	Parameter	Description / selection
WLAN security (for WPA2 enterprise / ieee802.1)	Authentication protocol	Select the authentication protocol: PEAP , EAP-TLS or EPA-TTLS
	User	Definition of the user name
	Password	Definition of the password
	Client certificate and CA certificate	<p>Download the certificate via USB port of the device when EAP-TLS is selected</p> <p>→ Connect USB stick to the device and press Load  .</p> <p>Certificate structure: a single file in pem. format contains client certificate, of origin, private key. The private key may or may not be encrypted. If it is encrypted, the user name and password need to be entered.</p>
Advanced	<input type="checkbox"/> Hidden	Check box "Hidden" = if the SSID is configured as hidden in the Wi-Fi network, the check box "SSID Hidden" needs to be activated.
	Anonymous identity	Enter an anonymous identity (name)
WLAN network	see Ethernet parameters	Settings network parameters


9.4 Regional settings

Sub-menu	Parameter	Description / selection
Date/time	Various	Date and time format
		Time zone
Keyboard	Various	Date and time setting
		→ Key Sync time with server. Time and date on the device are updated. The device needs to be restarted.
Keyboard	Keyboard layout	Select a language
	External keyboard layout (bar-code scanner layout)	Selecting the character set for the external barcode scanner.
Language	Language	Select a language
Units	Weight	Units available are g, kg and lb
	Length	cm , m, inch
	Temperature	Celsius or Fahrenheit
Patient ID system	None Swedish Danish Finnish Norwegian	Using country-specific patient IDs.

9.5 General

Menu	Parameter	Description / selection
Info	Various parameters	Software and hardware versions are displayed.
	<div>Write info to USB</div>	A diagnostic file (.nfo) is written to the connected USB USB memory stick.
Power management	Battery operation Dim backlight [s]	120 seconds (2 min.). If set to 0, this function is deactivated.
	Shut down device [s]	600 seconds (5 min.). If set to 0, this function is deactivated.
	Mains operation Dim backlight [s]	0 seconds (0 min.). If set to 0, this function is deactivated.
	Shut down device [s]	3600 seconds (1 hour). If set to 0, this function is deactivated.
Station	Device ID	Device identification
	Institute	Name of the institute
	Department	Name of the department
	Technician	Technician
Update	Network host name	Host name of the device (e.g. ft1) displayed in the network.
	Check Schiller update server	Update software The check is performed on the Schiller update server. Therefore, an Ethernet/WLAN connection is required, including the necessary network settings for this connection
	Check USB device for update file	The Update is performed via the connected USB stick.
Manage licenses	Available options	Automatic interpretation Worklist ETM Sport CCAA
	Activate license	Enter the licence key and activate
	Import licence from USB	Activation via USB stick (.lic file)
Mandatory fields	Defining the mandatory fields	Following fields must be filled before a recording can be taken. Mandatory fields for exercise ECG which cannot be deactivated: Gender, height, weight, date of birth.

Menu	Parameter	Description / selection
Workflow	Transmit after acquisition	ECG data is transmitted after acquisition and storage of the recording
	PDF to USB after save	Yes, No . After saving, the PDF is automatically exported to the USB stick
	Delete after transmission	ECG data is deleted once it has been successfully transmitted from the memory.
	Print after acquisition	ECG data is printed once it has been stored.
	PDQ mode	PDQ by Patient ID PDQ by Visit ID None (PDQ is not started, even if EPA integration has been selected)
	Default workflow	Worklist Recorder
	Worklist mode (only if option has been activated)	Record from worklist Record from work order details 
	Auto sync worklist	<input checked="" type="checkbox"/> Yes, No . Worklist is synchronised every minute.

Menu	Parameter	Description / selection
Access control (automatic logout when access control is activated, see menu "Automatic logout" next page) Important! These settings must only be performed by trained personnel.	Access control mode	<ul style="list-style-type: none"> • None No access control • Basic Login when switching on the device and/or accessing the Settings menu requires a password • Local Defining users, passwords and privileges locally on the device • Schiller Server Access control is defined via the Schiller Server.
	Basic	
	Device login active	<input checked="" type="checkbox"/> If activated, the login dialogue is displayed at switch-on.
	Device password	Defining the password (default)
	Settings Login Active	<input checked="" type="checkbox"/> If this is activated, the login dialogue is displayed when the settings are opened 
	Settings Password	Defining the password (admin)
	Local	
	User name	Administrator (additional users can be created)
	Password	Enter the password ("administrator" is used as password if no other password is entered)
	Retype Password	Confirm password
Automatic logout (Is only displayed if Access control is activated)	Privileges	Selecting the privileges: Adjust system settings; Analyse recordings (from memory); Create recordings.
	Schiller Server	This requires a working EMR connection and Schiller Server administrator rights. Access control is defined on the Schiller Server.
Automatic logout (Is only displayed if Access control is activated)	Automatic logout enabled	<input checked="" type="checkbox"/> Yes/No
	Logout timeout [s]	300
Print setting	Contrast	1-10 (5)
	Line width	Thin, normal , thick

