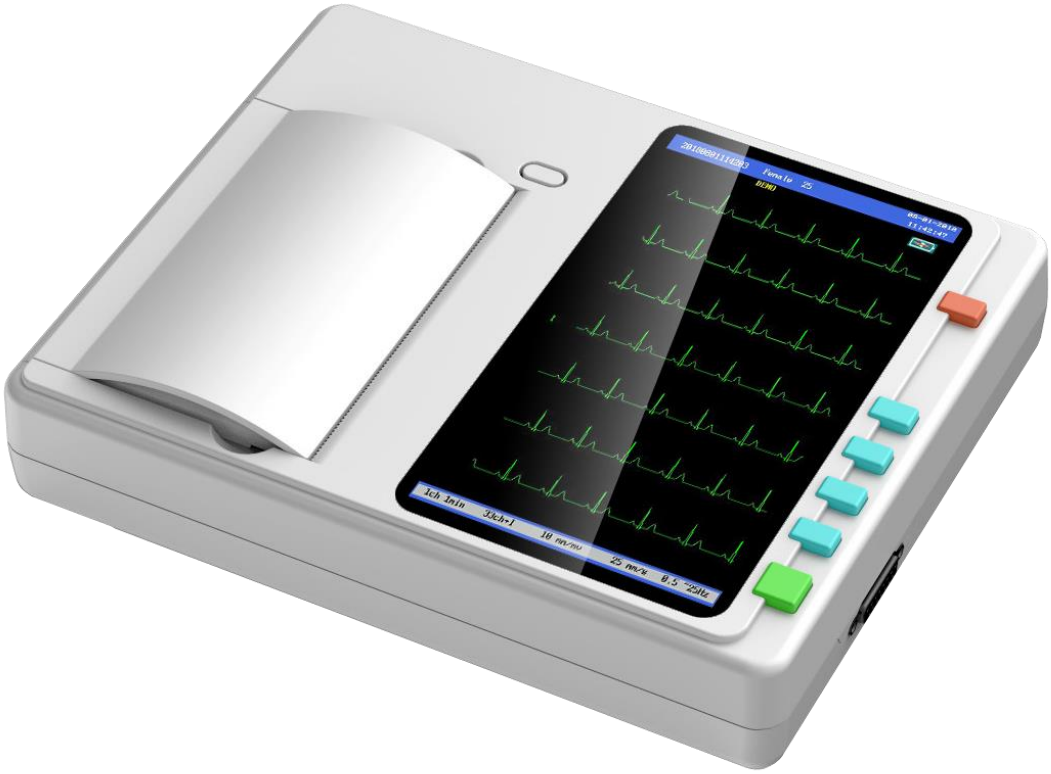
DIGITAL ELECTROCARDIOGRAPH

Operation Manual

Model No. ECG303/ECG306



Responsibility of the manufacturer
Advance Medical only considers itself responsible for any effects on safety, reliability and performance of the equipment if:
Assembly operations, extensions, re-adjustments, modifications or repairs are carried out by personnel authorized by us, and the electrical installation of the relevant room complies with safety standards.

NOTE:

This device is not intended for home use.

WARNING:

This device is not intended for treatment.

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1. Notice for operation

1.1 Notice for use

Thank you for purchasing medical electrical product made by us.

This manual is provided necessary illumination for your first use of electrocardiograph, andry of this manual which is protected by The People's Republic of copyright law. All the information cannot be copied, amended or translated without permission. The content of this manual is subject to change without notice. Please read the manual carefully before using and get to know how to use the machine correctly.

1.2 Notice for safety

Danger	**If ignore this symbol, it may cause die or severe injured, otherwise the device would be partly damaged or resulted in fire hazard.**
Warning	**If ignore this symbol, it may cause human die or severe injured, otherwise the device would be partly or entirely damaged.**
Attention	**If ignore this symbol, it may cause human injured or the device damaged.**
Notice	**Although it is not indication of warning, it provide the right method of use and operation in order to avoid error operation.**

Example of the symbol

	Indicating the contents of danger, warning and attention, which are illustrated on the corresponding area.

- **Warning and Attention**
- Precaution of using thermal paper
  - ✧ Don’t exposure thermal paper under the direct sunshine and high temperature.
  - ✧ Don’t put into the fluorescence light for a long time.
  - ✧ Don’t store thermal paper with PVC.
  - ✧ Don’t pile up thermal paper in long period to avoid waveform transfer.

1.3 Manufacturer's Declaration

As a specialized manufacturer of production and saAdvance Medical electronics, we takes every effort, is dedicating on the precise security and reliability for each device.

In order to ensure the reliable operation of the medical device, the user of ECG must take the responsibilities to guarantee the details as follows:

1. For the sake of guarantee the safety of the device, maintenance, repair and replacing the accessories should be operated by our company staff or the person who we have trained.
2. This unit only use or replace the accessories we recommend, which is the requirement for the safety of the device.
3. Insure to use the proper voltage and frequency according to the demand of the icons.
4. The device only can be used according to the user manual, and other purpose cannot be satisfied.
5. All the technical data (circuit diagram, list of components etc.) only are provided to the specialized staff that passed our technical training. For improving the technique, we will not notice in advance, and apologize to cause your inconvenience.

