User Manual – V4

EM650

Electrocardiograph

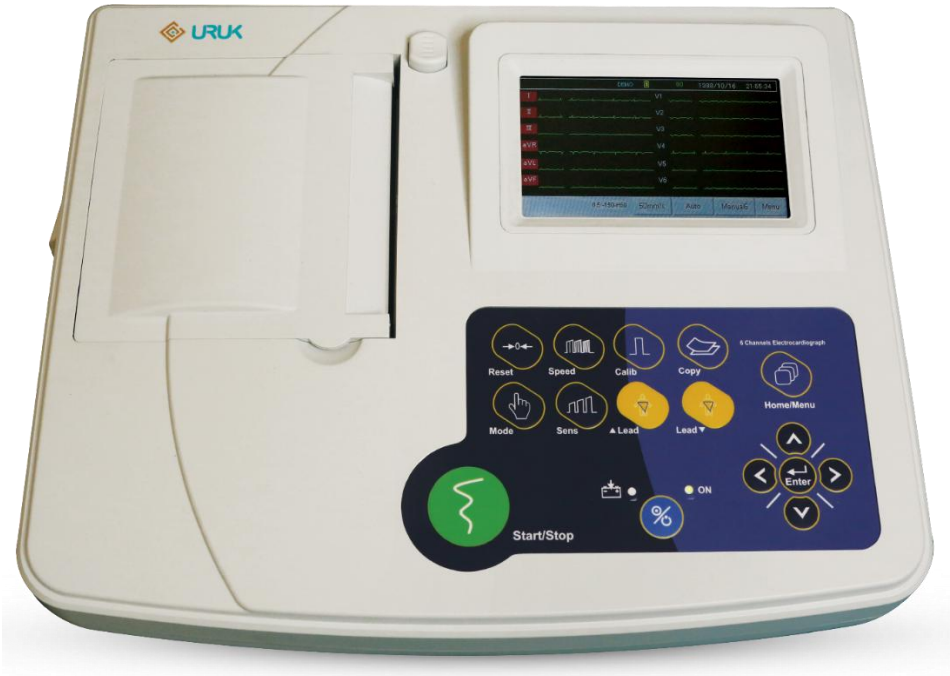
Change history					
Rev	Date	Description	Created By	Confirmed By	Approved By
1			Mohsen	Shima	S.Mohammad
2	2023/04/16	European Authorized Representative was changed	Mohsen	Shima	S.Mohammad
3	2024/01/03	Arabic Warnings Have Been Added	Abbas	Shima	S.Mohammad
4	2025/2/16	Amending	Alhussien	Shadi	Shima

URUK Co.

User Manual

EM650

Electrocardiograph



CE 2195

D00012-V4

URUK CO.

Zone 6, Block 16/3, Awareej Industrial Area, Baghdad, Iraq.
Tel: +9647806443322

Leagal Responsible:
Trionara Technologies AB
Polygonvägen 21. 18766. Täby. Sweden
E-mail: info@trionara.com
Tel: +46 31 135514

Website: www.urukmed.com

E-mail: support@uruk.com

Contents

Manual Purpose

Observance of this manual is a prerequisite for proper operation and ensures patient and operator safety. If you have any question about the device, please contact our customer service.

Intended Audience

This manual is provided for the clinical medical professionals. Clinical medical professionals are expected to have working knowledge of medical terminology and procedures as required for the device operation.

Explanations of the used expressions in this Manual

WARNING

A WARNING symbol advises against certain actions or situations that could result in personal injury or equipment damage.

NOTE

A NOTE symbol provides useful information and recommendations about device function.

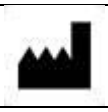
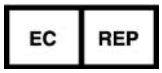
Version Information

This manual has a version number. The version number changes whenever the manual is revised due to software or technical specification changes. The version information of this manual is as follows:

Release date	Version number
February - 2025	D00012-V4

This version of the manual, is intended for EM 650 electrocardiograph with software version 4(202.4.0.0) and later.

Symbols

Symbol	Definition
	Consult user manual of the device and pay attention to the warnings and cautions.
	The device is IEC60601-1 type CF (Defibrillation proof applied part) equipment. The units displaying this symbol provide an F-type isolated (floating) patient applied part with a high degree of protection against shock and is suitable to use with defibrillator simultaneously.
	For protection against defibrillator, use only manufacturer recommended accessories.
	The equipment shall be disposed of in an environmentally-friendly manner.
100-240 VAC **60VA** **50/60 Hz**	AC power supply
	3A fast fuse
USB	USB port
SD	SD port
S/N	Serial number
	Manufacture date
	Manufacturer information
	European community representative

Patient's safety

Introduction

The EM 650 electrocardiograph device is designed to comply with the international safety standards requirements for medical electrical equipment. This device has floating input (isolated electricity) and is protected against the effects of defibrillation. If correct electrodes are used in accordance with the manufacturer instructions, the display screen will recover within 10 seconds after defibrillation.

Grounding

To protect the patient and hospital personnel, the electrocardiograph system must be grounded. The EM 650 is equipped with a detachable 3-wire cable which grounds the instrument to the power line ground (protective earth) when plugged into an appropriate 3-wire receptacle. If a 3-wire receptacle is not available, consult the hospital electricians. If there is any doubt regarding the integrity of the protective grounding wire, the equipment should run on the battery.

⚠ WARNING

- EM 650 is intended to be used only by qualified medical staff.
- Before use, carefully read this manual and directions for use of any accessories.
- EM 650 is intended for use only as an adjunct in patient assessment. It must be used in conjunction with clinical signs and symptoms.
- There could be hazard of electrical shock by opening the system casing. All servicing and future upgrading to this equipment must be carried out by personnel trained and authorized by manufacturer.
- The operator must check that the EM 650 and accessories function safely and see that it is in proper working condition before being used (e.g. Date of the last calibration must be valid).
- Do not touch the patient, bed or devices nearby during defibrillation.
- When defibrillator is used, the signals may be disturbed for a few seconds, after which the device will continue to operate normally.
- For people who have a pacemaker, be sure to enable the pacemaker detection feature on the device.
- The physician shall consider all well-known side-effects when using EM 650 .
- To prevent the environment pollution, the device and accessories (e.g. battery) shall be disposed in accordance with national laws after their useful lives. Contact your municipality to check where you can safely dispose of old batteries.
- Use disposable electrodes when using electroshock and electro surgery with an electrocardiograph.
- Do not connect items not specified as parts of EM 650 .
- Do not expose EM 650 near any local heating item such as the direct radiation.
- It is possible to increase leakage current when touching the patient and connected devices, or when several systems as well as EM 650 are connected to the patient simultaneously.

- Due to the possibility of explosion, the equipment is not suitable for use in the presence of a flammable anaesthetic mixture or in oxygen-rich places.
- To protect patient against the electrical shock hazards, EM 650 needs to be connected to grounded power receptacle.
- If any liquid is spilled on the system or accessories, immediately turn off the system and wipe up it by a soft cloth. If water seeps into the device, it should be inspected by trained personnel before reuse.
- Electric and magnetic fields cause the device to malfunction. EM 650 must be installed and serviced in accordance with the information in Appendix 3 Electro-magnetic compliance .
- Electrocardiograph needs to be installed and put into service according to the EMC information provided in the Appendix 3.
- To prevent EMC effect on EM 650, it should not be used adjacent to or stacked with other equipment and that if adjacent or stacked use is necessary, the system should be checked for normal operation in the configuration in which it will be used.
- Do not use EM 650 during X-ray and Magnetic Resonance imaging. Induced current could potentially cause burns and may affect the accuracy of EM 650 measurements. EM 650 may also adversely affect MRI and X-ray images.

⚠ تحذيرات عامة

- يرجى الرجوع إلى هذا القسم للحصول على معلومات عامة حول السلامة.
- تم صنع جهاز تخطيط كهربائية القلب من اجل أن يُستخدم من قبل كوادر طبية مؤهلة فقط.
- قبل الاستخدام، يُرجى قراءة هذا الدليل بعناية واتباع تعليمات استخدام الملحقات.
- يستخدم جهاز تخطيط كهربائية القلب استخدامه كمساعد فقط في تقييم المريض. يجب استخدامه بالتزامن مع العلامات والأعراض السريرية.
- لا تستخدم جهاز تخطيط كهربائية القلب خلال عملية التصوير بالرنين المغناطيسي (MRI). يمكن أن يتسبب التيار المحتث بحروق. وقد يؤثر الجهاز على صورة الرنين المغناطيسي، وقد تؤثر وحدة الرنين المغناطيسي على دقة قياسات الجهاز.
- قد يكون هناك خطر صعقة كهربائية عند فتح غطاء الجهاز. يجب أن يتم إجراء جميع خدمات الصيانة والتعديلات المستقبلية لهذا الجهاز من قبل الكوادر المدربة والمعتمدة من الشركة المصنعة.
- تحقق دائمًا من صوت الصفارة عند تشغيل الجهاز. (لمزيد من المعلومات، يُرجى الرجوع إلى القسم 8)
- المشغل يجب أن يتحقق من أن الجهاز وملحقاته تعمل بشكل آمن وان يتأكد من أنه في حالة عمل جيدة قبل استخدامه (على سبيل المثال يجب أن يكون تاريخ آخر عملية معايرة صالح).
- عدم استخدام الهاتف الخلوي في محيط هذا الجهاز. قد تؤدي مستويات عالية من الإشعاع الكهرومغناطيسي الناتجة عن مثل هذه الأجهزة إلى تداخل قوي مع أداء جهاز تخطيط كهربائية القلب.
- عدم لمس المريض أو السرير أو الأجهزة القريبة أثناء عملية إزالة الرجفان.
- عند استخدام جهاز إزالة الرجفان، قد يتم التداخل في الإشارات لبضع ثوانٍ، بعد ذلك سيستمر الجهاز في العمل بشكل طبيعي.
- يجب على الطبيب المعالج أن يأخذ في اعتباره جميع الآثار الجانبية المعروفة عند استخدام جهاز تخطيط كهربائية القلب.

- من أجل منع تلوث البيئة، يجب التخلص من الجهاز وملحقاته (على سبيل المثال البطارية) وفقًا للقوانين الوطنية بعد نهاية عمرها المفترض. اتصل ببلدية الخاصة بك للتحقق من مكان يمكنك التخلص فيه بشكل آمن من البطاريات القديمة.
- عدم تعريض الجهاز بالقرب من أي جهاز تسخين مثل الإشعاع المباشر.
- قد يكون من الممكن زيادة تسرب التيار عند توصيل عدة اجهزة وكذلك جهاز تخطيط كهربائية القلب إلى المريض في نفس الوقت.
- تم تصميم نظام تشغيل جهاز تخطيط كهربائية القلب بطريقة تقلل من المخاطر الناجمة عن أخطاء في برمجة الجهاز.
- عدم استخدام ملحقات لم يتم تحديدها كأجزاء من جهاز تخطيط كهربائية القلب.
- المعدات غير مناسبة للاستخدام في وجود خليط مخدير قابل للاشتعال.
- لحماية المريض من مخاطر الصعق الكهربائي، يجب توصيل جهاز تخطيط كهربائية القلب بمصدر طاقة مؤرض.
- يجب تنصيب جهاز تخطيط كهربائية القلب وتشغيله وفقًا لتعليمات التوافق الكهرومغناطيسي المقدمة في APPENDIX IV.
- لمنع تأثير التوافق الكهرومغناطيسي على جهاز تخطيط كهربائية القلب، يجب ألا يتم استخدامه بجوار أو فوق معدات أخرى، وإذا كان الاستخدام المتجاور أو المكدس ضروريًا، يجب فحص النظام للتأكد من عمله بشكل طبيعي في البيئة الذي سيتم استخدامه فيها.
- إذا تم سكب أي سائل على الجهاز أو ملحقاته، قم فورًا بإيقاف تشغيل الجهاز وامسحه بقطعة قماش ناعمة.

NOTE

- Before connecting the device to the power supply, make sure that the voltage and frequency match the specifications of the device.
- The environment in which the device is used must be free from vibration, dust, corrosive and flammable gases, high temperature and humidity.
- The device is designed to work well at temperatures between 5 and 40 degrees Celsius. When the ambient temperature exceeds this range, it adversely affects the measurement accuracy of the device and may damage electrical circuits.
- EM 650 software is designed to minimize the risk of software errors.
- Due to the frequency band up to 150 Hz and the sampling rate of 1000 sample/s, the accuracy of signal reconstruction in EM 650 is in accordance with the requirements of IEC 60601-2-25 standard.

1)Introduction

Device description

EM 650 (ECG Recorder) is one of the most important, safest, and simplest medical devices for measuring, displaying, storing, and recording cardiac signals to diagnose many heart diseases.

Intended use

EM 650 can be used for adults, children and infants. This device is intended for trained medical staff in all medical centers that have complied with the requirements of the medical location, for diagnostic purposes.

Contraindications:

- EM 650 is not intended for home or MRI use.
- EM 650 is not a therapeutic device. The results provided by the device should be evaluated based on the patient's clinical condition and these results cannot replace routine examinations.

Features

- Color display and touch screen
- Lightweight and portable
- Works with rechargeable batteries or AC power
- Recording and displaying 12-lead ECG waveform
- Displaying Rhythm-lead waveform separately on the screen
- Up to 6-channel waveform recording
- Adjustable filter, gain, paper speed and recording mode
- Data storage in internal and external memories
- Displaying and recording stored data
- Data transfer via USB
- Connection and online data transfer to PC
- Upgrading the software via USB
- Dividing the paper space according to the signal amplitudes
- Signal analysis and diagnosing cardiovascular abnormalities – Measurement and Interpretation
- Measurement of cardiac angles

Get started

1- Open the package and take out the EM 650 and accessories carefully. Keep the package for possible future transportation or storage. If trolley is available, assemble it according to its instruction and place the electrocardiograph on it properly.

- Check the device for any mechanical damage.
- If there is any problem, contact the distributor immediately.

2- Connect the power cable to the device.

- Make sure the AC power supply complies with 100-240 VAC, 50 /60Hz.
- Plug the power cable to the power supply socket of the device. Connect the other end of the power cable to a grounded power receptacle.

3- Power on the EM 650.

- Press the Power key to turn on the electrocardiograph.

4- Connect the patient cable. Connect all necessary accessories to patient and the EM 650.

⚠WARNING

- If any sign or error message is observed in EM 650 that may be due to its failure, please do not use it on the patient.

In the following, the different parts of this device will be explained.

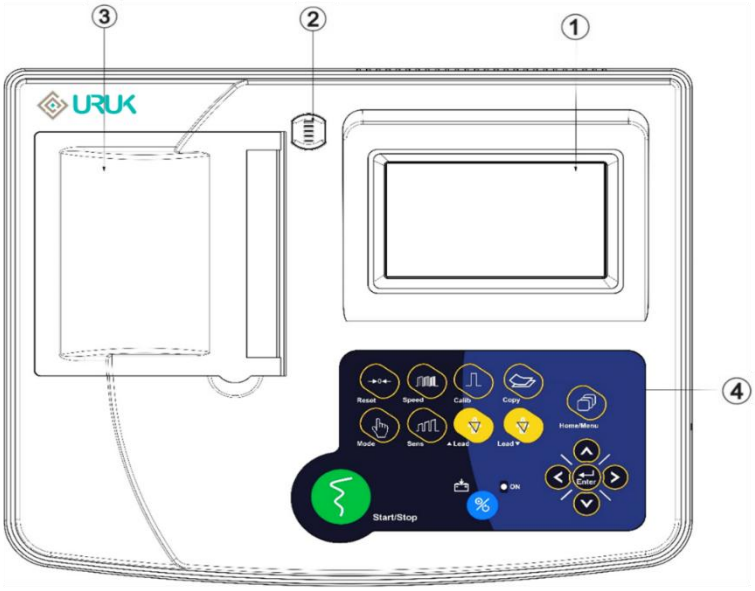


Figure 1-1 Top panel

1) Display Screen: ECG waveforms, patient information, messages, etc. are displayed on the screen. (more information follows).
2) Recorder Release Button: to open the recorder door.
3) Recorder: to load recording paper and record ECG waveforms.
4) Control panel: to control the system operation. (more information follows).