10 Transmission - Overview

! CAUTION

- ▲ Security of the network is the sole responsibility of the network operator.
- ▲ seca takes no responsibility for the configuration of Windows.
- ▲ In order to guarantee the security of the network, seca recommends the following:
 - isolating the CardioPad-2 network from other networks
 - defining access authorisation for the configuration of the host system, incl. CardioPad-2, so that no unauthorised alterations of the system are possible
 - limiting the data transmission between the host and other systems/networks to a minimum
 - installing the latest antivirus/firewall programs on the host in order to prevent malware from affecting the system
 - regularly installing security updates on the host
 - installing software updates that increase the CardioPad-2's security
 - taking the appropriate measures to check the system's security and ensure safe operation when changing the network configuration, installing security updates and adding/removing devices.

10.1 Transmission Options

With the CardioPad-2, transmission is possible via a network or Wi-Fi. The transmission options are as follows:

! WARNING



- ▲ When a non-medical device is connected to the interface, ensure that both units are securely connected to the same earth potential.
- ▲ An external device must only be connected using the original interface cable assembly.
- ▲ The transmission of ECG data via WLAN can disturb other devices, including pacemakers. Therefore, keep a distance of at least 20 cm from the patient while an ECG is transmitted.

LAN

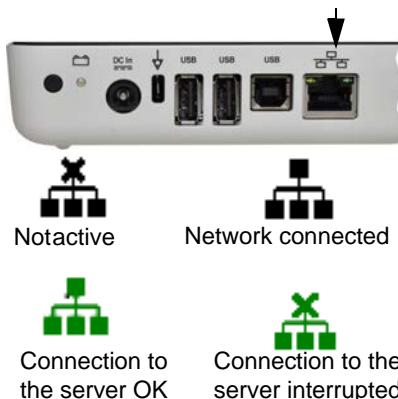
data transmission via local LAN network (Ethernet) to the EMR system. For an Ethernet (network) connection, connect the cable assembly to the RJ-45 connector.

LAN or WLAN not active/active

The network symbol in the status bar at the top right indicates with a square ■ that the connection (WLAN or LAN) is active.

Green = connection to network/server established

Black = no connection to network/server



Wifi

If Wifi is activated, the following symbols are displayed



- Green symbol: connected to the Wifi network and the SCHILLER Server.
- Black Symbol: connected to the network but no connection to the SCHILLER Server
- Signal strength is displayed with bars.

Schiller Link

Schiller Link offers easy communication with an EMR system within the same network. This communication comprises the following: import (GDT) of examination requests including patient data and recording type from an EMR system, export of recordings to an EMR system in the formats GDT, Sema2 or PDF. To activate this communication, set **Schiller Link** in the menu Connectivity > EMR integration (see page 82).

The transmitted patient data is displayed automatically when the patient data screen is open, if it does not contain any entries and is not in review mode after a recording.

SEMA

For patient data queries from the EMR system, the SCHILLER SEMA Server is required. A more detailed description of the transmission settings are given in the SCHILLER Communication Handbook 2.520036.

PDF export

Simple export of a recording as PDF to a memory stick

10.1.1 Automatic transmission



The automatic transmission setting is defined in Settings:

Menu > Settings > General - Workflow- Transmit after acquisition (Yes/No - see [Page 84](#)).

When auto transmission is defined, a recording is transmitted automatically after it has been saved.

10.1.2 Manual transmission

To transmit a recording, select the recording in the **Memory** and press **Export** (see [Page 67](#))

10.1.3 PDF export

Data integrity



- ▲ When exporting patient data to a memory stick, the responsible user needs to protect the data with appropriate security measures:
 - Make sure that only authorised people have access to the memory stick.
 - Once the data has been transmitted from the memory stick to a secure system, delete all data from the memory stick.
 - Deactivate the PDF export function if it is not used.

Settings

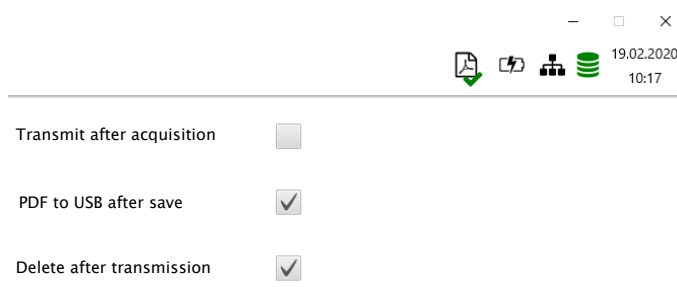


USB stick

Activate **PDF export** in the **Menu > Settings > Workflow > PDF to USB after save**. If **PDF export** is active, the recordings from the memory are transmitted as soon as a USB stick is connected. The symbol PDF export is displayed when data has successfully been transferred to the memory stick.