1.4 Icons for safety

ECG device strictly follows the standardIEC60601-1 that is the electromagnetism compatibility of medical equipment, corresponding to Type CF, Class I.

Attention	**For sake of the patient’s safety, please the electrodes connected with the body of patient and other unconnected electrodes don’t touch electric conducting products, for example, your hands don’t touch the ground.**

Attention	**Connected with other equipments increases leakage current may cause latent danger, please strictly operate according to the requirements. Connect with our company if necessary.**

Attention	**While using synchronously with cardiac pacemaker and other electric stimulator, these equipments occur baleful current, should adopting necessary measures to reduce the influence on the diagnosis which are**

	resulted from these devices.

Attention	**If non-isolating signal enters from external input, the end of this signal is not connected with protection ground, it will cause malfunction because of difference of is potential point.**
Attention	**Only the devices under IEC 60601-1 Type I can be connected with the input and output port of this device, please consult to the technical staff if necessary.**

✧ Explosion-proof requirements

Danger	**Don't use ECG device in the presence of inflammable gas and flammable gas such as anesthesia gas, oxygen, hydrogen, otherwise may be caused explosion and fire hazard.**

✧ Magnetic resonance interference

Danger	**Don't use ECG device during magnetic resonance imaging. Magnetic conduction can lead burning. ECG device can interfere magnetic resonance equipments meanwhile can be interfered by magnetic resonance equipments.**

✧ Defibrillation protection

Don't touch the device during defibrillation, which may cause electric short circuit for the patient and operator.

When the device is used synchronously with defibrillator, to avoid danger, please confirm the sort of lead cable, electrode fixing condition, and sort of electro cardio-electrodes, conductive gel used for defibrillator and the output energy of defibrillator. Besides, please confirm whether other devices are connected with ground.

1.5 Explanation of the symbols

	Remarks for special attention (see operating instructions for details)		Type CF equipment equipped with protector against defibrillation
	Output of the analog signal		Iso-potential point
	Input of the analog signal		Protective earth terminal

	POWER		1mV Scaling/ Function setting
	Forward and backward		Printing /Recording Mode
	Start/End record		

1.6 Precautions

- For the sake of improving the quality of product, specifications and design is subject to change without notice.
- AC power cable must be connected to medical three-cord electrical outlet. Using the power cable in the accessories to connect with medical three-cord electrical outlet can insure gounding reliably. Please use suitable sockets which can supply sufficient power to load for this device.
- Upgrading the procedure and maintenance should be operated by our technical staff, error operation may occur error. User doesn't do it without allowance.
- All the accessories must be used the appointed ones. If use other accessories, maybe cannot

correspond to the device properly.

- Don't open the shell of the device.
- Must switch off the power while doing connection.
- Don't leak any liquid such as alcohol to the internal of the device and socket.
- Don't use any abstergent and dilution containing organic liquid, methyl benzene, gasoline etc., which is harmful to the BAL shell.
- Don't scrape shell with grinding ointment and chemical detergent.
- Don't touch input signal connector and output signal connector simultaneously, for example RS-232 and patient isn't allowed to touch at the same time.
- Don't apply vapor sterilization to the device and accessories. Don't sterilize with high-temperature or γ-Ray or apply electrical beam.
- While using sprayer of physic liquor to sterilize, please don't spray the liquid to the internal device and socket.
- Don't install the device near to the interfere source such as wireless transistor, hypercator, mobile phone or wireless telephone. Otherwise, the interference will impact on the device.
- After effective life time is over, please deal with the device according to the local law or return to the manufacturer for recycle in order to protect environment.

- **Pay attention to the following ECG measurement and interpretations:**

  (1) AC/EMG Interference might cause mistakes in reading P Wave and Q Wave; baseline drift might cause misunderstanding in reading ST Segment and T Wave.

  (2) Measuring error might occur due to blur endings of S wave and T Wave.

  (3) Low voltage of QRS might cause the measurement result of HR not reliable.

  (4) Low voltage of QRS might cause the ECG coordinate axes calculation or QRS not reliable.

  (5) With frequent ventricular systole, at accidental situation, will be inspected out as heartbeat.

  (6) Multi arrhythmia might make it difficult to recognize P Wave and the relative parameters might be unreliable.

  (7) This device has self-interpretation function, which only analyze automatically the obtaining ECG trace, but don't reflect on all the conditions of patient. Maybe the analyzing result is different with the diagnosis by doctor, so the final conclusion must be made out by doctor to combine with patient clinic data and other analysis result.

- **Precautions for using electrode**
  - Whether clean the axunge on the skin of patient (where connect with electrodes) and wipe conductive gel on it.
  - When electrodes are sterilized and disinfected, please use cotton cloth to wipe and clean with medical alcohol or Glutamyl acetaldehyde disinfection.
  - If the electrodes are too dirty to clean, please use emery-paper to abrade gently, and repeat the above disinfecting method.
  - Whether the assembly of electrodes is loose. If it is too loose, please clamp closer.
  - Whether mix to use together different sorts of electrodes.
  - While the device is used synchronously with defibrillator, there will be super-voltage resulted from defibrillation which causes polarized voltage on the electrodes, so it can't measure in several seconds.