Display screen

EM 650 has a TFT color screen. The 12-wave ECG waveform, HR numerical value, patient name and ID, date and time, device status and system messages are displayed on this screen. The screen can be divided into Four parts:

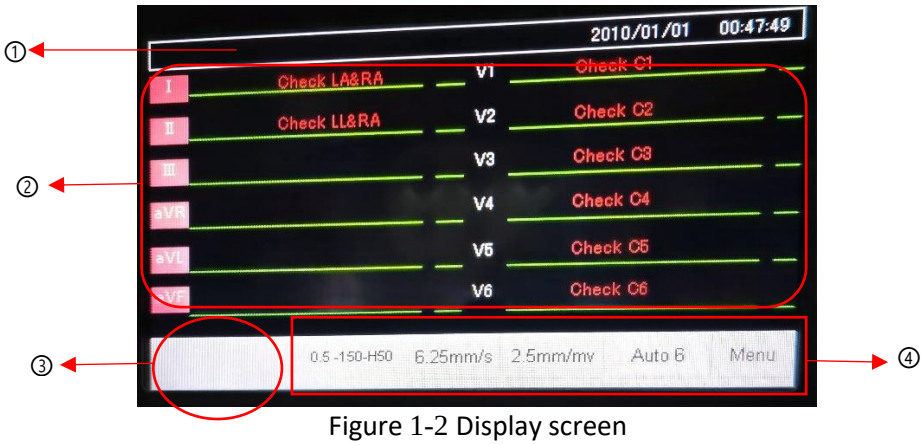


Figure 1-2 Display screen

Header area (figure 1-2-①),

Waveform / Menu area, Lead error message area (figure 1-2-②),

informative and system error messages area (figure 1-2-③).

touch keys area (Figure 1-2 ④).

Header Area:

The Header Area is at the top of the screen. The parameters displayed in Header Area are heart rate, patient name/ ID, current date and time and system operating status. This information is displayed on the screen throughout the system operation.

Symbol  will appear in the Header Area only if the device runs on the battery. The HR value is measured and updated per second.

Waveform/ Menu Area:

Rhythm-lead or 12-lead ECG waveforms are displayed on the screen and their arrangement can not be changed.
ECG lead type is displayed in Waveform Area.

Message Area:

The message area is divided into two parts:

1- Lead error message area:
All electrodes connection is checked continuously by the system and in case of improper connection, the related message will appear in this area in red (figure 1-2-②).
2- Informative and system error messages area (figure 1-2-③).
The system messages are displayed in white background and black text.
(more information follows).

Touch screen keys

The function of touch keys is the same as their corresponding hard keys on the control panel.
Refer to (Control Panel) for details.

Control panel

EM 650 is designed in such a way that user can easily perform operations using some keys and touch screen. Figure 1-3 illustrates these keys and indicators.

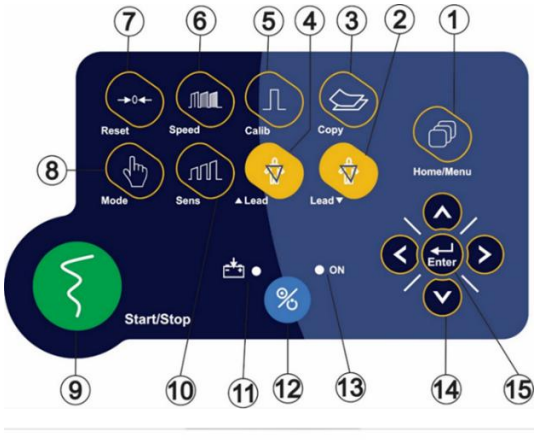


Figure 1-3 Control Panel

Table 1-1 Control panel Items

① **Menu**	Press to access Main Menu.
② **Lead▼**	Press to select next lead(s).
③ **Copy**	Press to record the last saved data
④ **▲Lead**	Press to select previous lead (s).
⑤ **Calib**	Press to record a 1mv calibration signal.
⑥ **Speed**	Use to adjust the recording speed.
⑦ **Reset**	Use to reset Drift filter and restore signals quickly to the screen.
⑧ **Mode**	Use to select recording mode.
⑨**Start/Stop**	Press to start/stop ECG recording.
⑩ **Sens**	Use to adjust the amplitude of ECG waveform on the screen and recording paper
⑪ 	Battery indicator. (green if fully charged, and otherwise orange)
⑫ 	Press to turn on or off the device.
⑬ ON	On/Off indicator. (green)
⑭ **Arrow Keys** 	Use to scroll between menus.
⑮ **Enter**	Press to enter software menus or select menus options

WARNING

- Before using the EM 650, check function of all keys and make sure that it is in proper working order.
- Do not use sharp objects to touch the screen.

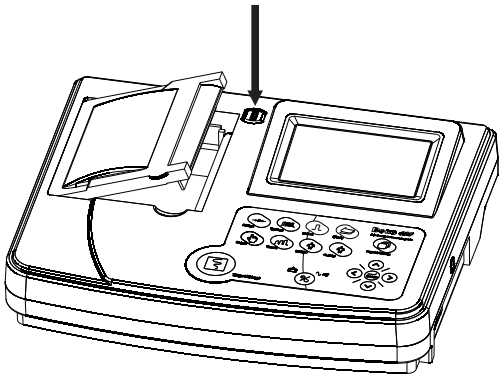
Recorder

WARNING

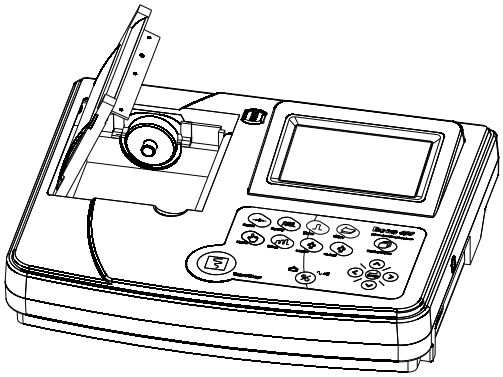
- Use only the manufacturer recommended record paper, otherwise the recording quality may be poor and the thermal head may be damaged.
- The thermal head and its surroundings are very hot during and immediately after recording, and touching it can cause injuries such as burns.

Paper loading

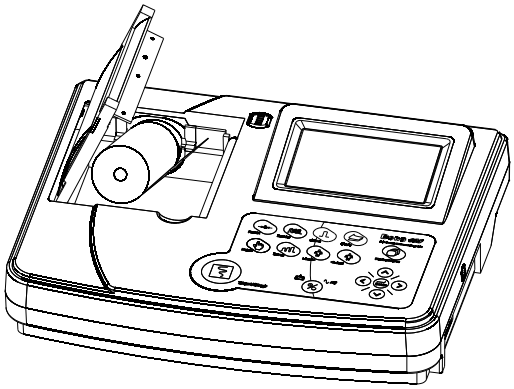
1- Press the recorder release button as shown in the figure below.



2- Open the recorder door.

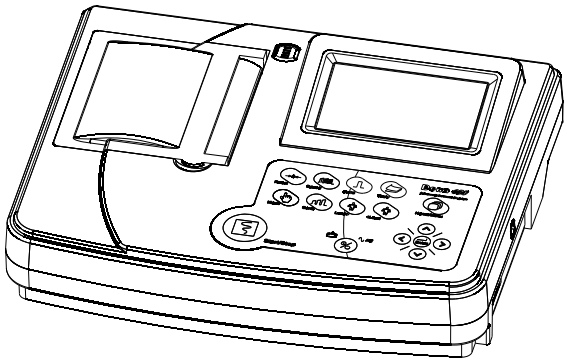


3- Place the paper roll inclined in the recorder and push it.



4- Place the other side of the paper roll in the recorder. Open the paper roll to leave some of it out of the recorder.

5- Close the recorder door firmly.



WARNING

- Do Not Open the Recorder Door During Recording, This Can Damage It.
- During the recorder operation the record paper exits steadily. pulling the paper will damage the recorder.
- If the paper is jammed, open the recorder door and remove the paper. Do not pull the paper out by force

NOTE

- The paper detector may not operate properly if covered with foreign matter. Therefore, if you find foreign matter on the sensor, remove it and clean the sensor.
- Be careful when loading the paper in the recorder. Avoid damaging the thermos sensitive print head. Do not touch thermos sensitive print head.
- It is recommended to use the paper with colored marks intended to aware user that the paper is near to finish. Otherwise user should ensure that sufficient paper has been fed to the recorder before recording.

Information printed on the recorder paper

- Recording type (Auto, Manual, Rhythm) and Status (Normal, Copy, Review, Periodic)
- Recording state (Real, Sync)
- Date and Time
- Patient information (Name, ID, Gender, Height, Weight, Blood type)
- HR value

- Rhythm lead
- Gain, Filter, Speed and Recording time
- Pacemaker status
- Measurement status
- Hospital/Ward and Physician name
- System model and Software version

NOTE

- The paper space is divided according to the size of the signals. It should be noted that after connecting the patient cable, it takes at least 4 seconds for these values to be calculated and the space to be divided proportionally between the leads.
- If the Drift filter is Off and there is DC offset in the signal, or if the patient has Pacemaker and the Pace option of the device is off, the paper space may not be divided properly.

Bottom panel

figure 1-4 shows the bottom panel:

1- Handhold: For transporting the device.

2- Battery Compartment: For loading the battery.

3- 3A fast fuse

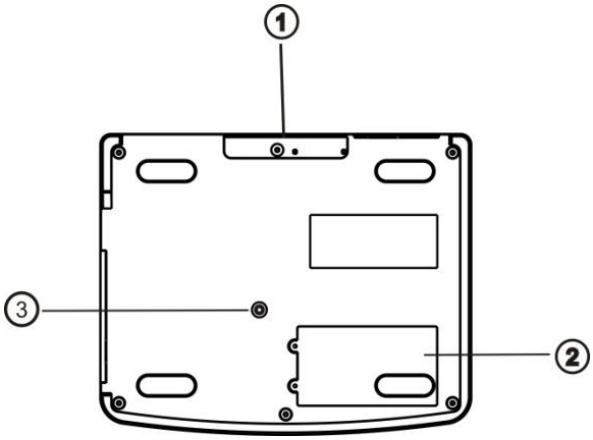


Figure 1-4 Bottom panel

Built-in Battery

EM 650 is equipped with a rechargeable battery. The battery will charge automatically once you connect the system to the AC INPUT (whether the device is on or off).

The charging and discharging time of the device can vary depending on the type of battery used (its types are described in the Technical specification chapter) and also the duration of use.

Table 1-2 shows the battery status in different conditions.

WARNING

- If the device is not to be used for a long time (more than 10 days), remove the fuse from the device to prevent full discharge of the battery.
- If the battery discharges in less than 1 hour, contact after-sales service to replace it.
- EM 650 will turn off automatically if the battery power is too low. When the electric power is going out, the message "BATTERY LOW" will be displayed.
- Use only the manufacturer recommended batteries. Other batteries may result in fire. Use only the manufacturer recommended batteries. Other batteries may result in fire.

Table 1-2 Battery status icons

Battery stats	Icon
Battery disconnection	
Charging (below 20%)	
Plugged in and fully charged	
20-40% charged	
40-60% charged	
60-80% charged	
80-99% charged	
20-40% charged, charging	
40-60% charged, charging	
60-80% charged, charging	
80-99% charged, charging	

WARNING

- Make sure the battery indicator lights up. If the battery indicator does not light up, check the local power supply and power cord connection. If this problem persists, contact after-sales service.
- The battery needs to be charged after transport or storage. If in this case you turn on the device without connecting the power cable, the device cannot be turned on due to insufficient charge, in this case, connect the device to the mains for a period of time according to the type of battery (by referring to the **Error! Reference source not found.**).
- After working with the battery for a while, the battery needs to be recharged. To do this, just connect
- the device to AC mains.

Rear panel

figure 1-5 shows the rear panel.

1) AC power input

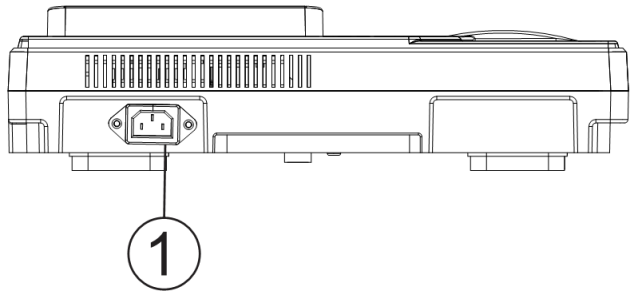


Figure 1-5 Rear panel

Side panel

The following connectors are located at the right side of the device:

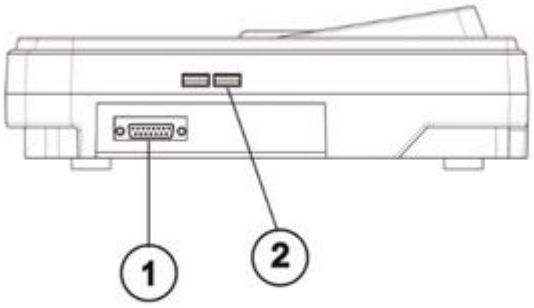


Figure Error! No text of specified style in document.**-1 Side panel**

1) ECG cable connector
2) USB port for data export and software update

2) Device settings

General

Different software menus of the device will be explained in this section.

You can access the Main Menu by pressing **Home/Menu key** on the control panel or touching **Menu** on the screen (Figure 2-1).

Different software menus of the device will be explained in this section.

- For date and time settings, please refer to **System setting/Time and Date**.
- For manufacturer information, please refer to **System setting/About**.
- For recording setting, please refer to **User Setting**.

NOTE

- It is recommended that the device is set properly before recording.

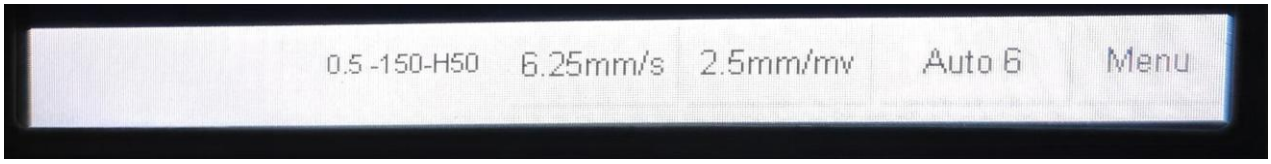


Figure (2-1) Home Screen

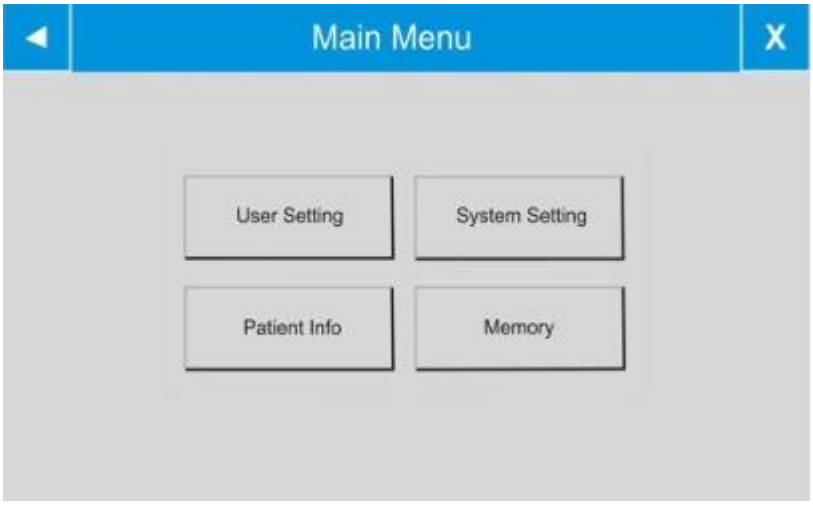


Figure (2-2) Main Menu

System Setting Menu

By pressing System Setting in the Main menu, you can access System Setting Menu (Figure 2-3).