Caution

If “**Delete after transmission**” is activated in the same menu, the recordings are deleted from the memory.



Manual PDF export from memory



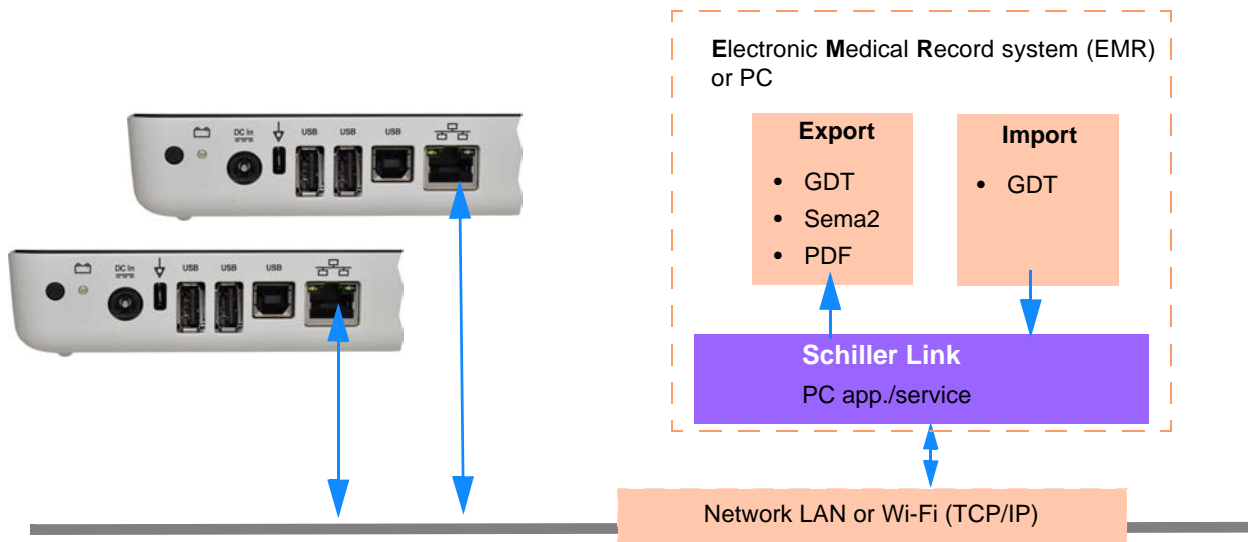
An individual recording can be exported to a USB stick from the memory if the setting above “Delete after transmission” has been selected.

- Open the Memory, select the recording and export with the key. Storage progress is shown in the status bar with the PDF symbol.

10.1.4 Schiller Link

Schiller Link is a PC application/service which communicates between the EMR system and the CardioPad-2.

- To activate this communication, set Schiller Link in the menu **Connectivity > EMR integration** (see page 82).
- Integration in the network is automatic, provided the CardioPad-2 is part of the same network



Procedure with EMR system

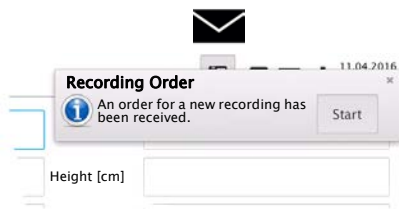
1. Enter/select a patient in the EMR system
2. Generate a new order for this patient
3. Upload the GDT file into the import folder of the Schiller Link service
4. Start and check the order incl. patient data on the CardioPad-2.
5. Perform the recording on the CardioPad-2.
6. Store the recording and export it automatically or manually to the export folder.
7. The EMR system imports the recording for review in the EMR system.

Procedure without EMR system

1. Manually enter the patient data on the CardioPad-2 (via keyboard or barcode reader).
2. Perform the recording on the CardioPad-2.
3. Store the recording and export it automatically or manually to the export folder.
4. Review the recording (PDF) on the PC and print or transmit it via e-mail.



If necessary, successfully exported recordings can be exported again. This feature is not available for the Schiller Server.




10.1.5 Receiving data from SEMA

Patient data can be received from a Schiller SEMA server and automatically entered on the CardioPad-2. This is called patient data query (PDQ). To do this, the Patient or Visit ID is entered in the patient data screen manually or via a barcode reader (see [Page 28](#)).



- Patient data query requires the Schiller SEMA Server being available via network.
- The server name, URL, TCP/IP address etc. as well as all other transmission settings are defined in the system settings (see [Page 82](#)).
- A communication overview is given in the SCHILLER Communication Handbook (Art. No. 2.520036).

10.1.6 Failed data transmission

Failed transmission of data is indicated with the symbol  in the status bar.



1. The blue figure indicates the number of failed transmissions.
2. Data that was not transmitted can be resent from the memory. See [Section 7.1.2 Transmitting and deleting stored recordings, page 67](#).