- **Precaution for cable lines**
  - Please use ECG cable line assembled with device.(or the accessories our factory provide)
  - Please use three-cord power line assembled with device, which can connect to the three-cord socket and realize grounding well.
  - When the device is used synchronously with defibrillator, please make sure to use the patient Cable. line which we assembled with defibrillating function.
  - Please check whether the connection of patient cable is loose or not.
  - Please notice whether patient cable is too closed to power cord during measuring. Please check whether the connection between each patient cable end and corresponding electrode is right or not.
  - Periodic inspect patient cable, and clean and disinfect it if it is necessary. Please use cotton with medical alcohol wipe gently, don't drag forcibly patient cable.
- **Precaution for rechargeable batteries**
  - The batteries built in the device are rechargeable batteries specialized for ECG-213.Please don't use for other equipments. Otherwise, maybe cause batteries to weep heat or rupture.
  - Don't throw the batteries into fire.
  - Don't weld directly the batteries to the device.
  - Don't disassemble and reconstruct battery. There is protecting circuit in the batteries to avoid danger. Maybe cause batteries weep or rupture after it is damaged.
  - Batteries contain the structure for discharging internal waste gas, which must be not obstructed, otherwise, will damage of batteries.
  - The liquid of batteries is harmful for your eyes. When it is splashed into your eyes, don't knead or wipe, please clean with water and see a doctor immediately.
  - Don't contact metal to the "+""-"polar of battery.
  - Don't flake or scrape the shell of batteries.
  - During charging, the process of charging isn't finish but exceeds rated charging time; please switch off AC power in time. Otherwise the batteries will heat severely until damage.
  - Internal liquid of batteries is rubbed to skin, which may cause burn, please clean with cleaner immediately.
  - Don't use or put battery in homeothermic places. Otherwise may cause battery weep, decrease life time and function.
  - Don't immerge battery into water, and moisten with medical liquid. Otherwise maybe cause battery heat or go moldy.
  - If any abnormality is found during using battery, please stop using immediately.
  - Don't store battery in the places out of touch by children.
  - Don't impact strongly or throw battery.
  - While battery is not used for a long period, please switch off the device, and pull out power cable from socket.
  - Please paste isolated belt on the ends and connection cable of scrap battery, and hand in them to our service staff to deal with.

2. Summary

ECG is mainly designed to record physiological electrical signal, resulted from activities of cordis and analyze rhythm and configuration for clinic diagnose and research.

Intended use: The cardiogram and heart rate recorded by the ECG can help doctors to analyze and diagnose heart disease or arrhythmia in hospitals. Its compact size makes it suitable for use while visiting patients at home.

NOTE:

- The patient who has a heart disease may have a normal electrocardiogram, so other tests are required for a full heart appraisal. This equipment cannot be connected to the heart directly

2.1 Features

- Digital signal processor for effective inhibition of baseline drift, AC interference filter, EMG interference filter and the heart rate, to guarantee the authenticity and dependability.
- Auto-regulation of baseline drift can effectively inhibit baseline drift, optimizing the printing position to achieve high-quality ECG.
- Have regular automatically measuring and analyzing function for ECG parameters to lessen doctor's load.
- With a high –resolution thermal printer to print out ECG trace, describing the trace clear and accurate, annotation as well as related parameters for diagnostic reference.
- Roll recording paper for ECG is 80mm in width, simultaneous 12 lead acquisitions and 3 lead live record, high affectivity of ECG examination, good effect and economic utility.
- Function of rhythm lead for observing abnormal ECG trace & heart rate.
- Supported by AC/Rechargeable battery for continuous examination whenever necessary. For Battery operation, ECG is equipped with a battery charger and a system for battery capacity management and protection.
- Safety level for ECG corresponds to Type CF, Class I according to the IEC60601-1 criterion. The amplifier is floating input circuit which can examine human cordis directly with safety and reliability.

2.2 safety classification

- Shock proof type :Class I, internal power device
- Shock proof degree : CF device
- Anti-splash degree :common device
- Safety degree used in the presence of atmosphere(or oxygen, lachgas)mixed with flammable anesthesia gas: not suitable to be used in the presence of atmosphere(or oxygen, lachgas)mixed with flammable anesthesia gas