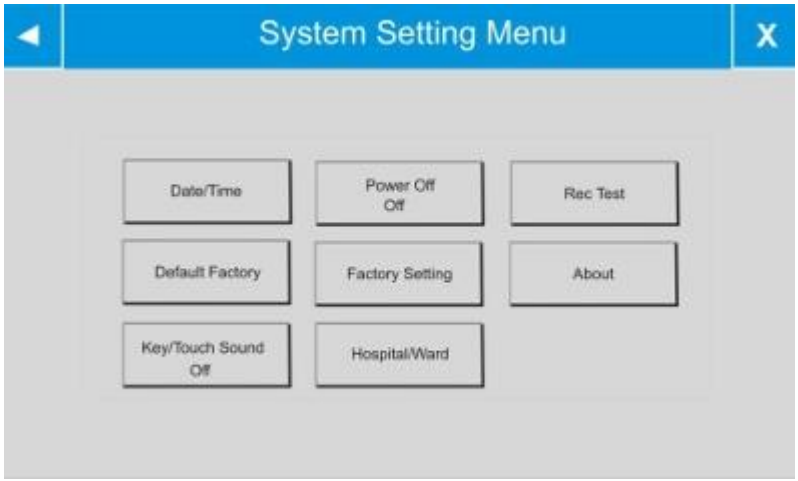


Figure (2-3) System Setting Menu

The following parameters can be set in this menu:

- **Date/Time:** To set date and time as shown in the figure below.

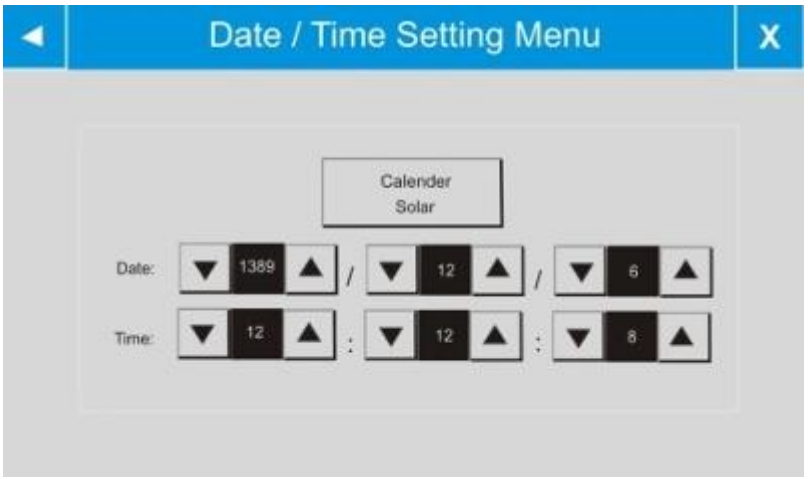


Figure (2-4) Date/Time Setting Menu

Calendar: Available options are Solar and Christian.
Date: To set the current date.
Time: To set the current time.

- **Power Off:** To shut down the device automatically after 5-60 min. Select Off to disable this function.
- **Rec Test:** To test the recorder function.
- **Default Factory:** To load factory default settings. Because of changing all your previous settings, the system asks if you are sure to change all by this message (Figure 2-5).

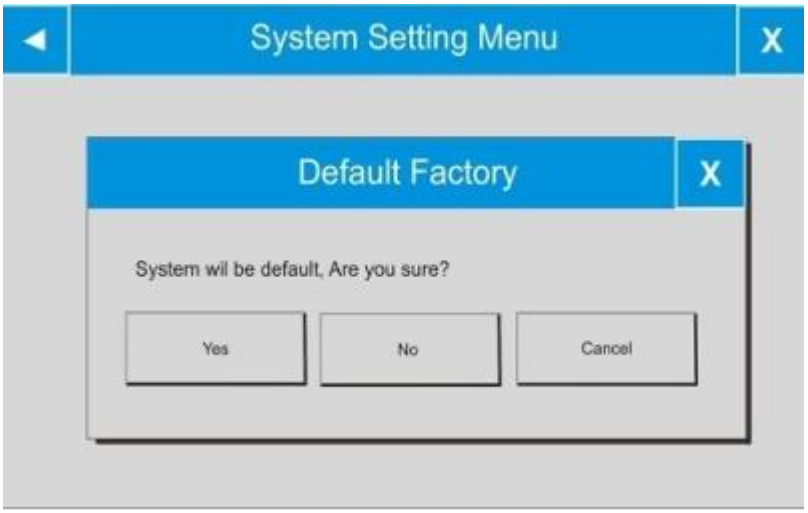


Figure (2-5) Default Factory

- **Factory Setting:** By selecting this option, you can access the following window.

Only manufacturer's authorized personnel have access to this menu.

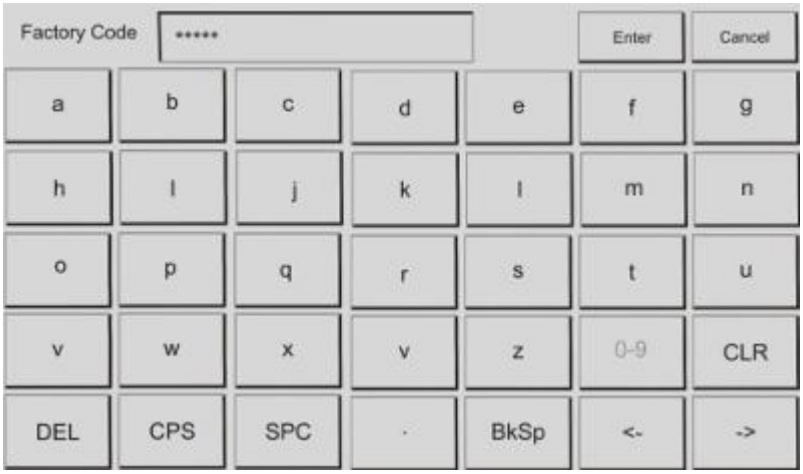


Figure (2-6) Factory Code

- **About:** By selecting this option, you can view product and manufacturer information as shown in the figure below.

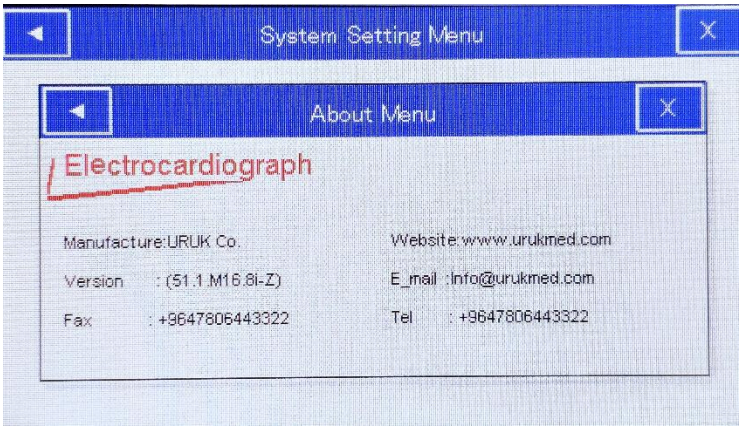


Figure (2-7) About Menu

- **Key/ Touch Sound:** To switch ON/OFF the sound of touch or hard keys.

- **Hospital/Ward:** By selecting this option, you can access the following window and enter hospital or ward name.

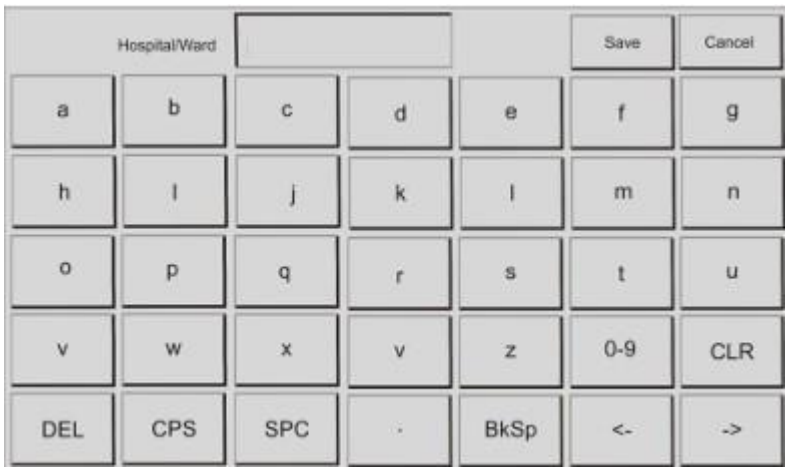


Figure (2-8) Hospital/Ward

User Setting Menu

By pressing User Setting in the Main menu, you can access User Setting Menu (Figure 2-9).

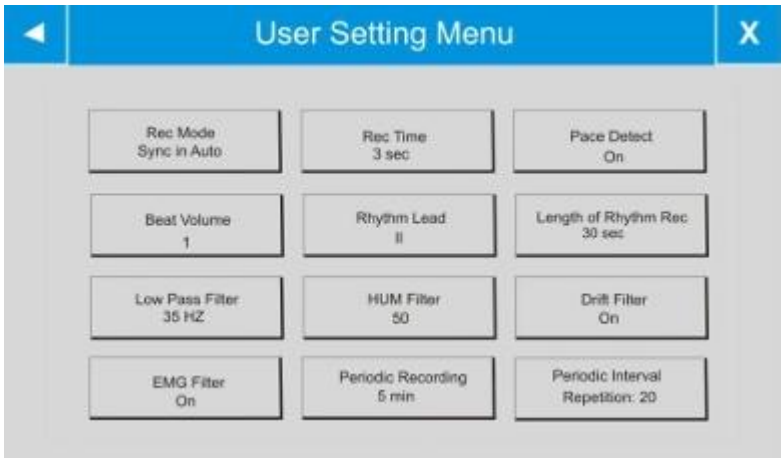


Figure (2-9) User Setting Menu

The following parameters can be set in this menu:

- **Rec Mode:** Available options are Real Time and Sync in Auto.

In the **Sync** mode, the signals of different leads are recorded simultaneously i.e. recording of all leads starts at the same time.

- **Rec Time:** Press to set recording duration for different leads in Auto mode. It ranges from 3 to 12 seconds.
- **Pace Detect:** Available options are Off and On. Electrocardiograph system detects and rejects pacemaker-generated signals from ECG signal so that they will be ignored in determining heart rate. If you select On for patients with pacemaker, detected pacemaker signals will be marked on the ECG waveform as a white vertical line.

NOTE

- For more information about Recording types, see the chapter Recording Operation.
- Sync recording can be performed only in Automatic and Periodic modes.

WARNING

- For patients with pacemaker, the PACE DETECT function must be switched "ON", otherwise, the pacing impulse may be counted as normal QRS complex.
- In patients with pacemaker, if the PACE DETECT function is "OFF", turn off the low pass (25Hz, 35Hz) and EMG filters to check pacemaker function.
- ECG signal saturation occurs when the signal is not displayed or exceeds lower or upper limits of the display area.

- **Beat Volume:** Available options are 1, 2, 3 and off, if the Beat Volume is “off”, the heart rate volume is turned off.
- **Rhythm Lead:** The Rhythm lead can be one of the leads I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5 and V6.
- **Length of Rhythm Rec:** Press to set duration of Rhythm lead recording. Available options are 30, 60, 90, 120, 150 and 180 seconds.
- **Low Pass Filter:** Press to toggle between 25, 35, 75 and 150 Hz. This filter is used to remove muscle artifacts and high frequency noises, yet some of the signal details might be removed. The cutoff frequency of these filters is 25 ± 2Hz, 35 ± 2 Hz, 75 ± 7 Hz and 150 ± 20Hz. The frequency of the selected filter is displayed on the screen.

WARNING

- During use of low-pass filter (25, 35, and 75Hz), you might lose some of useful details of the signal.
- Due to the significant changes in the ECG amplitude, if 25 Hz or 35 Hz and EMG filter are turned on simultaneously, the available LowPass filters are Off, 75 Hz and 150 Hz.

- **HUM Filter:** Press to toggle between 50 Hz, 60 Hz and Off. Select this filter with regard to your local AC frequency. If the HUM filter is turned on, the third harmonic in accordance with the selected frequency will be deleted. In other words, when the HUM filter is set to 50 Hz, the frequency of 150Hz as well as 50 Hz will be removed. If the frequency of 60 Hz is selected, the frequency of 180 Hz will also be eliminated. When 50 Hz and 60 Hz are selected, “H50” and “H60” will be displayed respectively on the screen.

- **Drift Filter:** Press to switch On or Off. This filter is used to reduce signal oscillations. The cutoff frequency of this filter is 0.9 Hz. Using this filter will remove the frequencies below the cutoff value from the ECG report. If the drift filter is switched off, the cutoff frequency of the device will be about 0.05Hz. If the drift filter is set On, “0.5” will be displayed on the screen and otherwise “0.05”.

NOTE

0.5 filter is used to remove signal baseline oscillations and may interfere with the ST Segment analysis.

- **EMG Filter:** Press to toggle between On and Off. This filter is used to reject muscular noise. If EMG is set On, "+M" will be displayed on the screen. EMG filter is a lowpass filter which varies based on time and the signal slope. The filter bandwidth varies from one sample to another sample proportional to the signal slope. The purpose of the EMG filter is to remove skeletal muscle artifact from the ECG baseline. The EMG filter will eliminate noise from the baseline, but it will not affect QRS complex components. The cut-off frequency of This filter increases to about 55Hz in areas where the signal slope is high and decreases to about 10Hz when the signal slope is low. If the EMG filter is set On, "M" and "EMG" will be displayed on the screen and recording paper and otherwise it will be blanked.

To remove ECG signal noise, take the following steps:

1. At first remove any noise sources (for more details, please refer to Troubleshooting chapter)
2. If after taking above action the noise is not rejected, set On EMG filter.
3. If the signal is still noisy, set off the EMG filter and use the lowpass filter (25-35Hz).
4. It is necessary to mention, if the LowPass filters are used, the amplitude of the QRS complex will be reduced
5. If the EMG filter is enable, the available LowPass filters are Off, 75 Hz and 150 Hz.

NOTE

After setting On the EMG filter, wait a few seconds to record.

WARNING

- Using 25 Hz and EMG filters together may cause variation in the ECG signal amplitude. Using the Drift and EMG filters together may change position of the pace spike. Pay attention to the above warnings when using the filters.
- The EMG filters is an adaptive, non-linear and time- variant low pass filter that is designed to apply on ECG signals. Thus using the EMG filter may affect P, QRS and T waves.
- The EMG filter is designed only for ECG signals. In case of other applications (e.g. calibration), turn off this filter.

- **Periodic Recording:** Press to set time interval in periodic recording. Available options are 5-60 min and Off. If you select Off, periodic recording will be stopped.
    - **Periodic Interval Repetition:** Press to set repetition of recording. Available options are 1-20 and Infinite.

NOTE

Each time you exit from the Patient Info menu; a message will appear on the screen asking you whether to save changes or not.