If no data can be transmitted, check the following:

- Network settings (see [Page 82](#))
- Network connection WLAN or LAN
- Encryption settings on the server
- Settings in the Schiller Link App.



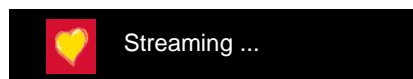
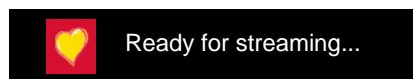
Connectivity		
Ethernet	N/A	[MAC --:--:--:--:--:--:--]
Wi-Fi	N/A	[MAC --:--:--:--:--:--:--]
EPA-Integration	Schiller-Server	
URL not valid		
<div>Close</div>		

10.2 CardioPad-2 streaming



As soon as the switched on CardioPad-2 is connected to a PC via the USB interface type B, the device indicates "Ready for streaming".

As soon as a recording is started with the CS-104 application on the PC, the CardioPad-2 indicates "Streaming.." and transmits the ECG raw data to the PC where the data is displayed online in the CS-104 application. In addition to the raw data, the lead-off status and detected pacemaker pulses are transmitted.



11 Maintenance



The regular system maintenance must include a software check according to the manufacturer's instructions. The test results must be recorded and compared to the values in the accompanying documents.

Maintenance work not described in this section may only be accomplished by a qualified technician authorised by seca.

The following table indicates the intervals and responsibilities of the maintenance work required. Local regulations in your country may stipulate additional or different inspection intervals and tests.

Interval	Maintenance step	Responsible
Before each use	<ul style="list-style-type: none"> Visual inspection of the device and ECG electrodes 	→ User
Every 6 months	<ul style="list-style-type: none"> Visual inspection of the device (see page 98, 11.6 Inspection report) <ul style="list-style-type: none"> – Touch screen test – Cables and accessories – Power supply unit and mains cable Functional tests according to the instructions (see page 98, 11.6 Inspection report) 	→ User
Every 12 months	<ul style="list-style-type: none"> Safety test according to IEC/EN 62353 	→ Qualified service personnel

11.1 Visual Inspection

Visual inspection of the unit and the cable assembly for the following:

- Device casing and power supply unit not broken or cracked
- LCD screen not broken or cracked
- Electrode cable sheathing and connectors not damaged
- No kinks, abrasion or wear in any cable assembly.
- Input/output connectors not damaged.

In addition to the visual inspection, switch on the CardioPad-2, toggle through the menu and check some functions randomly. In this way, you can check that:

- the device performs faultlessly
- the display works
- the touch screen works



- ▲ Defective units or damaged cables must be replaced immediately.

11.2 Cleaning the casing and cables

WARNING

- ▲ Switch the device off before cleaning and disconnect it from the mains by removing the plug. Do not, under any circumstances, immerse the device in cleaning liquid and do not sterilise it with hot water, steam or air.

CAUTION

- ▲ Do not autoclave the device and accessories.
- ▲ Do not immerse the device in liquid.
- ▲ Do not spray liquid onto the device/cable.
- ▲ The use of detergents with a high acid content or detergents that are otherwise unsuitable can damage the device (i.e. cracks and wear of the plastic casing).
- ▲ Always follow the usage instructions provided by the manufacturer of the cleaning solution.
- ▲ With time, the casing may become less resistant:
 - if an alkaline cleaner or a cleaner with a high alcohol concentration is left for a long time on the surface, or
 - if a warm disinfectant or detergent is used. seca therefore recommends using only cleaning agents that are adequate for sensitive materials such as plastics, and using them at room temperature (approx. 20°C).
- ▲ Never use any of the following solutions or similar products to clean the equipment: ethyl alcohol, acetone, hexane, abrasive or scouring powder or material, any cleaning material that damages plastic.
- ▲ The patient cable and other cable assemblies must not be exposed to excessive mechanical stress. Whenever disconnecting the leads, hold the plugs and not the cables. Store the leads in such a way as to prevent anyone stumbling over them or any damage being caused by the wheels of instrument trolleys.
- ▲ When cleaning, ensure that all labels and safety statements, whether etched, printed or stuck to the device, remain in place and remain readable.

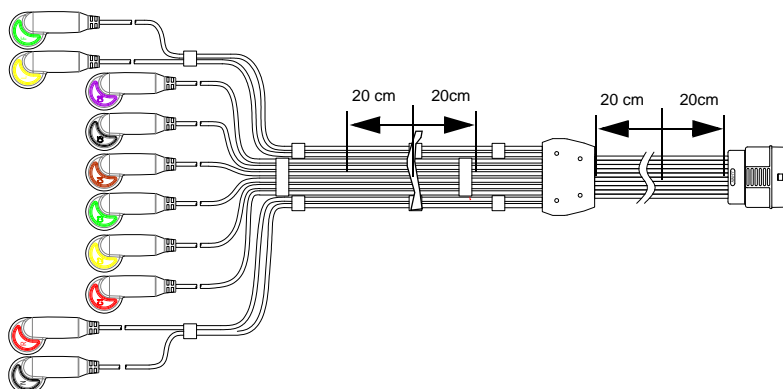
Thoroughly inspect the device and the accessories before cleaning.