3. General Information

3.1 Name of components

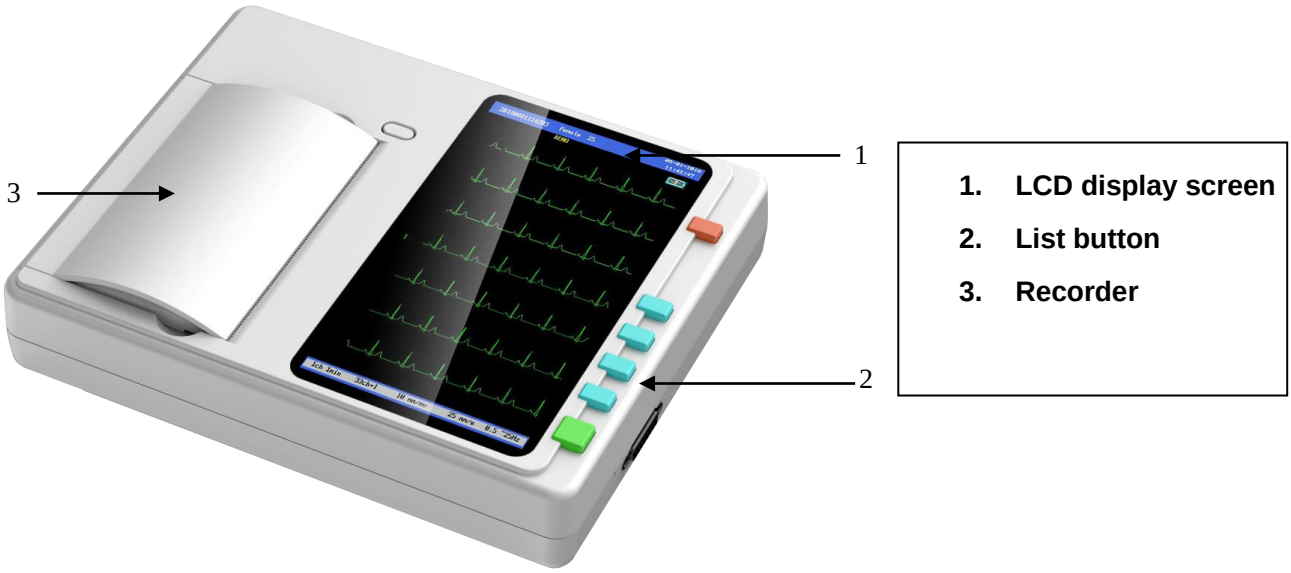


Fig. 1 top panel

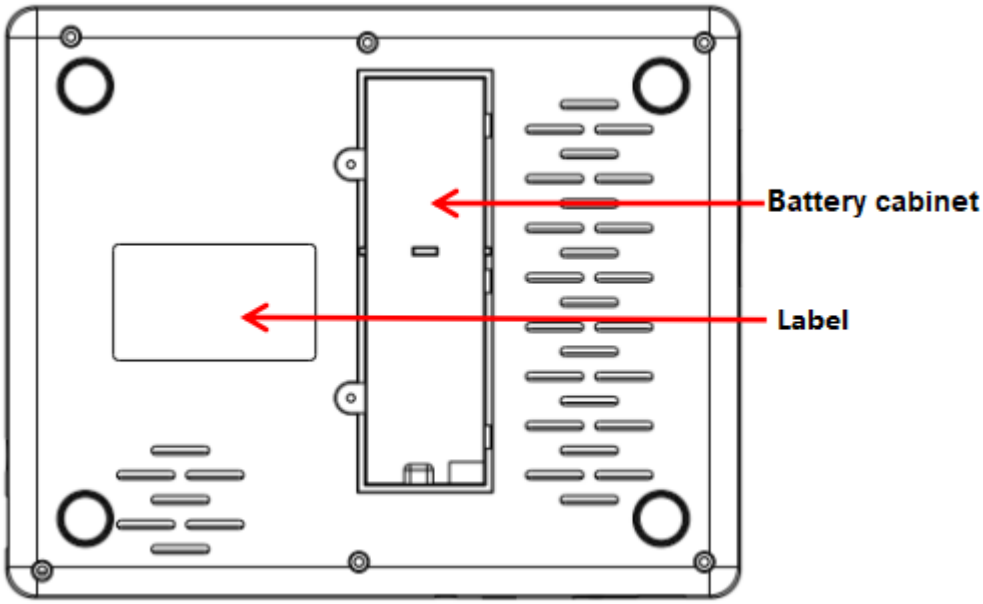


Fig. 2 bottom panel

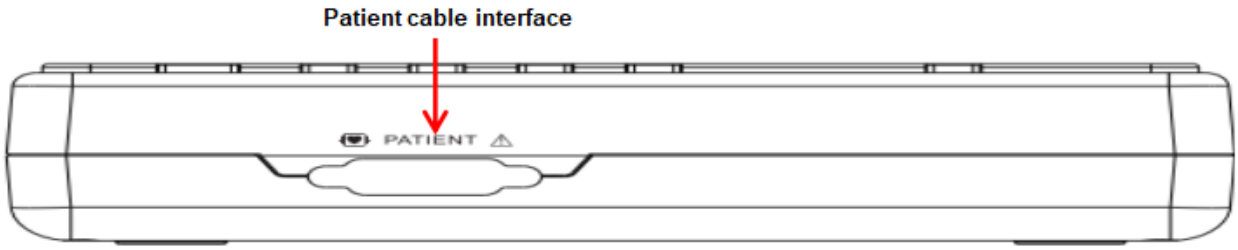