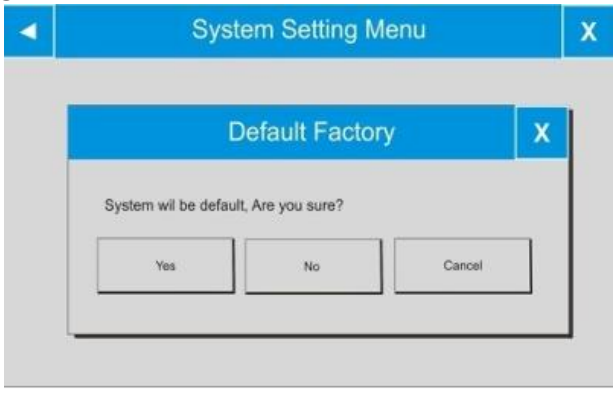


Figure (2-10) Conformation Menu

3)Patient information

Touch **Patient Info** in the **Main Menu**, or select **Patient Info** using arrow keys and then press **Enter**, the **Patient Info Menu** will appear.

Figure 3-1 Patient Info Menu

Patient Data Entry
Select each item to access the related window.

- **Name**

Enter the patient name and press Save to exit from this window (Figure 3-2). Up to 15 characters can be input in this field.

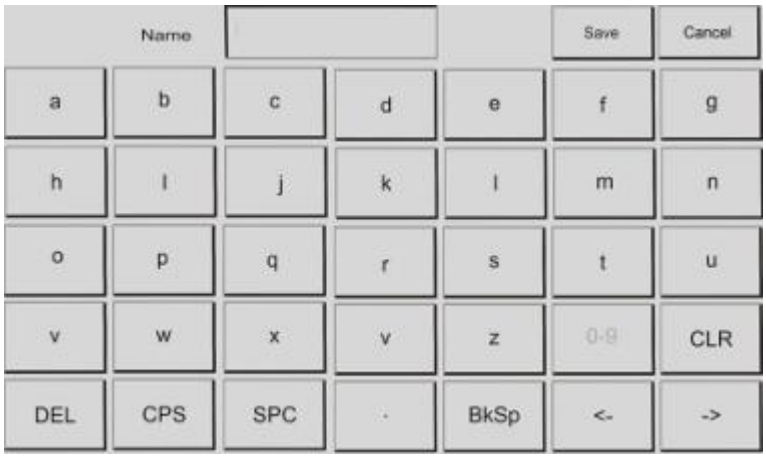


Figure 3-2 Name

Press **Cancel** to exit from this window and return to the previous menu.

- **Age**

Available options are **Years** and **Months**. Factory default setting is Years.
According to the selected option, year or month of patient age should be entered in this field.
Patient age can be registered in year or month according to the selected option.
Enter the patient age and press **Save** to exit this window.

Figure 3-3 Age

Press Cancel to exit from this window and returning to the previous menu.

- **Gender**

Available options are Male and Female. Factory default setting is None.

- **ID**

Enter the patient ID number and press Save to exit this window. Up to 10 characters can be input in this field.

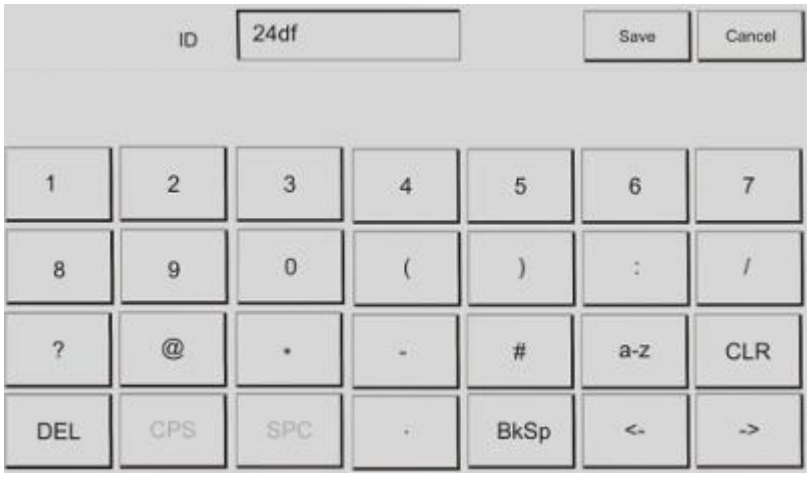


Figure 3-4 ID

Press Cancel to exit this window and return to the previous menu.

- **Height**

Available options are Foot and cm. Factory default setting is cm.
Enter the patient height and press Save to exit this window.

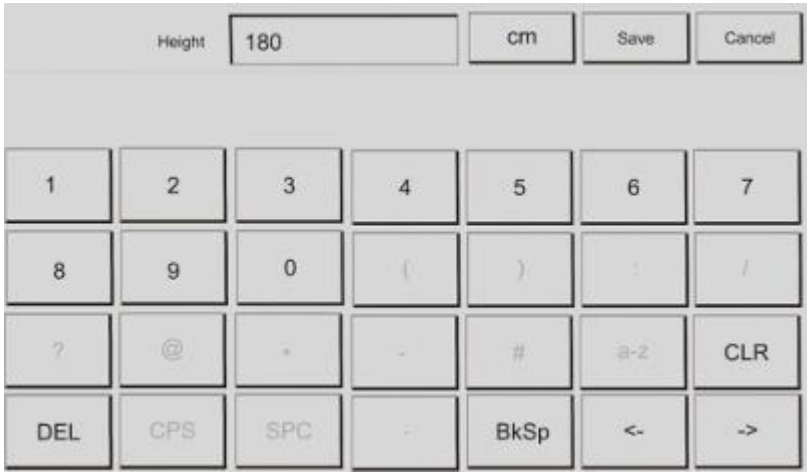


Figure 3-5 Height

Press Cancel to exit from this window and return to the previous menu.

- **Weight**

Available options are Kg and 1b. Factory default setting is Kg.
Enter the patient weight and press Save to exit this window.

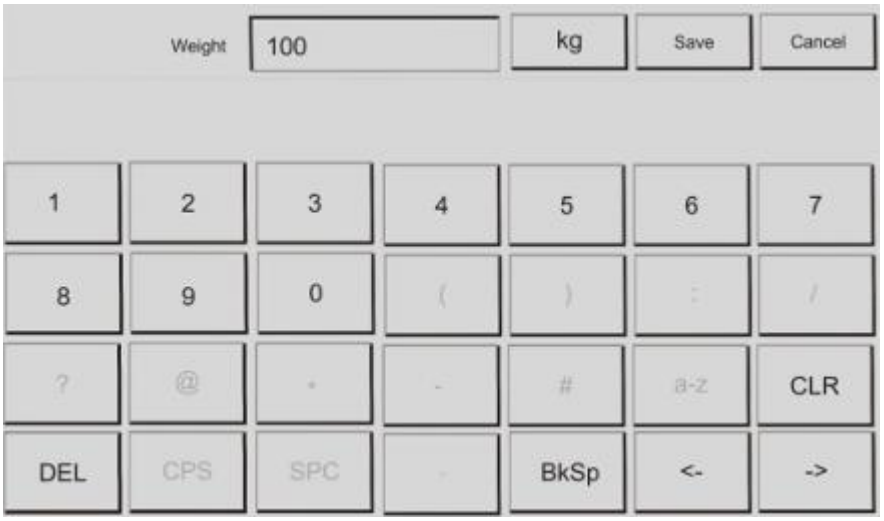


Figure 3-6 Weight

Press **Cancel** to exit from this window and return to the previous menu.

- **Physician Name**

Enter the physician name and press Save to exit this window. Up to 15 characters can be input in this field.

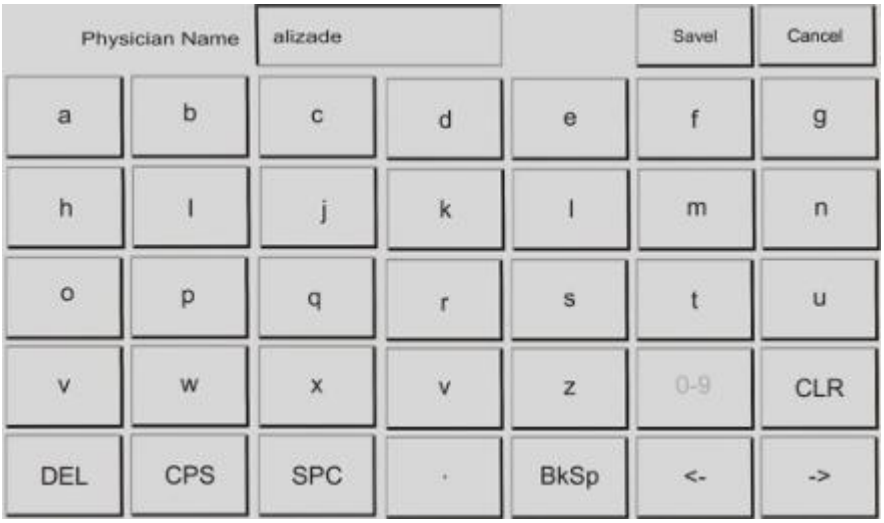


Figure 3-7 Physician Name

Press Cancel to exit from this window and return to the previous menu.

- **Blood Type**

Press to toggle between A+, A-, B+, B-, AB+, AB-, O+, O- and Unknown. Factory default setting is Unknown.
Note: Each time you exit from the Patient Info menu; a message will appear on the screen asking you whether to save changes or not

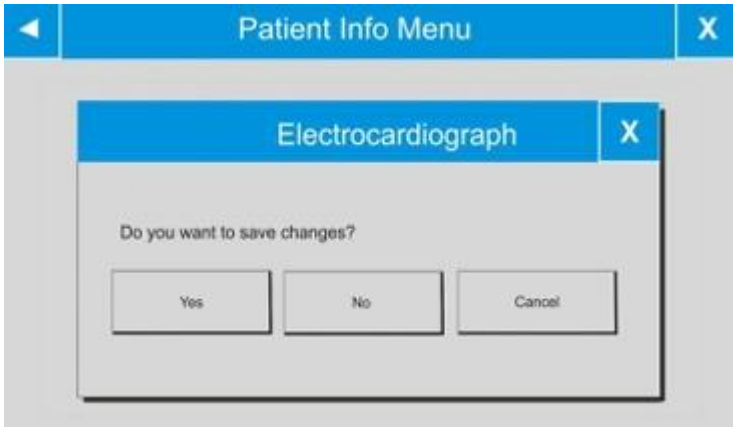


Figure 3-8 Confirmation Menu

4- Data Management

General

All ECG recorded data in Auto modes will be automatically stored in the internal memory of the device for future reference.

Up to 5 records can be stored in the internal memory. When the memory is full the new data will overwrite the oldest data.

Memory Menu

Select Memory in the Main Menu to access Memory Menu (Figure 4-1).

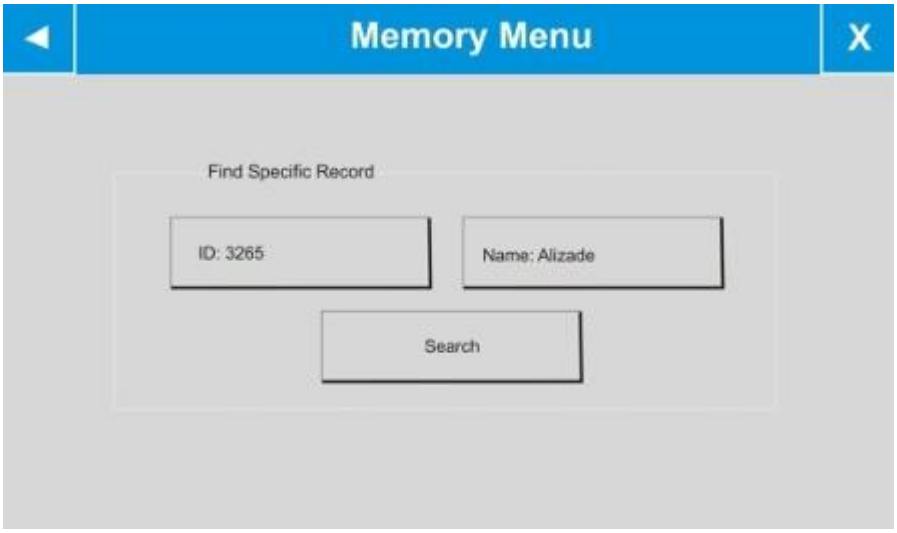


Figure 4-1 Memory Menu

- **Name:** Select to enter the patient name (Figure 4-2).

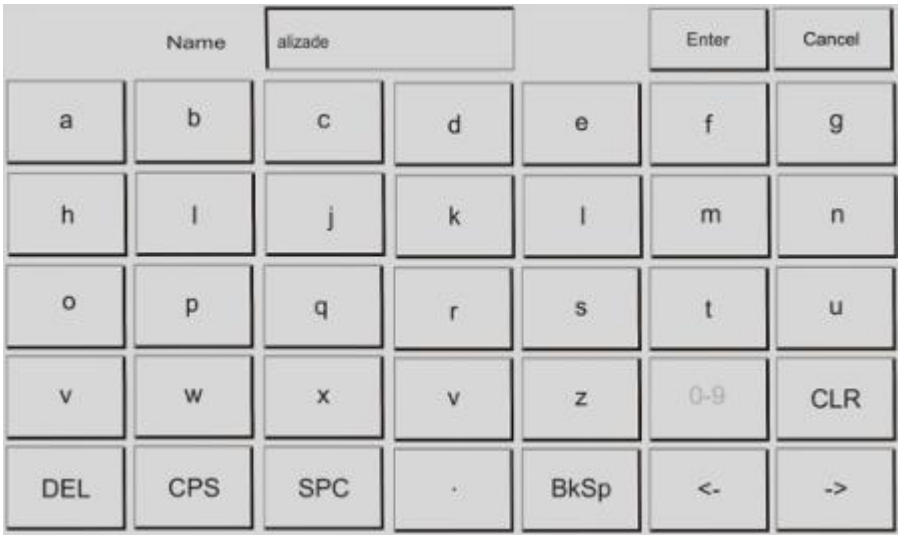


Figure 4-2 Name/ Memory Menu

- **ID:** Select to enter the patient ID as shown in the figures below.

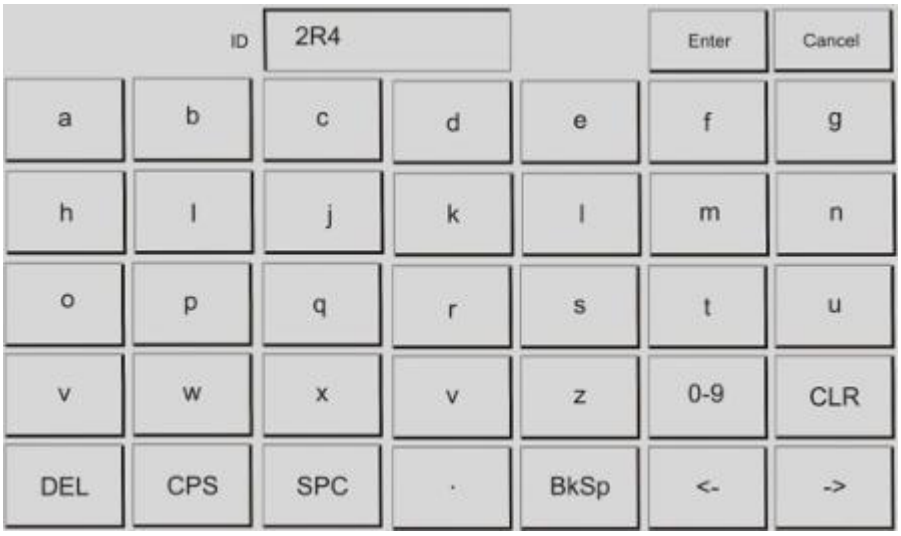


Figure 4-3 ID/ Memory Menu

- **Search:** Enter patient name/ID and press Search to view all stored data of the patient.

If you leave Patient name/ID blank and select Search, all stored records in the memory will be displayed in a list as shown in the figure 4-4.

If no data is available, the message "**There is no record**" will appear.

If patient name/ID is entered incorrectly, the message "**There is no record, change selection"** will appear.