- Look for any signs of damage and make sure that the keys and connectors work correctly.
- Gently bend and flex cables, inspecting them for damage or extreme wear, exposed wires, and bent connectors.
- Confirm that all connectors engage securely.

The casing of the CardioPad-2 and the cable assemblies can be cleaned with a cloth slightly moistened (not wet) on the surface only. If necessary, a domestic non-caustic cleaner or a 50 % alcohol solution can be used to remove grease stains and finger prints. Wipe the equipment with a cloth slightly moistened (not wet) with one of the approved cleaning solutions (see section 11.2.2). Thoroughly wipe off any excess cleaning solution. Do not let the cleaning solution run into or accumulate in connector openings, switches, or gaps. If liquid gets into connectors, dry the area with warm air and check that the device operates properly.

11.2.1 Cleaning the cable assembly

1. Before cleaning, inspect the cable for damage. Gently bend and flex all parts of the cable. Inspect for splits in the sheathing, damage or extreme wear, exposed wires or bent connectors.
2. Wipe the cable with a cloth slightly moistened (not wet) with one of the approved cleaning solutions listed below.
3. Gently grip the cable with the damp cloth in the centre of the cable and slide the cable through the cloth 20 cm at a time until clean. Do not clean the whole length in one single action as this may cause 'bunching' of the insulation sheathing.



4. Thoroughly wipe off any excess cleaning solution. Do not let the cleaning solution run into or accumulate in connector openings, switches, or gaps. If liquid gets into connectors, dry the area with warm air.



11.2.2 Approved cleaning solutions

- 50 % isopropyl alcohol
- neutral, mild detergent
- all products designed for cleaning plastic.

11.2.3 Non-admissible detergents

Never use products containing the following:

- Ethyl alcohol
- Acetone
- Hexane
- Abrasive cleaning powder
- Plastic-dissolving products

11.3 Disinfection

Disinfection removes certain bacteria and viruses. Please refer to the manufacturer's information. Use commercially available disinfectants intended for clinics, hospitals and medical practices.

Disinfect the units in the same way as described for cleaning the units ([previous page](#)).

11.3.1 Approved disinfectants

- Isopropyl alcohol 50%
- Propanol (35%)
- Aldehyde (2-4 %)
- Ethanol (50%)
- all products that are suitable for sensitive surfaces, such as:
 - Bacillo® 30 foam/ Bacillo® 30 Tissues
 - Mikrozid® AF

11.3.2 Non-admissible disinfectants

Never use products containing the following:

- Organic solvents
- Ammonia-based detergent
- Abrasive cleaning agents
- 100 % alcohol
- Conductive solution
- Solutions or products with the following ingredients:
 - Ketone (Acetone)
 - Quaternary ammonium compound
 - Betadine
 - Chlorine, wax or wax compound
 - Sodium salt

11.4 Cleaning the thermal print head



Over a period of time, the printing ink from the grid on the paper can form a film on the thermal print head. This can cause the print quality to deteriorate. We recommend therefore that the print head is cleaned with alcohol every month. This is done as follows:

1. Open the paper tray and remove the paper. The thermal print head is located directly above the pressure roller (when the paper tray is closed).
2. With a tissue dampened in alcohol, gently rub the printhead to remove the ink residue. If the print head is badly soiled, the colour of the paper grid ink will show on the tissue.


11.5 Battery

- No maintenance is required for the lithium-ion polymer batteries.
- Replace the battery approx. every 4 years (depending on the application) when the battery running time falls substantially under one hour.
- Storage and operation conditions outside the temperature range of 15-25 °C will reduce the service life of the battery!
- Make sure that the batteries remain charged during storage. If the device is not used for more than 3 to 4 months, the battery needs to be protected from deep discharge by recharging it; the ideal capacity is 50-80%. If a fully charged battery is stored for a long period of time, this may reduce its service life.

11.5.1 Charging the battery

A totally discharged battery requires approximately 3 hours to be 100% charged (when the unit is switched off). It is possible to use the unit when the battery is being charged; however, the charging time may be longer.

No harm will be done to the battery by leaving the unit connected to the mains supply.

1. Connect the device to the mains supply.
2. Mains via external power supply unit .
3. The blinking battery LED indicates that the battery is being charged.
4. Charge the battery for at least 3 hours.

11.5.2 Battery disposal



The battery must be disposed of in municipally approved areas or sent back to seca.



- ▲ Explosion hazard! The battery must not be burned or disposed of in domestic waste.
- ▲ Acid burn hazard! Do not open the battery.