Fig. 3 right side panel of ECG

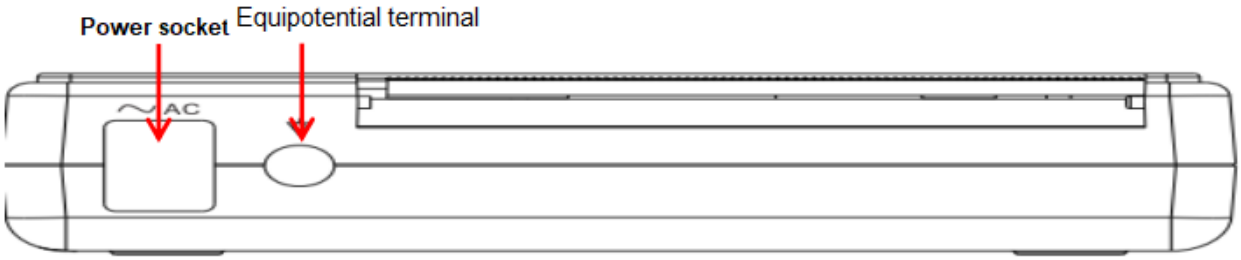


Fig. 4 left side panel of ECG

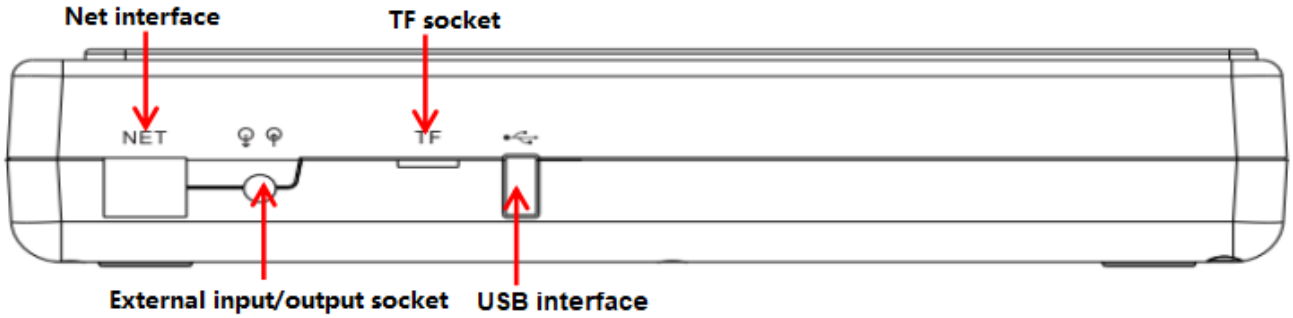
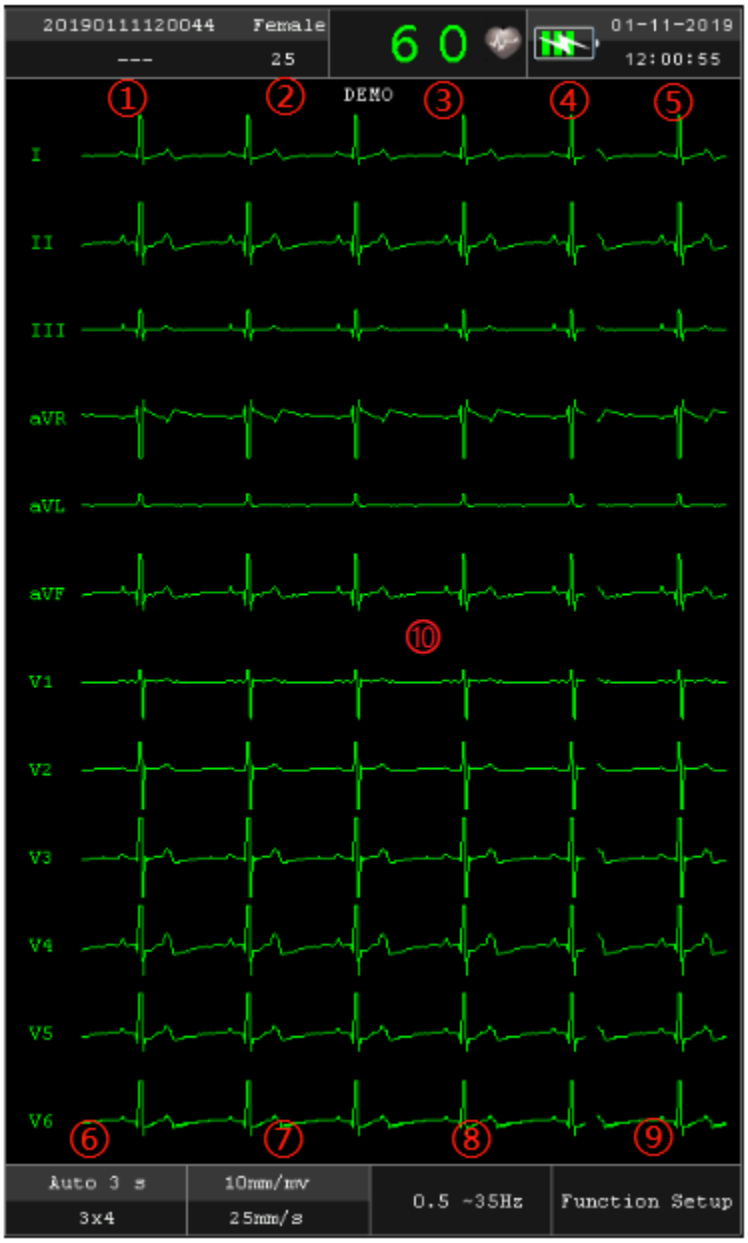