Figure 4-4 Show Records Menu

Each record in Show Records Menu contains the following information:

_ Assigned code by the system

_ Patient Name (if any)

_ Patient ID (if any)

_ Date and time of recording

_ Recording mode: "R" indicates Rhythm mode and "P" indicates Periodic mode.

You can also see current page number, total pages and remaining records for storage in this window.

The last record is always displayed at the top of the list.

▪ Press ⏫or ⏬ to move to the previous or next pages.

▪ Press ▼ or ▲ to move to the previous or next records.

▪ Press **Delete**, the following dialog box appears. If you select Yes, the highlighted record will be deleted.

Figure 4-5 Delete

⚠**WARNING**

Deleted data cannot be recovered.

▪ Press **Review** to observe the information of highlighted record.

"Reviewing…" is displayed below the screen (Figure 4-6).

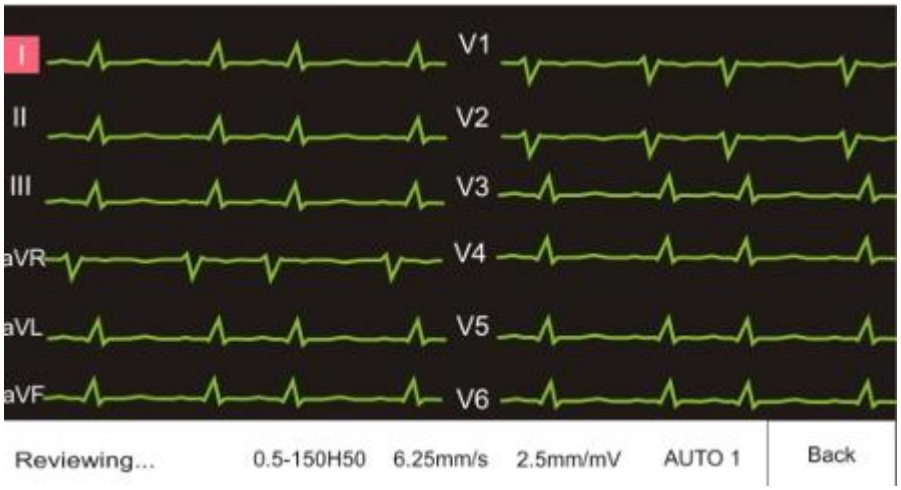


Figure 4-6 Review

This page contains:

_ ECG waveforms

_ HR value

_ Speed, Gain and recording mode

_ Filter name

_ Patient name and ID

_ Date and time of recording

Press Start/Stop key to print the stored ECG signals in the same condition as the recording time.

5)Patient preparation

Actions Before Recording

Before recording the signal, pay attention to the following:

- Give the patient enough time to relax after lying on the bed.
- If necessary, shave the hair where the electrodes are placed on the patient's skin.
- The connection of the electrodes to the skin should be cleaned with alcohol or a solution of soap and water and then dried.
- Use enough gel.
- The ambient temperature should be appropriate and the patient should not suffer from cold and tremors.
- Make all necessary settings on the device before recording.
- During the recording, ask the patient to be as calm and immobile as possible, not to talk, and not to contract their muscles.
- At the beginning / end of recording, or at least at the end of each shift, the accessories, especially the suction chest electrodes and clamp, should be cleaned.

ECG Electrodes Connection

ECG cable consists of two parts: main cable that is connected to the device and lead wires that are connected to the patient. (figure 5-1).

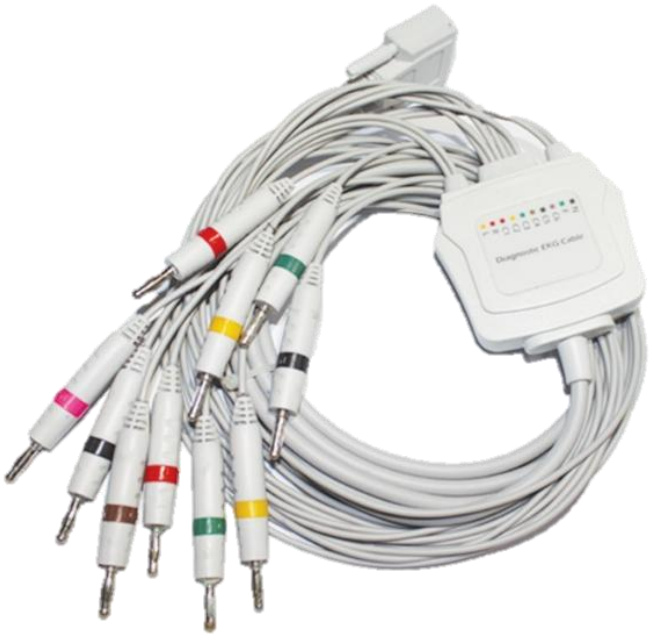


Figure 5-1 ECG cable

⚠WARNING

- Use only one type of electrode on the same patient to avoid variations in electrical impedance. It is recommended to use silver/silver chloride electrode. When dissimilar metals are used for different electrodes, the electrodes may cause large offset potentials due to polarization, which may be severe

- enough to prevent obtaining an ECG trace. Using dissimilar metals may also increase recovery time after defibrillation.
- Use intact and clean electrodes only. Electrodes with damaged surface may cause ECG waveform inaccuracy.
- Use only the manufacturer recommended ECG cable with internal resistance. Other ECG cables and leads may cause burns, improper performance and/or provide inadequate protection during defibrillation.
- When you connect the cables and electrodes, make sure that no metal part is in contact with the safety ground.
- Verify that all ECG electrodes are correctly attached to the patient.
- Interference from a non-grounded instrument near the patient and/or ESU (Electrosurgical Unit) interference can cause inaccuracy of ECG waveform.
- When the device is used with electrocautery unit, please note the position of leads. In order to reduce the hazard of burns, the leads should be located away from the electrocautery pen and return electrode.

Connection of the Limb Electrodes

4 electrodes of 10 ECG electrodes are attached to the limbs (Figure 5-3.)
The location of the limb electrodes for the 12-lead ECG is as follows:

- Left hand (L)
- Right hand (R)
- Left foot (F)
- Right foot (N)

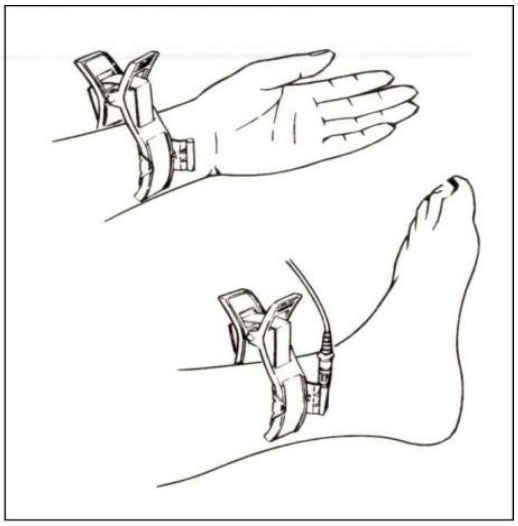


Figure 5-2 Connection of the Limb Electrodes

Connection of the Chest Electrodes

Press the suction bulb and place the chest electrode on proper site (Figure 5-3) and then release.
The location of the chest electrodes is as follows:

- C1 (V1): Fourth intercostal space at the right margin of the sternum
- C2 (V2): Fourth intercostal space at the left margin of the sternum
- C3 (V3): Midway between V2 and V4
- C4 (V4): Fifth intercostal space at the left midclavicular line
- C5 (V5): Left anterior axillary line at the horizontal level of V4
- C6 (V6): Left mid-axillary line at the horizontal level of V4

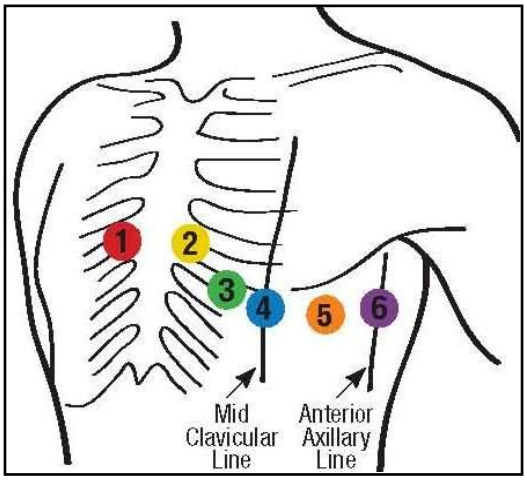


Figure 5-3 Connection of the Chest Electrodes

Detection of electrode disconnection

EM 650 continuously monitors the connection status of the electrodes, and in the event of a disconnection, displays the relevant messages at the location of the signals on the screen.

- If any of the R, L, or F electrodes are disconnected, the messages Check R, Check L, and Check F are displayed.
- If any of the chest electrodes are disconnected, the message Check Cx is displayed (x from 1 to 6).
- If the N electrode is disconnected, one or more disconnection messages may be displayed.

NOTE

Refer to 9)Troubleshooting and Error messages chapter to view device messages.

Color codes and Labels of Electrodes

There are different labels and color codes for ECG electrodes according to IEC and AHA standards. Select ECG cable with regard to acceptable standard in your hospital.

- IEC standard:

Site for electrodes	Symbol for electrodes	Color code for electrodes
Right arm	R	Red
Left arm	L	Yellow
Right leg	N (RF)	Black
Left leg	F	Green
Chest	C1	White/ Red
	C2	White/Yellow
	C3	White/Green
	C4	White/Brown
	C5	White/ Black
	C6	White/ Violet

- AHA standard:

Site for electrodes	Symbol for electrodes	Color code for electrodes
Right arm	RA	White
Left arm	LA	Black
Right leg	RL	Green
Left leg	LL	Red
Chest	V1	Brown/Red
	V2	Brown/ Yellow
	V3	Brown/ Green
	V4	Brown/ Blue
	V5	Brown/ Orange
	V6	Brown/ Violet

Lead Placement Diagram

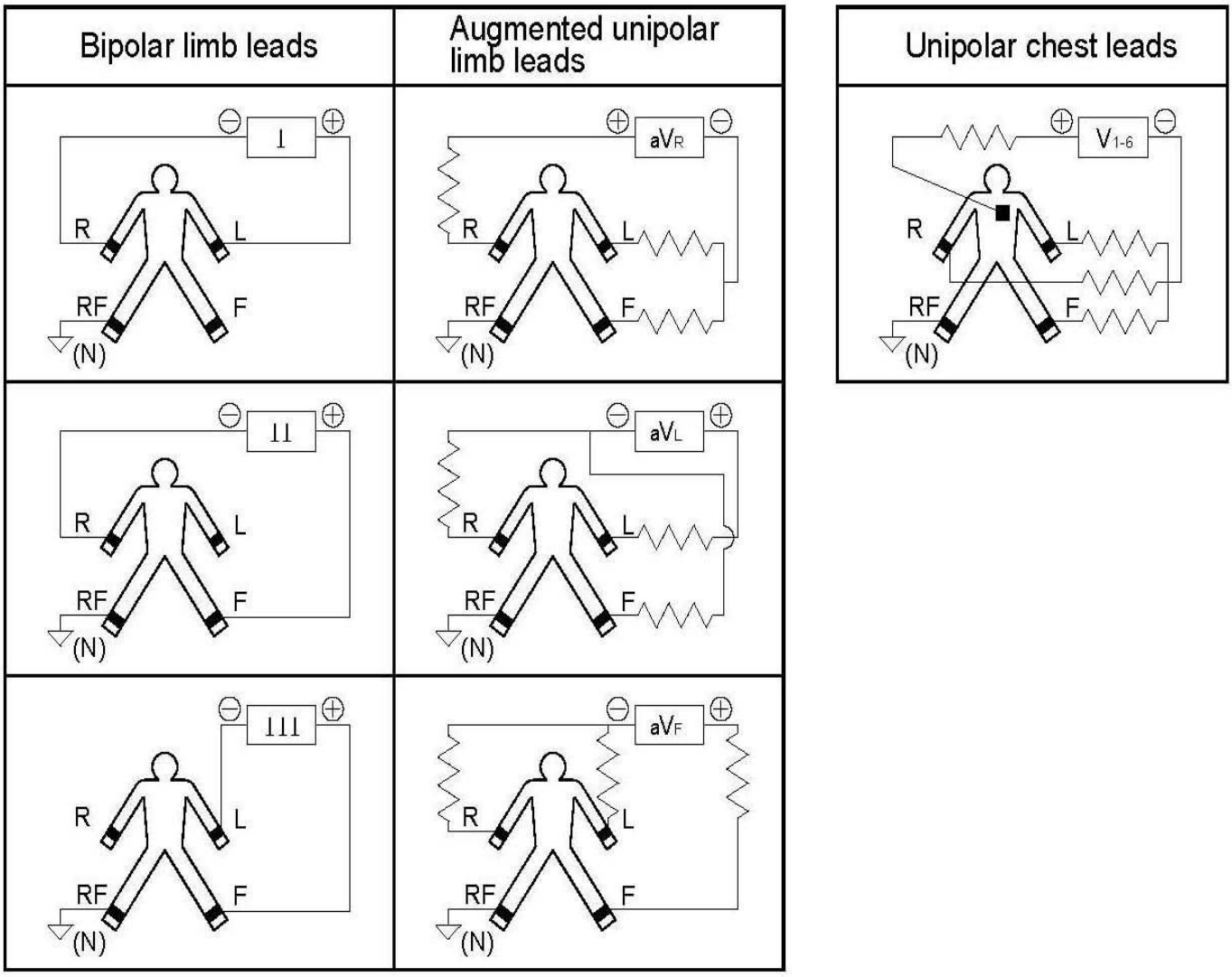


Figure 5-4 Lead placement diagram

6)Recording Operation

NOTE

See the System settings chapter to view the recording settings.

Recording Types

Manual Recording

Press Mode key on the screen or the control panel to toggle between Manual 1+1, Manual 3, Manual 3+1 and Manual 6.

Press the Start/Stop key on the control panel to start recording. The recording will continue until you press this key again.

Press **▲Lead** and **Lead▼** keys to switch lead (lead group) during the recording. Note that you can only record the selected lead (s).

- **Manual 1+1:** In this mode, a selected lead and a Rhythm lead will be recorded.
  In the recording paper, the first waveform indicates the waveform of selected lead and the second one is the waveform of selected Rhythm lead.
- **Manual 3:** In this mode, 3 selected leads will be recorded.
- **Manual 3+1:** In this mode, 3 selected leads and a Rhythm lead will be recorded.
  In the recording paper, the first 3 waveforms indicate the waveform of selected leads and the last one is the waveform of selected Rhythm lead.
- **Manual 6:** In this mode, 6 selected leads will be recorded.

Automatic Recording

Press Mode key on the screen or the control panel to toggle between Auto 1+1, Auto 3, Auto 3+1 and Auto 6.

By pressing Start/Stop key on the control panel, recording starts and ends after 3 to 12 seconds based on selected option.

It is not possible to toggle between different leads using **▲Lead** and **Lead▼** keys.

- **Auto 1+1:** In this mode, a Rhythm lead will be recorded along with the other leads (individually).
- In the recording paper the first waveform indicates the selected lead and the second one is the waveform of Rhythm lead.
- **Auto 3:** In this mode, the leads will be recorded in groups of three.
- **Auto 3+1:** In this mode, a Rhythm lead will be recorded along with the other leads (in groups of three).
- In the recording paper the first three waveforms indicate the selected leads and the other one is the waveform of Rhythm lead.
- **Auto 6:** In this mode, the leads will be recorded in groups of six.

Rhythm Recording

Select **Rhythm** using the **Mode** key on the screen or control panel to see the ECG waveform of the Rhythm lead in four traces. Press Start/Stop key to record according to “Length of Rhythm Rec”.
In this mode, there are always six channels of recording on the paper.