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- ▲ The user guide, especially chapter 11, must be read before the inspection.
- ▲ **Recommended inspection interval:** Every 6 months

Test		Results		Date					
Visual inspection 11.1		• Casing not damaged							
→ External condition		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
		• Electrode connector port not damaged		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
→ Availability and condition of accessories		<input type="checkbox"/>	• ECG Electrodes (expiration date and compatibility)	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
		• User Guide		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
		• Mains and patient cable		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Functional test 2.3		• No error message shown in the standard display		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
→ ECG test				<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
→ Multi-touch screen test		• Touch screen works		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
→ Check the battery		• Battery OK		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
→ Printer		• Contrast and line strength		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
		• Cleaning the thermal print head		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	
Remarks									
→ Recurrent test conducted (every 12 months)					<input type="checkbox"/>		<input type="checkbox"/>		
Inspection carried out by:									


Name:
Phone:


11.6.1 Lifed-item replacement every 3 - 5 years

Inspection	Results	Replacement				
Internal battery						
→ Replace internal battery if operation falls substantially under one hour.		• Unit sent to seca service centre for accumulator replacement.				
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Date of replacement:						
Inspector:						

12 Trouble shooting

12.1 Possible problems

Error	Possible causes and indicators	Error localisation and troubleshooting
Unit does not switch on; blank screen	<ul style="list-style-type: none"> No mains supply; green mains indicator on the power supply unit is off. 	<ul style="list-style-type: none"> → Check the power supply unit and fuses. → If the mains indicator is lit, it indicates that power is reaching the unit and the internal power supply should be OK. Press and hold the On/Off key for 10 seconds. Wait a few seconds and switch the device on again.
	<ul style="list-style-type: none"> Mains connection OK, but indicator  and LED are not lit. 	<ul style="list-style-type: none"> → Check / change the battery. If the battery is faulty, it is possible that the unit cannot be switched on even if the mains supply is connected. → If the screen is still not lit, it indicates a software fault, monitor problem or internal power supply. Call your local seca representative.
QRS traces overlap	<ul style="list-style-type: none"> Incorrect settings for patient. 	<ul style="list-style-type: none"> → Change sensitivity setting. → Check electrode contact and reposition the electrodes. → If the problem persists, call your local seca representative.
	<ul style="list-style-type: none"> Bad electrode contact. 	<ul style="list-style-type: none"> → Note: Some patients have very high amplitudes and even on the lowest sensitivity settings, the QRS traces can overlap.
"Noisy" traces	<ul style="list-style-type: none"> High resistance between skin and electrodes 	<ul style="list-style-type: none"> → Check the electrode resistance (all leads need to be shown in green) → Re-apply electrodes.
	<ul style="list-style-type: none"> Patient not relaxed 	<ul style="list-style-type: none"> → Ensure that the patient is warm and relaxed.
	<ul style="list-style-type: none"> Incorrect settings 	<ul style="list-style-type: none"> → Check all filter settings (Menu > Settings > ECG > Filters & formulas). → Activate the myogram filter and change the cut-off frequency. → Ensure mains filter is correct for mains supply. → If the problem persists, call your local seca representative.
No printout obtained after an auto mode recording.	<ul style="list-style-type: none"> No paper 	<ul style="list-style-type: none"> → Ensure that paper is loaded.
	<ul style="list-style-type: none"> Paper incorrectly loaded. 	<ul style="list-style-type: none"> → Reload paper. → Ensure that the paper has been inserted correctly with the black mark at the top.
	<ul style="list-style-type: none"> Incorrect settings 	<ul style="list-style-type: none"> → Check that the printout is activated for at least one setting, and that Print after acquisition is activated (see page 57 and 84) → If the problem persists, call your local seca representative.
Printout fades, is not clear or the printout is 'patchy'.	<ul style="list-style-type: none"> Old paper inserted. 	<ul style="list-style-type: none"> → Ensure that new seca paper is inserted. → Note that the CardioPad-2 thermal paper is heat- and light-sensitive. If it is not stored in its original seal, stored in high temperatures or is simply old, print quality can deteriorate.
	<ul style="list-style-type: none"> Dirty print head 	<ul style="list-style-type: none"> → Over a period of time, the printing ink from the grid on the paper can form a film on the thermal print head. Clean the thermal print head.
	<ul style="list-style-type: none"> Line width/contrast setting incorrect 	<ul style="list-style-type: none"> → Set the line width, contrast, printer, see page 86. → If the problem persists, call your local seca representative.
	<ul style="list-style-type: none"> Print-head out of adjustment. 	