Fig. 5 Upper side panel of ECG

3.2 Content on LCD as follows

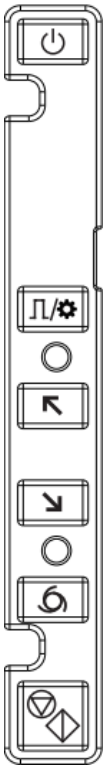
Display on LCD is as follows after power on:



No	Icon name	Description
①	Patient ID	Display the ID of the currently inspected patient; ID is automatically generated by the system according to the printing time. The format of the ID number is the year, month, day, hour, minute, and second. For example, printing at 12:00:44 on January 11, 2019, the ID will be generated: 20190111120044.
②	Gender & Age	The gender of the patient being examined is entered by the operator Gender : Male, Female; The age of the patient being examined is entered by the operator.
③	Heart rate❤& Heart icon	Displays the actual heart rate; the heart rate icon flashes when the ECG detecting the heart rate
④	Battery capacity	Display battery capacity when the device is in internal battery powered mode This flag is not displayed when the device uses the network power mode.

No	Icon name	Description
⑤	System time	Display the current time. System time can be set by the operator
⑥	Operation mode	Displays the current analysis mode: a. In the automatic redirection mode, the automatic redirection time of each lead is displayed, for example, the retransmission time is 3 seconds, shows “automatic 3 s”; b. In manual redirection mode, shows "manual"; c. In 1 lead 1 minute mode, shows "1 lead 1 minute" d. In rhythm analysis mode, shows "rhythm analysis".
⑦	Sensitivity	Displays current sensitivity(2.5,5,10,20mm/mV): Example 1: The sensitivity of the system setting is 2.5mm/mV, shows 2.5mm/mV; Example 2: The sensitivity is automatically adjusted in the automatic commutation mode. When the signal is normal, the sensitivity is 10mm/mV, shows 10mm/mV; when the signal amplitude is too large, it will be automatically halved, the sensitivity is 5mm/mV, shows 5mm/mV.
⑧	Filters setting	AC Filter Freq：50Hz/60Hz EMG Filter：25Hz/35Hz/45Hz/75Hz/100Hz/150Hz High pass filter：0, 0.05, 0.5Hz
⑨	Function setup	Press this key to enter menu settings.
⑩	Current lead	Display the current lead (I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6) If the C1 lead falls off, the line mark of the off lead wire is displayed in the interface, which is displayed as “lead off V1”

3.3 Content on keyboard as follows

	Button Symbol	Function
		
		ON/OFF Being used for power switch on and charging in standby condition.
		Mark/ Function Keys: Under MAN mode, press this key to record a 1mV calibration pulse at any time while recording. You can combine this key with the left and right direction keys to set automatic redirection mode and interval.
		Forward/backward switch key: Use to switch or exit settings between different functions on the button during function setting. It can be used to select different leads during manual redirection, 1 lead 1 minute or rhythm analysis.
		Recording mode: Transform from different recording mode: automatic, manual, 1 lead 1 minute or rhythm analysis.
		Start/stop button: Start or stop recording.

4. Operation preparation

⚠WARNING⚠:

Check the main unit and its accessories carefully before operating the ECG. Replacement should be taken if there is any evident defectiveness or aging symptom which may impair the safety or performance. Make sure that the equipment is in proper working condition.

4.1Connecting to power

⚠WARNING⚠:

To avoid any possible electric shock, please connect the ECG with AC power by a three-phase power cable. Don't open the ECG while it is powered on.

⚠WARNING⚠:

If the integrity of external protective conductor in installation or arrangement is in doubt, the ECG should be operated from the built-in rechargeable battery.

Insert one end of the 3-cord power cable into the device and the other end into the power socket in wall. Then bridge the grounding cable between the grounding terminal of the device and ground.

1) Mains Supply

The mains socket is on the left upper side of the ECG. Properly connect the ECG with mains supply.

Rated voltage: 100V-120V/220V-240V

Rated frequency: 50Hz/60Hz

Rated input power: 60A

Make sure the mains supply meets the above requirements before power on.

2) Built-in Rechargeable Battery

The built-in rechargeable battery pack is used, because of the consumption during storage and transport, the capacity of battery may not be full. In this case please recharge the battery first. Replace the battery when the battery has been recharged over 300 times.

NOTE:

The battery is put into the battery compartment without connecting to the battery socket at factory. After receiving the ECG, if built-in rechargeable battery is to be used, connect the battery to the socket first.