NOTE

- In all Manual recording types, press **▲Lead** and **Lead▼** keys to switch lead (lead group) during the recording.
- In Manual recording types, after the recording starts, the recording stops just by pressing the "Start / Stop" key again.
- Copy key is used to retrieve the last record (except manual types). By turning the device on and off due to the lack of a previous record, the information cannot be copied.

Periodic Recording

To perform periodic recording:

1- Enter the “Recorder setting menu”, and select the desired time interval (5-60 min) for “Periodic Rec. Interval”.

2- Select number of recording repetitions. Available options are “infinite” and 1-20.

3- The recording type in this case is similar to other types of recording and is determined using the Print Mode menu.

NOTE

- In this case, the recording is always done according to the latest settings of the device.
- You can also perform Automatic, Manual and Rhythm recordings during Periodic recording. For this purpose:

  1- select the recording mode and desired settings.

  2- Press the Start/Stop key.

  After the recording in the selected mode is finished, Periodic recording will be continued automatically.
- If the device is set on Manual modes and the Periodic mode is active, the device records the equivalent Automatic mode. For example, the device considers the Manual 3+1 as Auto 3+1.
- It is possible to copy the stored information only in Auto and Rhythm modes (since recording in periodic mode is also done in automatic mode, it is also possible to copy in this mode).
- In all recording types and at any stage of recording, it ends by pressing the Start/Stop key.

7)ECG analysis and measurement

General information

In order to automatically analyze the ECG signal, the analysis and interpretation software of the University of Glasgow (The Glasgow Program) has been added to EM 650. This software helps in more accurate diagnosis of the disease in two parts: Measurement and Interpretation. The Measurement section measures and reports the important parameters of the ECG signal and the Interpretation section uses the results of the Measurement section to diagnose the disease.

For best results, the physician must enter the patient's gender and age. It should be noted that the Glasgow software analyzes and interprets 10 seconds of the ECG signal.

Reported parameters in Global mode

In Global mode, reported signal specifications, are not dependent on individual ECG leads and are generally calculated for the ECG signal.

Table 7-1 Reported parameters in Global

ECG parameters	Description
P Duration [ms]	Time interval from the beginning to the end of the P wave
PR Interval [ms]	Time interval from the beginning of the P wave to the beginning of the Q wave
QRS Duration [ms]	Time interval from the beginning of the Q wave to the end of the S wave
RR Interval [ms]	Average time interval between two consecutive R peaks
QT Interval [ms]	Time interval from the beginning of the Q wave to the end of the T wave
QTc Interval [ms]	Normalized QT based on RR Intervals
T Duration [ms]	Time interval from the beginning to the end of the T wave
ST Duration [ms]	Time interval from the beginning to the end of the ST segment
P/QRS/T/ST Axis [degree]	Heart Axis

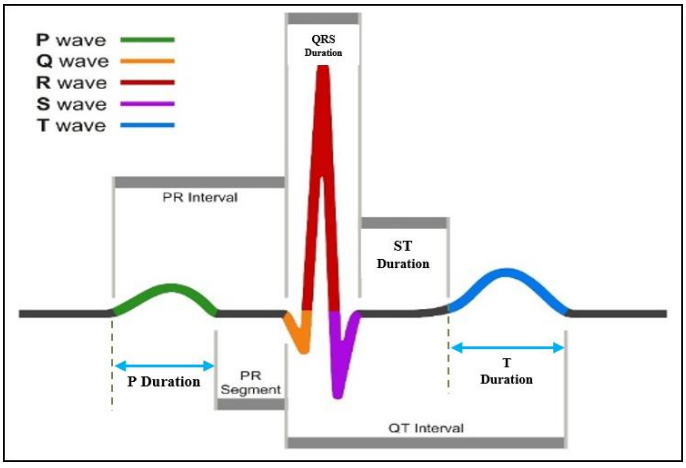


Figure 7-1 Signal parameters in Global

Heart Axis

The cardiac vector (Heart axis) is the average sum of the electrical forces inside the heart, or in other words, the angle of the result of the vector of the heart's electrical activity.
The electric vector can be calculated for P, QRS and T waves.
Among cardiac angles, the QRS axis has the most clinical use and is easily calculated. Leads I, II and III or aVF, aVL and aVR leads can be used to calculate the QRS axis.

Each of these leads shows the electrical activity of the heart in a specific direction. The normal cardiac vector is in the range of -30 to +90 degrees. The following figure shows the angles corresponding to each lead.

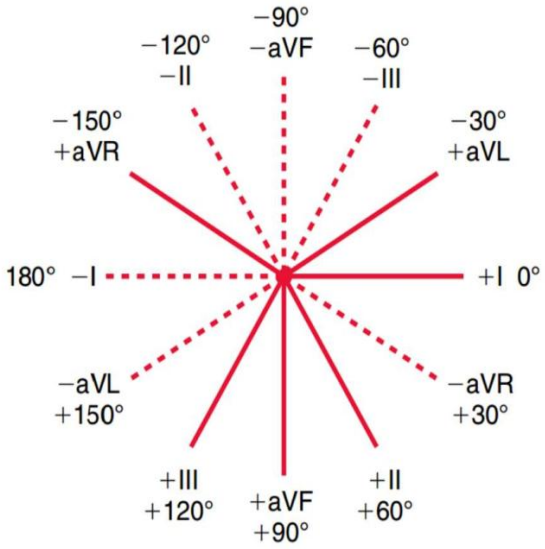


Figure 7-2 Heart angles related to different leads

QTc Parameter

The QT Interval is from the beginning of the QRS to the end of the T wave, which indicates the duration of ventricular depolarization and repolarization.

Since QT is affected by heart rate, it needs to be corrected and normalized to the heart rate (normalizing QT means eliminating its dependence on HR). For example, increasing HR reduces QT, and this dependence needs to be removed to make a diagnostic comparison with the normal range.

In order to normalize the QT parameter, the following equations are used:

$$QTc = \frac{QT}{\sqrt{RR}} \quad و \quad RR = \frac{60}{HR}\ [sec]$$

Reported parameters in Details mode

In this mode, the details of 12 leads are reported in addition to the Global mode. These details are given in table 7-2.

Table 7-2 Reported parameters in Details

ECG PARAMETERS	DESCRIPTION
P Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE P WAVE

QRS Dur [ms]	TIME INTERVAL FROM THE BEGINNING OF THE Q WAVE TO THE END OF THE S WAVE
T Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE T WAVE
ST Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE ST SEGMENT
PR Int [ms]	TIME INTERVAL FROM THE BEGINNING OF THE P WAVE TO THE END OF THE Q WAVE
QT Int [ms]	TIME INTERVAL FROM THE BEGINNING OF THE Q WAVE TO THE END OF THE T WAVE
QTc Int [ms]	NORMALIZED QT BASED ON RR INTERVALS
Q Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE Q WAVE
R Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE R WAVE
S Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE S WAVE
R' Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE SECONDARY R WAVE
S' Dur [ms]	TIME INTERVAL FROM THE BEGINNING TO THE END OF THE SECONDARY S WAVE
P+ Amp [μV]	AMPLITUDE OF ASCENDING EDGE OF P WAVE
P- Amp [μV]	AMPLITUDE OF DESCENDING EDGE OF P WAVE
Q Amp [μV]	AMPLITUDE OF Q WAVE
R Amp [μV]	AMPLITUDE OF R WAVE
S Amp [μV]	AMPLITUDE OF S WAVE
R' Amp [μV]	AMPLITUDE OF SECONDARY RWAVE
S' Amp [μV]	AMPLITUDE OF SECONDARY S WAVE
P2P Amp [μV]	AMPLITUDE OF QRS COMPLEX
T+ Amp [μV]	AMPLITUDE OF ASCENDING EDGE OF T WAVE
T- Amp [μV]	AMPLITUDE OF DESCENDING EDGE OF T WAVE
ST Amp [μV]	AMPLITUDE OF ST PARAMETER
ST Mid Amp [μV]	AMPLITUDE OF ST PARAMETER IN THE MIDDLE OF ST SEGMENT
ST Slope [deg]	SLOPE OF ST SEGMENT
P/QRS/T/ST Axis [degree]	HEART AXIS

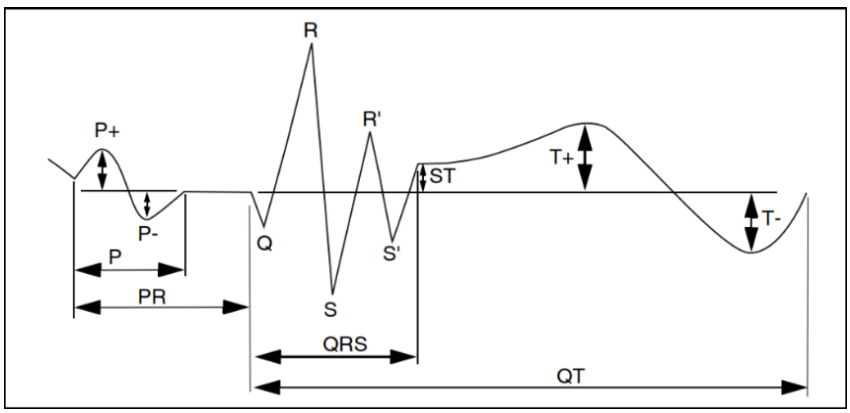


Figure 7-3 Signal parameters in Details

By selecting one of the two modes Global or Detail and recording the results, it will be printed as a table at the end of the record paper. The difference between Global and Detail modes is in the detailed expression of the ECG signal parameters (Measurement section) and the results of the Interpretation section are exactly the same in both cases.

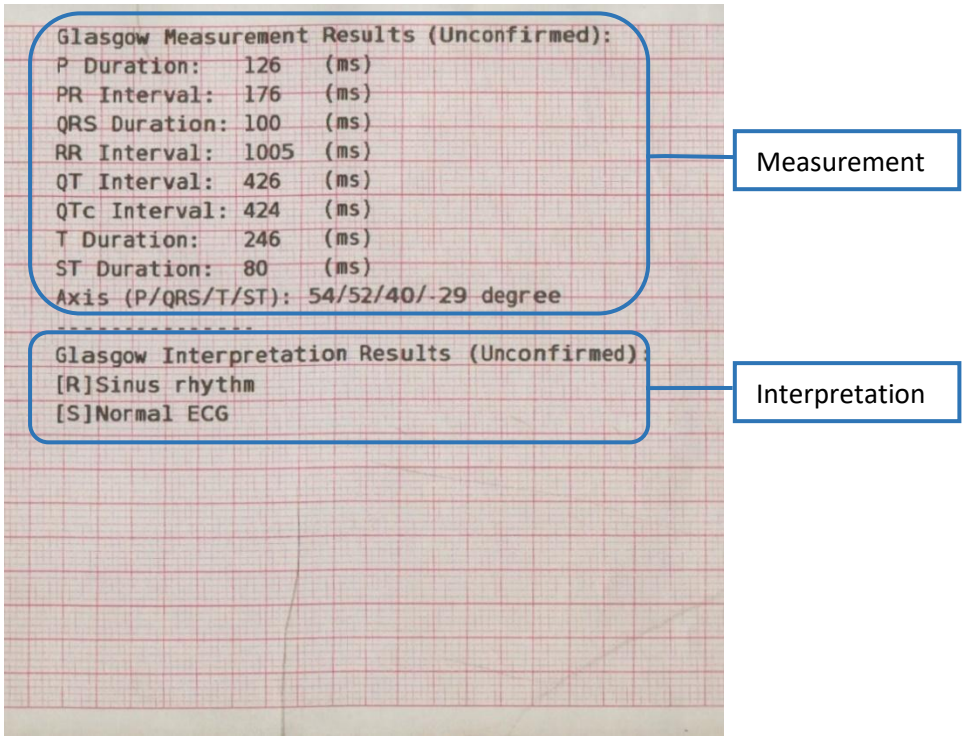


Figure 7-4 Reported parameters in Global

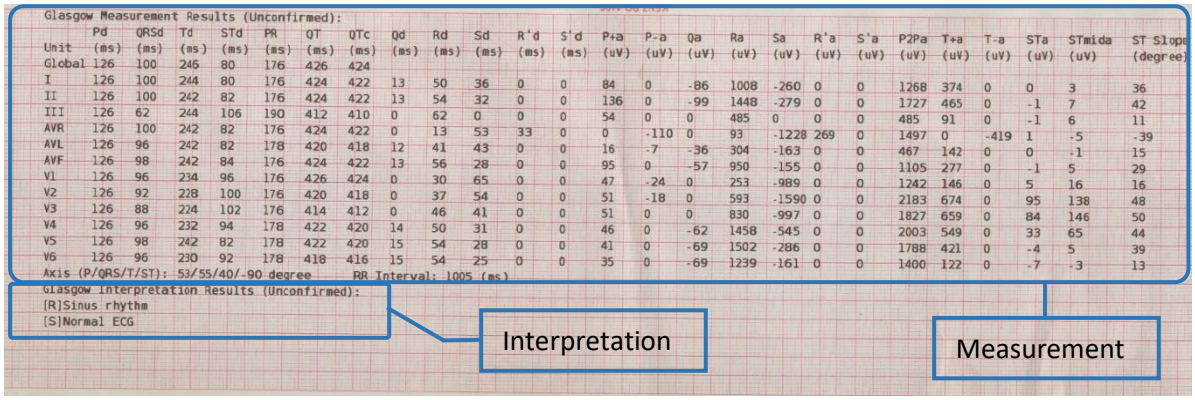


Figure 0-5 Reported parameters in Details

Each Interpretation phrase begins with a special letter that indicates the following:

{H}: Indicates the title of report and is written in first line.
{R}: Corresponds the rhythm interpretation.
{D}: Indicates the details of the signal analysis and identifies the diagnostic terms.
{S}: Shows a summary of the signal analysis status.

NOTE

- **The Measurement results are calculated using raw signal (unfiltered) recorded from the patient, and may differ slightly from the measurements made from the recorded signals.**
- The measurement table is printed at the end of recording, only in Automatic and Sync recording.

- The units for time parameters and amplitude parameters, are millisecond [ms] and microvolt [μV], respectively.
- Glasgow Analysis Software is merely a diagnostic aid software, and for treatment measures, it is essential that the specialist doctor make a definite statement about the patient's condition.
- The specific code of the expressions is reported according to the type of signal and the presence of cardiac abnormalities, and in some cases, not all of the codes mentioned in the interpretation results may be present. For example, if STEMI is detected, the corresponding expression is reported to the user with the code {H}, while for a normal signal, none of the expressions begin with the specific code {H}.
- For more information, refer to Appendix 4 **Error! Reference source not found.**.

8)Care and Cleaning

System check

Before using the device,

- Check if there is any mechanical damage in the system and accessories.
- Check if the power cable and accessories are firmly connected.
- Check if all the keys function correctly and are in proper condition.

⚠WARNING

- If users do not follow a satisfactory maintenance schedule, the device may become invalid, and human health may be endangered.

NOTE

- To ensure maximum battery life, let the EM 650 runs on the battery, at least once a month, until it turns itself off and then recharge the battery.
- If you find any damage in EM 650, stop using it on patient, and contact the biomedical engineer of the hospital or the manufacturer After Sales Service.
- The overall check of the device, including the safety check, should be performed only by qualified personnel.
- All checks which need the electrocardiograph to be opened or may affect the device safety should be performed by After Sales Service.

Maintenance

NOTE

- It is recommended that the device be calibrated once a year by the manufacturer, but calibration is mandatory every 2 years.
- The life of the device is 10 years.
- The hospital can also request a calibration whenever the accuracy of the device is in doubt.