Error	Possible causes and indicators	Error localisation and troubleshooting
No printout of interpretation statement, average cycles or measurements	<ul style="list-style-type: none"> Incorrect settings 	<ul style="list-style-type: none"> → Check that the interpretation and measurement options are enabled for the printout and that the lead sequence is set to Normal (see page 57 section 5.6.7 and page 39 section 4.11.2,
Multi-touch screen is blocked	<ul style="list-style-type: none"> Software hangs up 	<ul style="list-style-type: none"> → Switch off and on again after a few seconds. → Press and hold the On/Off button for 10 seconds to force the device to switch off. Reconnect mains and switch on. → If the problem persists, call your local seca representative.
Multi-touch screen responds in an irregular way	<ul style="list-style-type: none"> Excessive EMC interferences 	<ul style="list-style-type: none"> → Check for sources of excessive EMC interferences.
Not able to start ECG recording	Memory full 	<ul style="list-style-type: none"> → Delete old ECG recordings, see page 65.

12.2 Preventing electromagnetic interferences



"Non-ionising electromagnetic radiation"

The user can help avoid electromagnetic disturbances by keeping the minimum distance between **portable** and **mobile** HF telecommunication devices (transmitters) and the CardioPad-2. The distance depends on the output performance of the communication device, as indicated below.

HF source Wireless communications devices	Transmitter frequency [MHz]	Testing frequency [MHz]	max. Power P [W]	Distance d [m]
Various radio services (TETRA 400)	380-390	385	1.8	0.3
- Walkie-talkies (FRS) - Rescue service, police, fire brigade, servicing (GMRS)	430-470	450	2	0.3
LTE band 13/17	704-787	710/745/780	0.2	0.3
- GSM800/900 - LTE band 5 - Radio telephone (microcellular) CT1+, CT2, CT3	800-960	810/870/930	2	0.3
- GSM1800/1900 - DECT (radio telephone) - LTE Band 1/3/4/25 - UMTS	1700-1990	1720/1845/1970	2	0.3
- Bluetooth, WLAN 802.11b/g/n - LTE Band 7 - RFID 2450 (active and passive transponders and reading devices)	2400-2570	2450	2	0.3
WLAN 802.11a/n	5100-5800	5240/5500/5785	0.2	0.3



- ▲ **Portable** HF telecommunication devices must not be used within a radius of 0.3 m from the CardioPad-2 and its cables.
- ▲ Do not place the CardioPad-2 on top of other electric/electronic devices - i.e. maintain a sufficient distance to other devices (this includes the patient cables).

For permanent HF telecommunication devices (e.g. radio and TV), the recommended distance can be calculated using the following formula: $d = 0.6 \times \sqrt{P}$. (The formula is based on the max. immunity level of 10 V/m in the frequency domain of 80 MHz to 3000 MHz).

d = recommended minimum distance in meters
P = transmitting power in Watts



For more information on operation in an electromagnetic environment according to IEC/EN 60601-1-2, please consult the service manual.

12.2.1 Measures to prevent electromagnetic interferences

The user can take the following measures to solve this problem:

- Increase distance to the source of interference.
- Turn the device to change the angle of radiation.
- Connect the potential equalisation cable.
- Connect the device to a different mains connector.
- Only use original accessories (especially patient cables).
- Immediately replace defective cables, especially patient cables with defective sheathing.
- Make sure the patient cable is securely screwed on.
- Observe the maintenance intervals as stated in [Section 11 Maintenance, page 93](#).

12.3 Accessories and disposables

⚠ WARNING

▲ Always use seca replacement parts and disposables, or products approved by seca. Failure to do so may endanger life and/or invalidate the warranty.

Your local representative stocks all the disposables and accessories available for the CardioPad-2. A comprehensive list of all seca representatives can be found on the seca website (www.uk.secashop.com). In case of difficulty, contact our head office in Switzerland. Our staff will be pleased to help process your order or to provide information on all secaseca products.

Art. no.:	Article
2.310320	Earth cable for the potential equalisation stud
2.400226	10-lead patient cable, IEC, push-button
2.400227	10-lead patient cable, AHA, push-button
2.400330	10-lead patient cable, IEC, banana plug
2.400331	10-lead patient cable, AHA, banana plug
2.000041	Electrode kit for adults
2.000052	Electrode kit for children
2.155020	Limb electrodes, adults
2.155000	Suction electrodes 24 mm
2.310317	Suction pump adaptor
2.155025	Blue Sensor electrodes for exercise ECG
2.155031	Biotabs Ag/AgC electrodes for resting ECG
2.155032	Adapter snap/clip for banana plug cables (10 pieces)
2.155030	CARDIO-PREPS (abrasive skin preparation) (50 pieces)
2.157055	Thermal chart paper
4.410300	Pressure roller
2.300000	Mains cable Switzerland
2.300002	Mains cable Schuko Europe
2.300011	Mains cable UK
2.300012	Mains cable (medical grade) USA
2.300014	Mains cable China
2.300016	Mains cable Japan
2.300025	Mains cable Brazil
2.200126	Medical-grade power supply unit, 100-240 VAC, 1.0 -0.6 A, 50/60Hz, 15 VDC 30 Watts