4.2 Paper loading

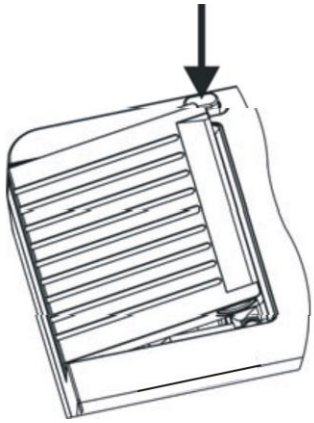


Fig. 1

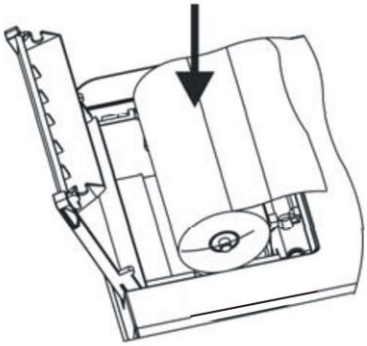


Fig. 2

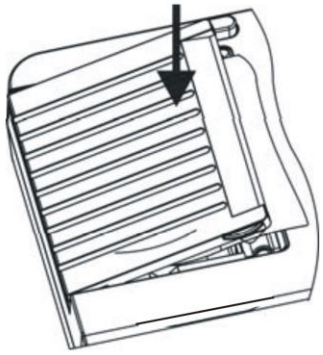


Fig.3

Step 1: Push the Open Button to open the paper compartment cover.

Step 2: Take out the paper rollers, remove remaining paper if necessary. Insert the rollers into the new roll paper and put the paper with rollers back into the paper compartment. Be sure that the paper is installed with the paper's grid side facing downward.

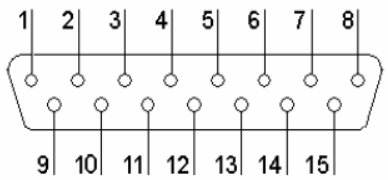
Step 3: Pull about 2cm of the paper out, and close the cover gently.

- The recording paper applied to the device is 80mm three channel roll thermal paper.
- Cover the paper cabinet, and leave the beginning of paper.
- Make the square side downward.

4.3 Connection of patient cable

Connection of patient cable is involved whether record ECG is accurate or not. Please ensure to connect the patient cable well. New and old electrodes or reusable and disposable electrodes can't be used synchronously. Different type of electrodes can't be used together, which will have great influence on ECG record. Electrodes or cable plug can't touch other surface or conductor, such as metal bed. Renovate all the electrodes together.

1) Patient Cable Socket



Definition of corresponding pins:

Pin	Signal	Pin	Signal	Pin	Signal
1	C2 (input)	6	SHIELD	11	F (input)
2	C3 (input)	7	RF	12	NC
3	C4 (input)	8	FG	13	C1 (input)
4	C5 (input)	9	R (input)	14	NC
5	C6 (input)	10	L (input)	15	Lead Check (input)

Patient Cable Definition of Pins

2) Placement of limb electrodes

a) Ensure the electrodes are clean;

b) Align lead wires of patient cable to avoid twisting, and connect the electrode connectors to corresponding electrodes according to the color and identifier;

c) Clean electrode area on a short distance above the ankle or wrist with alcohol;

d) Daub the electrode area on limb with gel evenly;

e) Place a small amount of gel on the metal part of limb electrode clamp;

f) Connect the electrode to limb, and be sure that the metal part be placed on the electrode area above the ankle or wrist. Attach all limb electrodes in the same way.

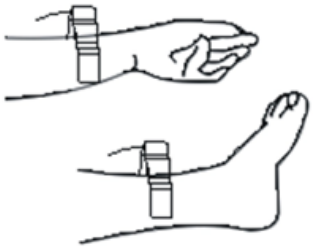
R(RA) for right arm

L(LA) for left arm

RF(RL) for right leg

F(LL) for left leg

It shows as the right picture:



3) Placement of chest electrodes

a) Ensure the electrodes are clean;

b) Align all lead wires of patient cable to avoid twisting, and connect the associated electrodeconnectors with corresponding electrodes according to the color and identifier;

c) Clean electrode area on chest surface with alcohol;

d) Daub the round area of 25mm diameter on each electrode site with gel evenly;

e) Place a small amount of gel on the brim of chest electrode's metal cup;

f) Place the electrode on chest electrode site and squeeze the suction bulb. Unclench it and then the electrode is adsorbed on chest. Attach all chest electrodes in the same way.

The chest electrode should be placed on body surface as shown below.

V1: Fourth inter-costal space at right border of sternum.

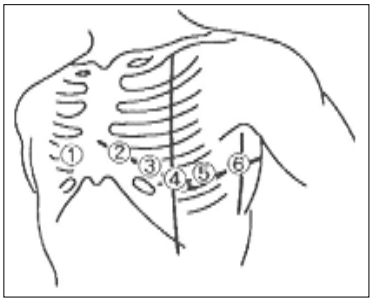
V2: Fourth inter-costal space at left border of sternum.

V3: Midway between V2 and V4.

V4: Fifth inter-costal space at left mid-clavicles line.

V5: Left anterior axillary line at the horizontal lever of V4.