It is recommended that the following be checked daily:

- Accessory physical health
- Accessory function

It is recommended that the following be checked weekly:

- Cleanliness of the device
- Physical health of the device (body, screen, keys, indicators, door and recorder key)
- Recorder performance

It is recommended to check the following on a monthly basis:

- Calibration label control (the device should be sent to the manufacturer on the date specified for calibration)
- Physical health of the device
- Cleanliness of the device
- Function of device keys and indicators
- Accessory physical health
- Recorder performance

Cleaning & Disinfection

Use only the substances approved by us and methods listed in this chapter to clean or disinfect your equipment.

Manufacturer makes no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's Infection Control Officer or Epidemiologist. See also any local policies that apply within your hospital.

WARNING

- Before cleaning the electrocardiograph or the accessories, make sure that the equipment is switched off and disconnected from the power line.
- Sterilization may cause damage to ECG device and is therefore not recommended for this device otherwise indicated in the instructions delivered with accessories or your hospital's maintenance schedule.
- If you see any signs of damage or deterioration in the device and its accessories, do not use it, and if necessary, contact the After-sales service.
- Allow the device to dry completely before making connections. Make sure all connections are secure before using the system.

NOTE

1- EM 650 and accessories should be kept away from dust.

2- Do not use detergents that contain ammonia or acetone.
3- Most cleaning agents must be diluted before use.
4- Don't use rough or sharp material or your fingernail to remove stubborn stains.
5- Do not let the cleaning agent enters into the chassis of the system.
6- Do not leave the cleaning agents on any part of the equipment.

⚠WARNING

- Do not use ETO gas to disinfect EM 650.

External surfaces of the device

In-between patients and as required, wipe gently using a moist cloth and warm soapy water or mild detergent to clean the device and also recommended to use 70% alcohol or Isopropyl alcohol or N-propanol for its disinfection

Display screen

In-between patients and as required use clean and soft cloth with screen cleaner or mild soapy water and with Isopropyl alcohol may be used for cleaning and disinfection.

NOTE

- Take extra care when cleaning the screen of the monitor because it is more sensitive to rough cleaning methods than the housing.
- Avoid direct spray of a liquid on the screen.

Recorder

Accumulation of paper powder or foreign matter between the thermal head and platen roller deteriorates the print quality. Clean the head elements and platen roller surface using alcohol and a cotton swab. Wait until the alcohol dries then close the recorder door.

⚠WARNING

- Do not clean the recorder immediately after recording due to overheating of the head and the surrounding environment.

Accessories

Refer to the accompanying instructions for cleaning, disinfecting, and sterilizing reusable accessories such as cables, leads, electrodes, etc.

Also, the trolley of the device (if any) should be cleaned and disinfected after each patient or, if necessary, using a soft, clean cloth soaked in soap and water and, if necessary, with isopropyl alcohol, and then wiped dried with a cloth.

⚠WARNING

- Do not immerse any part of the EM electrocardiograph in any fluids.
- Disposable accessories shall not be sterilized or reused.
- To prevent environmental pollution, the disposal of single-use accessories shall be done in accordance with the policies of the hospital.

The following table summarizes the methods of cleaning, disinfecting and sterilizing the various parts of the device:

<table>
<tr><th>Device parts</th><th>Single-use</th><th>Cleaning</th><th>Disinfection</th><th>Sterilization</th></tr>
<tr><td>External surface of device</td><td>-</td><td rowspan="2">In-between patients and as required wipe gently using a moist cloth and warm soapy water or mild detergent.</td><td>In-between patients and as required use
■ Alcohol 70%
■ Isopropyl alcohol
■ N-propanol</td><td rowspan="4">To avoid extended damage to the equipment, sterilization is not recommended for this device, related products, accessories or supplies unless otherwise indicated in the Instructions for Use that accompany the accessories and supplies or when stipulated as necessary in the Hospital Maintenance Schedule.</td></tr>
<tr><td>Trolley</td><td>-</td><td rowspan="2">In-between patients and as required use
■ Isopropyl alcohol</td></tr>
<tr><td>Display screen</td><td>-</td><td>In-between patients and as required:
Clean and soft cloth with screen cleaner or mild soapy water</td></tr>
<tr><td>Recorder (print head)</td><td>-</td><td>as required:
1-Gently wipe around the print head using cotton swabs dampened with alcohol.

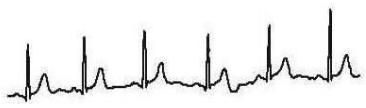
2-After the alcohol has completely been dried, reload the paper and close the recorder door.</td><td>use as required
■ Isopropyl alcohol</td></tr>
<tr><td>ECG Accessory
(Cables, lead wires, Electrodes)</td><td>disposable electrodes</td><td colspan="3">According to the instructions delivered with the reusable accessories
To clean, disinfect and sterilize reusable accessories, refer to the instructions delivered with them.</td></tr>
</table>

9)Troubleshooting and Error messages

Troubleshooting

Repairing the internal parts of EM 650 must be only done by trained and authorized personnel of After Sale Service; otherwise the manufacturer will not take any responsibility for any possible hazard to the patient and the device.

Troubleshooting guide is intended to help users to solve minor problems caused by incorrect use of the EM 650 or failure of accessories. When you face any problem, please ensure that you have followed all actions mentioned in Solution column before you contact After- Sales Services.

Problem	Possible Cause	Solution
The device is not turned on		● Check AC power path. ● Call After- Sales Services.
The device is unable to run on the battery	● Battery is discharged. ● Faulty fuse	● Charge the battery for 5 hours. ● Check the battery fuse. ● Call After- Sales Services.
NO ECG waveform	● ECG cable connection failure ●Faulty ECG cable ●Improper placement of electrodes	● Check ECG cable connection to the device. ● Check ECG cable connection to the electrodes. ● Check ECG cable connection to the patient. ● Short circuit all leads with each other. If ECG cable is ok, lead error message will not appear. ● Do not use old and faulty electrodes. ● Call After- Sales Services.
Inappropriate HR value	● Noisy and improper ECG signal ● After connecting the electrodes and before recording, wait for a few moments.	● Check the leads and electrodes. ● Make sure the patient is relaxed and immobile. ● Pay attention to the following points (related to signal quality) ● Call After- Sales Services.
There is irregular up and down shifts in ECG waveform from baseline 	● Various electrodes are used together ● Loose connection of electrodes to lead wires ● Electrodes are placed on bony site of body. ● Unclean or sulfated electrodes ● Insufficient gel is applied to electrodes. ● Patient skin is not prepared. ● Abnormal patient breathing	●Use the same electrodes. ●Check connection of electrodes to lead wires. ● Check proper placement of electrodes. ● Clean electrodes after each use. ● Apply sufficient gel. ● perform actions before recording (Patient preparation chapter). ● Relax patient in a comfortable position. ● Press Reset key. ● If the problem still persists, use Drift filter.

High frequencies and muscle artifacts make ECG signal noisy. (This may occur concurrently with AC noises) 	● Patient has stress or placed in an uncomfortable condition. ● Patient feels cold and starts shaking. ● Patient's limbs are not placed properly. ● Bed dimensions are not suitable for comfortable placement of patient hands and feet. ● Limb electrodes are attached tightly.	● Relax the patient. ● Warm the patient with a suitable blanket. ● Check electrodes connection. ●If the problem persists, use Lowpass or EMG filter. ● If the problem still persists, take the following actions to reduce AC noise.
Noisy ECG signal due to AC power interferences 	● Electrodes are placed on bony site of the patient body. ● Unclean or sulfated electrodes. ● Insufficient gel is applied. ● Contact with metal parts of bed, trolley, etc. ● Lead wires, patient cable or power cable fails to make connection. ● There are other electronic devices in the vicinity of the electrocardiograph. ● Improper ambient light for example using fluorescent lamp in the room which ECG record is taken. ● Improper HUM filter. ● Improper Earth system.	● Check electrodes and lead wires connection. ● Check that lead wires are not tangled or connected to ground. ● Check that the patient does not contact the metal parts. ● Check that patient cable and power cable have no contact. ● Turn on the HUM Filter. ● If the problem persists, unplug the power cable (the device runs on the battery). ● If the problem still persists, noise source may be other devices, room or its earth system. Consequently, this room is not suitable for ECG recording.

Error messages

Message	Cause	Solution	Remarks
Leads Error Messages			
CHECK R	Lead R is not properly connected to patient.	Make sure that mentioned electrode is properly connected.	The message is displayed in red color on the screen.
CHECK L	Lead L is not properly connected to patient.	Make sure that mentioned electrode is properly connected.	The message is displayed in red color on the screen.
CHECK F	Lead F is not properly connected to patient.	Make sure that mentioned electrode is properly connected.	The message is displayed in red color on the screen.
CHECK C1	Improper connection of C1 electrode	Make sure that C1 electrode is properly connected to patient.	The message is displayed in red color on the screen.
CHECK C2	Improper connection of C2 electrode	Make sure that C2 electrode is properly connected to patient.	The message is displayed in red color on the screen.
CHECK C3	Improper connection of C3 electrode	Make sure that C3 electrode is properly connected to patient.	The message is displayed in red color on the screen.

Message	Cause	Solution	Remarks
CHECK C4	Improper connection of C4 electrode	Make sure that C4 electrode is properly connected to patient.	The message is displayed in red color on the screen.
CHECK C5	Improper connection of C5 electrode	Make sure that C5 electrode is properly connected to patient.	The message is displayed in red color on the screen.
CHECK C6	Improper connection of C6 electrode	Make sure that C6 electrode is properly connected to patient.	The message is displayed in red color on the screen.
System Messages			
Recorder Error Messages			
Rec. Hardware Error	Recorder hardware error	Turn the system off and on. If the problem still exists, contact the manufacturer's After Sales Service.	The message blinks in yellow color on the screen.
Door Open	The recorder door is open.	Close the recorder door.	The message blinks in yellow color on the screen.
Paper Out	Paper roll is used up or the paper is not exited from the recorder.	Check the paper placement or insert a new paper roll into the recorder.	The message blinks in yellow color on the screen.
Head High Temp	The Print head is too hot.	Stop operation for a few minutes.	The message blinks in yellow color on the screen.
Head High Vol	The Print head voltage is high.	Turn the system off and on. If the problem still exists, contact the manufacturer's After Sales Service.	The message blinks in yellow color on the screen.
Head Low Vol	1- The print head voltage is low. 2- The battery voltage is low.	1- Turn the system off and on. 2- Make sure that the battery is sufficiently charged. If the problem still exists, contact the manufacturer's After Sales Service.	The message blinks in yellow color on the screen.
Time out Error	The recorder could not record.	Turn the system off and on. If the problem still exists, contact the manufacturer's After Sales Service.	The message blinks in yellow color on the screen.
Battery Error Messages			
Battery Low	Low battery voltage	Connect the power cable to the system.	The message blinks in yellow color on the screen.
Save & Copy Messages			
Rec's Saving please wait	The system is saving data	Wait a few minutes to finish data saving	The message is displayed in yellow color and yellow box.
Data Acquisition	The system is loading saved file	Wait a few minutes to load the file	The message blinks in yellow color.
There's No Copy Rec	The last stored data could not be recorded after turning the system off and on	Avoid turning the system off and on when the Copy key is pressed.	The message is displayed in yellow color.

10)Technical specification

CLASSIFICATION	
Protection against electroshock	Class I, Type CF , defibrillation-proof applied part
Mode of operation	Continuous operation equipment
Harmful Liquid Proof Degree	Ordinary equipment, (without Liquid Proof)
Method of sterilization and disinfection	Refer to Care and cleaning chapter for detail.
Safety in presence of anesthetic mixture	Not suitable for use in the presence of a flammable anaesthetic mixture with air or with oxygen or nitrous oxide.
DISPLAY	
Display	TFT COLOR, 5''
Resolution	480 × 272
Waveforms	12 Lead ECG/Rhythm Lead
Numeric Parameters	HR
Operation Method	Membrane Keys and Touch
Displayed data	Waveforms, Patient Information (Name and ID), Data & Time, Recording Speed, Sensitivity, Operation Mode, Filter, HR Value, Message
ECG	
Input Channel	Simultaneous acquisition of all 12 leads/ Rhythm Lead
Standard leads acquired	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
Sensitivity Selection	2.5, 5, 10, 20 mm/mV , Auto
Filters	Drift: on or off
	HUM: on or off
	Low pass: 25, 35, 75, 150 HZ & off
	EMG: on or off
Calibration	1 mV
Dynamic Range	±5 mV
Leakage Current	< 10 μA
CMRR	> 98 dB
Time Constant	3.2 sec.
Frequency Response	0.05~150 Hz
Pace	Detection & Rejection: 0.1~2 ms, ±2~±250 mV Indication : 0.5~2 ms, ±2~±250 mV
Protection	Defibrillator
Standards	IEC 60601-2-25

ECG Storage		
Internal Memory	Up to 100 Records	
Recorder		
Model	URUK Thermal Printer	
Print Method	Thermal dot line printing	
Dots per line	832 dots	
Resolution	16 dots/mm (Horizontal) @ 25 mm/sec	
	8 dots/mm (Vertical)	
Printing Speed	6.25, 12.5, 25, 50 mm/s	
Paper Width	110mm	
Print Width	104mm	
Printed data	12 Lead ECG Waveforms, HR Value, Patient Information, Hospital/ward, system model, software version, date and time, paper speed, sensitivity, filter	
Recording Mode	Type	Auto, Manual, Rhythm
	State	Sync, Realtime
	Format	1+1, 3, 3+1, 6
	Status	Normal, Periodic, Copy, Review
GENERAL		
Safety	Class I (Based on IEC60601-1)	
Protection	Against Defibrillator	
AC Power	100-240 VAC, 60VA 50/60 Hz	
Internal Rechargeable Battery	Lithium Polymer, 11.1V, 4.3Ah Charge time: ~ 6 h Usage (New & Full Charged): ~ 8 h or 100 records or Lithium-Ion, 11.1V, 3.35Ah Charge time: ~ 5 h Usage (New & Full Charged): ~ 7 h or 80 records or Lithium-Ion, 11.1V, 2.2Ah Charge time: ~ 5 h Usage (New & Full Charged): ~ 5 h or 60 records	
Dimension	290mm (W) x 70mm (H) x 350mm (L)	
Weight	2.5 Kg (with battery)	
Environment		
Temperature	Operating: 5~40 °C	
	Storage: -25~60 °C	
Humidity	20~90 % (Non condensing)	
Altitude	-200~3500 m	

Appendix 1: Accessories

⚠WARNING

- The accessories listed below are specified to be used for EM 650. Manufacturer does not take responsibility for any possible hazard to the patient or device if other accessories are used.
- Use only the manufacturer recommended ECG cable. Other ECG cables and leads may cause improper device performance, patient injury and inadequate protection during defibrillation.