13 Technical data

13.1 Device

Dimensions	230 x 160 x 33 mm, approx. 1.1 kg incl. thermal paper
Display	<ul style="list-style-type: none"> Multi-touch backlit LCD screen for graphic and alphanumeric representation Resolution: 1200 x 768 dots, 8 "
Power supply with:	Medical grade switching power supply, protection class I
• external power supply unit	(Note: because the protective earth (PE) ends in the power supply, the protective earth test does not need to be performed.)
Input	100 - 240 VAC, max. 1.0 A (100 V) - 0.6 A (240V), 50-60 Hz
Output to CardioPad-2	15 VDC, max. 2 A
• Battery	Operation with built-in rechargeable battery
Power supply device	15 VDC 30 VA
Battery	
Capacity	<ul style="list-style-type: none"> Lithium-ion polymer 11.1 V, 2.4 Ah 4 hours normal use without printing and WLAN
Battery life	Under normal operating conditions, 4 years
Charging time	100 %: approx. 3 hours when the device is switched off
Printer	High-resolution thermal head printer; 8 dots/mm (amplitude axis); 20 dots/mm (time axis) @ 25 mm/s
Frequency range	0 to 250 Hz (IEC/AHA)
Chart paper	Thermo-reactive, Z-fold, 114 mm wide, optimal positioning on 150 mm
Speed	<ul style="list-style-type: none"> 5/12.5/ 25/ 50 mm/s (5 /12.5 mm/s only available for manual printouts), for resting rhythm: 6.25 mm/s 5 /10 / 20 mm/mV, for resting rhythm: 2.5/5 mm/mV
Sensitivity	
ECG review	Display of the ECG on an area of 118 x 192 mm with different layouts.
Speed	<ul style="list-style-type: none"> 12.5 / 25 / 50 mm/s, for resting rhythm: 6.25 mm/s 5 /10 / 20 mm/mV, for resting rhythm: 2.5/5 mm/mV
Sensitivity	
Interfaces	<ul style="list-style-type: none"> ECG cable connection Potential equalisation Network connection (1Gbit) 2x USB type A 1x USB type B
Memory	Memory for at least 350 ECG recordings and 100 resting rhythm recordings

Ambient conditions

Operating temperature	• 10 to 40 °C
Relative humidity	• 15 to 95% (non-condensing)
Pressure during operation	• 700 to 1060 hPa
Storage temperature	• 5 to 50 °C
Transport temperature	• -10 to 50 °C
Humidity during storage/ transport	• 10 to 95% (non-condensing)
Pressure during storage/ transport	• 500 to 1060 hPa

13.2 ECG

Patient input	Fully floating and isolated, defibrillation protected (only with original seca patient cable)
Lead configurations	<ul style="list-style-type: none"> • Standard 12-lead • Paediatric • Right precordials • Standard C4r • Left posterior • Nehb • Balanced
Display	
Leads	<ul style="list-style-type: none"> • Display of the selected leads, 2x6 or 4x3 leads (configurable) <ul style="list-style-type: none"> – Chart speed 12.5, 25 or 55 mm/s (configurable) – Amplitude 5, 10 or 20 mm/V (configurable)
Status	<ul style="list-style-type: none"> • Filter status • Power source • Leads • Electrode contact status • Heart rate (HR) • Date and time • Patient name and number • WLAN transmission
Filter	
Myogram filter (muscle tremor)	Set to 25, 40, 150, 250 Hz (250 Hz = Filter Off)
Notch filter	Distortion-free suppression of superimposed AC 50 or AC 60 Hz sinusoidal interferences by means of adaptive digital filtering
Data record	<ul style="list-style-type: none"> • Patient data (name, age, height, weight, BP, device ID, MTA ID) • Listing of all ECG recording conditions (date, time, filter) • ECG measurement results (intervals, amplitudes, electrical axes) • Average complexes • Guidance on interpreting adult and paediatric ECGs
With optional interpretation (C) program	
ECG amplifier	Complies with IEC 60601-2-25 and ANSI/AAMI EC11

13.3 Safety standards

Safety standard	IEC/EN 60601-1 IEC/EN 60601-2-25
EMC	IEC/EN 60601-1-2
Protection class	Device as a system: Class I in accordance with IEC/EN 60601-1
Conformity/classification	CE/IIa in accordance with directive 93/42/EEC
Protection	This device is not designed for outdoor use (IP 20)

13.4 WLAN standards

Modules	WL1837MOD
FCC ID IC ID	Z64-WL180DBMOD 4511-WL18DBMOD
Transmission standards	IEEE 802.11 a, b, g, n
Safety/encryption	WPA2 enterprise / ieee802.1, WPA2-PSK, WPA-PSK, WEP64/128/256, TKIP, AES
Frequency range	Dual-band 2.4 GHz and 5 GHz
Max. power output 2.4 GHz (1DSSS)	+16.5 dBm
Max. power output 5 GHz (OFDM6)	+18 dBm

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