Accessories

Accessories	**Part #**
EKG Clamp electrodes, Adult, FIAB, Ref F9024SSC	P28042
EKG Suction chest electrode, Adult , FIAB, Ref F9009SSC	P28043
EKG Clamp electrodes, Pediatric, FIAB , Ref F9023SSC	P28047
ECG Suction chest electrode, Pediatric-FIAB , Ref F9015SSC	P28048
Electrocardiograph Cable,10wires, Banana Ends (URUK)	P28078
ECG GEL	P28045
Recorder Paper, 110mm ,Roll	P28026

Appendix 2: system parameters

ITEM	SELECTION	DEFAULT
Patient Information Menu		
Name		Blank
ID		Blank
Age	Year/Month	Year
Gender	Male/Female/None	None
Weight	Kg/lb.	Kg
Height	cm/Foot	cm
Physician Name		Blank
Blood Type	A+/A-/B+/B-/AB+/AB-/O+/O-/ Unknown	Unknown
Recording Mode		
Rec. Types	Auto, Manual, Rhythm	Auto
Rec. Status	Normal, Copy, Review, Periodic	Normal
Auto / Manual		
Formats	1+1, 3, 3+1, 6	6
Rec State (Auto)	Sync/ Real Time	Sync
Header	ON/ OFF	ON
Rhythm Lead	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6	I
Rhythm		
Length of Rhythm Recording	30, 60, 90, 120, 150, 180 Seconds	30
Header	ON/ OFF	ON
Rhythm Lead	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6	I
Recorder Setting Menu		
Rec Time	3-12 Seconds, Interval=1(s)	3
Periodic Recording	Off, 5-60 Min, Interval=5	Off
Periodic Interval	1-20, Infinite, Interval=1	1
Sensitivity	2.5, 5, 10, 20, Auto	10
Paper Speed	6.25, 12.5, 25, 50	25
Filter Setting Menu		
LowPass Filter	Off, 25, 35,75, 150 Hz	150
HUM Filter	ON/ OFF	ON
Drift Filter	ON/ OFF	ON
EMG Filter	ON/ OFF	OFF

ITEM	SELECTION	DEFAULT
F1	Low Pass Filter, HUM Filter, Drift Filter, EMG Filter	Low Pass Filter: Off HUM Filter: On Drift Filter: On EMG Filter: On
F2	Low Pass Filter, HUM Filter, Drift Filter, EMG Filter	Low Pass Filter: 25 Hz HUM Filter: On Drift Filter: On EMG Filter: Off
F3	Low Pass Filter, HUM Filter, Drift Filter, EMG Filter	Low Pass Filter: 35 Hz HUM Filter: On Drift Filter: On EMG Filter: Off
F4	Low Pass Filter, HUM Filter, Drift Filter, EMG Filter	Low Pass Filter: 150 Hz HUM Filter: Off Drift Filter: Off EMG Filter: Off
User Setting Menu		
Save	Enable/ Disable	Enable
Pace Detect	Enable/ Disable	Disable
Measurement	Global/Details/Disable	Disable
Smart Record	Enable/ Disable	Disable
Setting Menu		
Date & Time	Date, Time	
Hospital Ward	Ward	Blank
Rec Test	Testing Recorder	
Default	Default Factory	
Key & Touch Sound	ON/ OFF	OFF
Language	English/Persian	English
Date & Time		
Date	Calendar Type (Christian, Solar) Year, Month, Day, Cursor up, Cursor down	-
Time	Hour, Minute, Second Cursor up, Cursor down	-

Appendix 3: Electro-magnetic compliance

⚠WARNING

- Use only the recommended manufacturer accessory. Using the accessory other than in relevant chapter may cause to increase the EMISSION or decrease the IMMUNITY of system.
- Measurements can be affected by mobile and RF communications equipment. It should be assured that EM 650 is used in the electromagnetic environment specified.
- To prevent EMC effect on EM 650, the system should not be used adjacent to or stacked with other equipment and that if adjacent or stacked use is necessary, the equipment should be observed to verify normal operation in the configuration in which it will be used.
- Do not use cellular phone in the vicinity of this equipment. High result in strong level of electromagnetic radiation emitted from such devices may interfere with EM 650 performance.

Guidance and manufacturer's declaration – electromagnetic emissions		
The EM 650 is intended for use in the electromagnetic environment specified below. The customer or the user of the EM 650 should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The EM 650 uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The EM 650 is suitable for use in all establishments, including domestic establishments and those directly connected to the public low- voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Complies	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Guidance and manufacturer's declaration – electromagnetic immunity			
The EM 650 electrocardiograph is intended for use in the electromagnetic environment specified below. The customer or the user of the EM 650 electrocardiograph should assure that it is used in such an environment.			
Immunity test	**Port**	**Compliance level**	**Electromagnetic environment - guidance**

Electrostatic discharge (ESD) IEC 61000-4-2	Enclosure	±8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
	electrocardiograph coupling		
	Signal input/output parts		
Electrical fast transient/burst IEC 61000-4-4	Input a.c. power	± 2 kV, 100 kHz repetition frequency	Mains power quality should be that of a typical commercial or hospital environment.
	Signal input/output parts	± 1 kV 100 kHz repetition frequency	
Surge IEC 61000-4-5	Input a.c. power	± 0,5 kV, ± 1 kV Line-to-line ± 0,5 kV, ± 1 kV, ± 2 kV Line-to-ground	Mains power quality should be that of a typical commercial or hospital environment.
	Signal input/output parts	± 2 kV Line-to ground	
Voltage dips, IEC 61000-4-11	Input a.c. power	0 % UT; 0,5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315°	
		0 % UT; 1 cycle and 70 % UT; 25/30 cycles Single phase: at 0°	
Voltage interruptions IEC 61000-4-11	Input a.c. power	0 % U_T; 250/300 cycle	
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	Enclosure	30 A/m 50 Hz or 60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of test level.			

Guidance and manufacturer's declaration – electromagnetic immunity

The EM 650 electrocardiograph is intended for use in the electromagnetic environment specified below. The customer or the user of the EM 650 electrocardiograph should assures that it is used in such an environment.

Immunity test	Port	Compliance level	Electromagnetic environment – guidance
Conducted RF IEC 61000-4-6	Input a.c. power	3 V 0,15 MHz – 80 MHz 6 V in ISM bands between 0,15 and 80 MHz 80 % AM at 1 kHz	
	Electrocardiograph coupling		
	Signal input/output parts		
Radiated RF IEC 61000-4-3	ENCLOSURE	3 V/m 80 MHz – 2,7 GHz 80 % AM at 1 kHz	
Proximity fields from RF wireless communications equipment IEC 61000-4-3	ENCLOSURE	Refer to the following table (table 9 of EN 60601-1-2: 2015)	

Test specifications for ENCLOSURE PORT IMMUNITY to RF wireless communications equipment						
Test frequency (MHz)	**Band a) (MHz)**	**a) Service**	**b) Modulation**	**Max power (W)**	**Distance (m)**	**IMMUNITY TEST LEVEL (V/m)**
385	380-390	TETRA 400	Pulse modulation b) 18 Hz	1.8	0.3	27
450	430-470	GMRS 460, FRS 460	FM C) ±5 KHz deviation 1 KHz sine	2	0.3	28
710	704-787	LTE Band 13, 17	Pulse modulation b) 217 Hz	0.2	0.3	9
745						
780						
810	800-960	GSM800/900, TETRA 800, iDEN 820, CDMA850, LTE Band 5	Pulse modulation b) 18 Hz	2	0.3	28
870						
930						
1720	1700-1990	GSM 1800; CDMA 1900; GSM 1900; DECT; LTE Band 1, 3, 4 25; UMTS	Pulse modulation b) 217 Hz	2	0.3	28
1845						
1970						

Appendix 4: The GLASGOW program

ATRIAL ABNORMALITIES

- Possible right atrial abnormality
- Consider left atrial abnormality
- Possible right atrial abnormality consistent with pulmonary disease
- Possible left atrial abnormality
- Possible biatrial enlargement

QRS AXIS DEVIATION

- Indeterminate axis
- Leftward axis
- Left axis deviation
- Marked left axis deviation
- QRS axis leftward for age
- Rightward axis
- Right axis deviation
- Marked right axis deviation
- Left anterior fascicular block
- Possible left anterior fascicular block
- Possible left posterior fascicular block
- Severe right axis deviation

CONDUCTION DEFECTS

- Left bundle branch block
- Incomplete LBBB
- Right bundle branch block
- RBBB with left anterior fascicular block
- RBBB with RAD - possible left posterior fascicular block
- IV conduction defect
- Incomplete RBBB
- rSr'(V1) - probable normal variant

WOLFF-PARKINSON-WHITE PATTERN

- WPW pattern – probable right posteroseptal accessory pathway
- WPW pattern – probable midseptal accessory pathway
- WPW pattern – probable anteroseptal accessory pathway
- WPW pattern – probable right anterolateral accessory pathway
- WPW pattern – probable right posterolateral accessory pathway
- WPW pattern – probable left anterolateral accessory pathway

- WPW pattern – probable left posteroseptal accessory pathway
- WPW pattern – probable left posterolateral accessory pathway

HYPERTROPHY

LEFT VENTRICULAR HYPERTROPHY

- Left ventricular hypertrophy
- Possible left ventricular hypertrophy
- Left ventricular hypertrophy, possible digitalis effect
- Possible left ventricular hypertrophy, possible digitalis effect
- Left ventricular hypertrophy by voltage only
- Borderline high QRS voltage – probable normal variant

RIGHT VENTRICULAR HYPERTROPHY

- Right ventricular hypertrophy
- Possible right ventricular hypertrophy
- Right ventricular hypertrophy, possible digitalis effect
- Possible right ventricular hypertrophy, possible digitalis effect

BIVENTRICULAR HYPERTROPHY

- Biventricular hypertrophy
- Possible biventricular hypertrophy

MYOCARDIAL INFARCTION

INFERIOR INFARCTION STATEMENTS

- *** INFERIOR INFARCT – POSSIBLY ACUTE ***
- Inferior infarct – age undetermined
- Possible inferior infarct – age undetermined
- Small inferior Q waves: infarct cannot be excluded
- Small inferior Q waves noted: probably normal ECG
- Abnormal Q waves of undetermined cause
- Inferior Q waves may be due to cardiomyopathy
- Q waves may be due to cardiomyopathy

LATERAL INFARCTION STATEMENTS

- *** LATERAL INFARCT – POSSIBLY ACUTE ***
- Lateral infarction – age undetermined
- Possible lateral infarction – age undetermined
- Small lateral Q waves noted: probably normal ECG
- Abnormal Q waves of undetermined cause
- Lateral Q waves may be due to cardiomyopathy
- Q waves may be due to cardiomyopathy

ANTEROSEPTAL MYOCARDIAL INFARCTION STATEMENTS

- *** ANTEROSEPTAL INFARCT – POSSIBLY ACUTE ***
- Anteroseptal infarct – age undetermined
- Possible anteroseptal infarct – age undetermined
- Cannot rule out anteroseptal infarct – age undetermined
- Abnormal Q waves of undetermined cause
- Anteroseptal QRS changes may be due to ventricular hypertrophy
- Anteroseptal QRS changes may be due to corrected transposition
- QRS changes may be due to LVH but cannot rule out anteroseptal infarct
- Poor R wave progression – cannot rule out anteroseptal infarct
- Poor R wave progression consistent with pulmonary disease
- Q waves may be due to cardiomyopathy

ANTERIOR MYOCARDIAL INFARCTION STATEMENT

- *** ANTERIOR INFARCT – POSSIBLY ACUTE ***
- Anterior infarct – age undetermined
- Possible anterior infarct – age undetermined
- Cannot rule out anterior infarct – age undetermined
- Abnormal Q waves of undetermined cause
- Anterior QRS changes may be due to ventricular hypertrophy
- Anterior QRS changes may be due to corrected transposition
- QRS changes V3/V4 may be due to LVH but cannot rule out anterior infarct
- Anterior QRS changes are probably related to pulmonary disease
- Poor R wave progression
- Q waves may be due to cardiomyopathy

SEPTAL INFARCTION STATEMENTS

- *** SEPTAL INFARCT – POSSIBLY ACUTE ***
- Cannot rule out septal infarct – age undetermined
- Q in V1/V2 may be normal variant but septal infarct cannot be excluded
- Q in V1/V2 may be due to lead placement error though septal infarct cannot be excluded
- Q in V1/V2 may be due to LVH though septal infarct cannot be excluded
- Abnormal Q waves of undetermined cause
- Septal QRS changes may be due to ventricular hypertrophy
- Septal QRS changes may be due to corrected transposition
- QRS changes in V2 probably due to LVH but cannot rule out septal infarct
- Poor R wave progression – cannot rule out septal infarct
- Poor R wave progression may be due to pulmonary disease
- Q waves may be due to cardiomyopathy

POSTERIOR MYOCARDIAL INFARCTION

- Possible posterior infarct – age undetermined
- Possible posterior extension of infarct
- Tall R V1/V2 probably reflect the infarct

ANTEROLATERAL MYOCARDIAL INFARCTION

- *** ANTEROLATERAL INFARCT – POSSIBLY ACUTE ***
- Anterolateral infarct – age undetermined
- Possible anterolateral infarct – age undetermined
- Abnormal Q waves of undetermined cause
- Q waves may be due to cardiomyopathy

EXTENSIVE MYOCARDIAL INFARCTION

- *** EXTENSIVE INFARCT – POSSIBLY ACUTE ***
- Extensive infarct – age undetermined
- Possible extensive infarct – age undetermined
- Abnormal Q waves of undetermined cause
- Q waves may be due to cardiomyopathy

ST ABNORMALITIES

- Inferior ST elevation
- Lateral ST elevation
- Anteroseptal ST elevation
- Anterior ST elevation
- Septal ST elevation
- Extensive ST elevation
- Anterolateral ST elevation
- Anteroseptal ST depression
- Marked anteroseptal ST depression
- Marked inferior ST depression
- Marked lateral ST depression

MISCELLANEOUS

LOW QRS VOLTAGES

- Low QRS voltages in limb leads
- Low QRS voltages in precordial leads
- Generalized low QRS voltages

TALL T WAVES

- Tall T waves – consider acute ischemia or hyperkalemia
- Tall T waves – consider hyperkalemia

CRITICAL VALUES

- Consider Acute STEMI
- Acute MI/Ischemia
- Extreme Tachycardia
- Extreme Bradycardia
- Significant Arrhythmia
- Prolonged QTc Interval

INTERVALS

- Short PR interval
- Prolonged QT interval
- Short QT interval

DOMINANT RHYTHM STATEMENTS

Sinus rhythm

- Sinus tachycardia
- Sinus bradycardia
- Sinus arrhythmia
- Sinus tachycardia with sinus arrhythmia
- Sinus bradycardia with sinus arrhythmia
- Atrial tachycardia
- Atrial flutter
- Atrial fibrillation
- Junctional rhythm
- Accelerated junctional rhythm
- Junctional bradycardia
- Atrial pacing
- Ventricular pacing
- A-V sequential pacemaker
- Pacemaker rhythm
- Possible ectopic atrial rhythm
- Possible ectopic atrial tachycardia
- Possible ectopic atrial bradycardia
- Irregular ectopic atrial rhythm
- Irregular ectopic atrial tachycardia
- Irregular ectopic atrial bradycardia
- Probable atrial tachycardia
- Probable sinus tachycardia
- Probable supraventricular tachycardia
- Marked sinus bradycardia
- Probable atrial flutter
- Probable atrial fibrillation
- Probable junctional rhythm
- Probable accelerated junctional rhythm
- Probable ventricular tachycardia
- Wide QRS tachycardia
- Accelerated idioventricular rhythm
- Possible idioventricular rhythm
- Possible atrial flutter
- Possible junctional rhythm
- Possible accelerated junctional rhythm
- Possible junctional bradycardia
- A-V dissociation
- Undetermined rhythm
- Regular supraventricular rhythm
- Irregular supraventricular rhythm

SUPPLEMENTARY RHYTHM STATEMENTS

- with PVC(s)
- with frequent PVCs
- with multifocal PVCs
- with frequent multifocal PVCs
- with interpolated PVC(s)
- with multifocal interpolated PVCs
- with paroxysmal idioventricular rhythm
- with multifocal PVCs
- with multifocal interpolated PVCs
- with frequent multifocal PVCs
- with non-sustained ventricular tachycardia
- with intermittent conduction defect
- with 1st degree A-V block
- with borderline 1st degree A-V block
- with 2nd degree A-V block, Mobitz I (Wenckebach)
- with 2nd degree A-V block, Mobitz II
- with 2:1 A-V block
- with 3:1 A-V block
- with 4:1 A-V block
- with high degree A-V block
- with varying 2nd degree A-V block
- with complete A-V block
- with 2nd degree (Mobitz II) SA block
- with bigeminal PACs

- with rapid ventricular response
- with uncontrolled ventricular response
- with slow ventricular response
- with PACs
- with frequent PACs
- with bigeminal PVCs
- with fusion complexes
- or aberrant ventricular conduction
- Demand atrial pacing
- Demand pacing