V6: Left mid-axillary line at the horizontal lever of V4.



Attention

Tangling of electrodes or overlap from one place to another of ECG cream is not allowed to avoid short circuit. If there is no ECG scream, inspecting ECG can be used 75% alcohol to clean each electrodes, and connect the electrodes to related position immediately to ensure that the attached skin is wet. Don't use normal saline instead of ECG scream to avoid rusting electrodes.

Attention

Patient cable plug should be screwed down to insert to the socket!

4) Electrode connection definitions and color code

	European		**American**		
Electrodes	**Identifier**	**Color code**	**Identifier**	**Color code**	**Socket Number**
Right arm	R	Red	RA	White	9
Left arm	L	Yellow	LA	Black	10
Right leg	RF	Black	RL	Green	14
Left leg	F	Green	LL	Red	11
Chest 1	C1	White/red	V1	Brown/red	12
Chest 2	C2	White/yellow	V2	Brown/yellow	1
Chest 3	C3	White/green	V3	Brown/green	2
Chest 4	C4	White/brown	V4	Brown/Blue	3
Chest 5	C5	White/black	V5	Brown/orange	4
Chest 6	C6	White/violet	V6	Brown/ violet	5

5) ECG lead sequence:

two options for lead mode: standard lead, European lead.

The lead mode is defined as follows:

No.	1	2	3	4	5	6	7	8	9	10	11	12
Standard leads	I	II	III	aVR	aVF	aVF	V1	V2	V3	V4	V5	V6
European lead CABRERA	aVL	I	-aVR	II	aVF	III	V1	V2	V3	V4	V5	V6

4.4 Inspection before Startup

In order to avoid safety hazards and get good ECG record, the following inspection procedures are recommended before turning on the ECG and beginning operation.

1) Environment:
   - ◆ Check and make sure that there is no electromagnetic interference source around the equipment, especially large medical electrical equipment such as electrosurgical equipment, radiological equipment and magnetic resonance imaging equipment etc. Switch off these devices when necessary.
   - ◆ Keep the examination room warm to avoid muscle action voltages in ECG signal caused by cold.
2) Power Supply:
   - ◆ If mains power used, please check whether the power cord has been connected to the ECG and it is properly grounded.
   - ◆ Recharge the battery first before use when the battery capacity is low.
3) Grounding:
   - ◆ Check the grounding cable is properly connected.
4) Patient Cable:
   - ◆ Check whether the patient cable has been connected to the ECG firmly, and keep it far away from the power cord.
5) Electrodes:
   - ◆ Check whether all electrodes have been connected with lead wires of patient cable correctly according to the identifier and color.
   - ◆ Be sure that all electrodes have been connected to the patient correctly.
   - ◆ Ensure that the chest electrodes haven't contacted with each other.
6) Recorder Paper:
   - ◆ Ensure that there is enough recording paper loaded.
   - ◆ Make sure the case of the recorder has been secured.
7) Patient:
   - ◆ The patient should not contact with conducting object such as earth, and metal part of bed etc.
   - ◆ Ensure the patient is warm and relaxed, and breathe calmly.
8) AC Filter Frequency
   - ◆ Check the setup of AC Filter Frequency and make sure is identical with the local regulations, or it will influence the anti-jamming effect.

⚠WARNING⚠:

The ECG is provided for the use of qualified physicians or personnel professionally trained. The operator is supposed to be familiar with the contents of this Operation Manual before use.

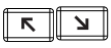
5. Operation Instructions

NOTE:

- Whether boot or shutdown should hold down the ON / OFF key a few seconds. Hold the boot until the display shows information on manufacturers, equipment model and version, shut down until the screen display closed.

5.1 Operation mode

5.1.1 Manual Mode

- Press  key to choose “Manual Mode”, which will be displayed in the lower left corner of the LCD screen.
- Set the recording format of the “Manual Mode” in the menu.
- Press the “Manual Mode” to select the sensitivity (wave gain), filter according to the requirement before recording.
- Press  arrow key to select the leads to be recorded.
- Press  **RUN/STOP** to start recording; manually switch the leads while recording.
- Press  during recording to stop recording at any time.

Patient ID will be changed automatically if the recording is interrupted. If the ID number needs to be unchanged, the operator should adjust patient ID before continuing recording.

5.1.2 Auto Mode (Auto 3s Mode)

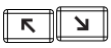
- Press  key to choose “Auto 3s Mode”, which will be displayed in the lower left corner of the LCD screen.
- Set the recording format of the “Auto 3s Mode” in the menu.
- Press the “Auto 3s Mode” to select the sensitivity (wave gain), filter according to the requirement before recording.
- After the waveform and heart rate are stabilized, press  to print a complete ECG waveform.
- During printing, the operator can press  key to stop recording any time.

5.1.3 One channel one minute mode (1ch 1min Mode)

- Press  key to choose “1ch 1min Mode”, which will be displayed in the lower left corner of the LCD screen.
- Set the recording format of the “1ch 1min Mode” mode in the menu.
- Touch the “1ch 1min Mode” to select the sensitivity (wave gain), filter according to the requirement before recording.

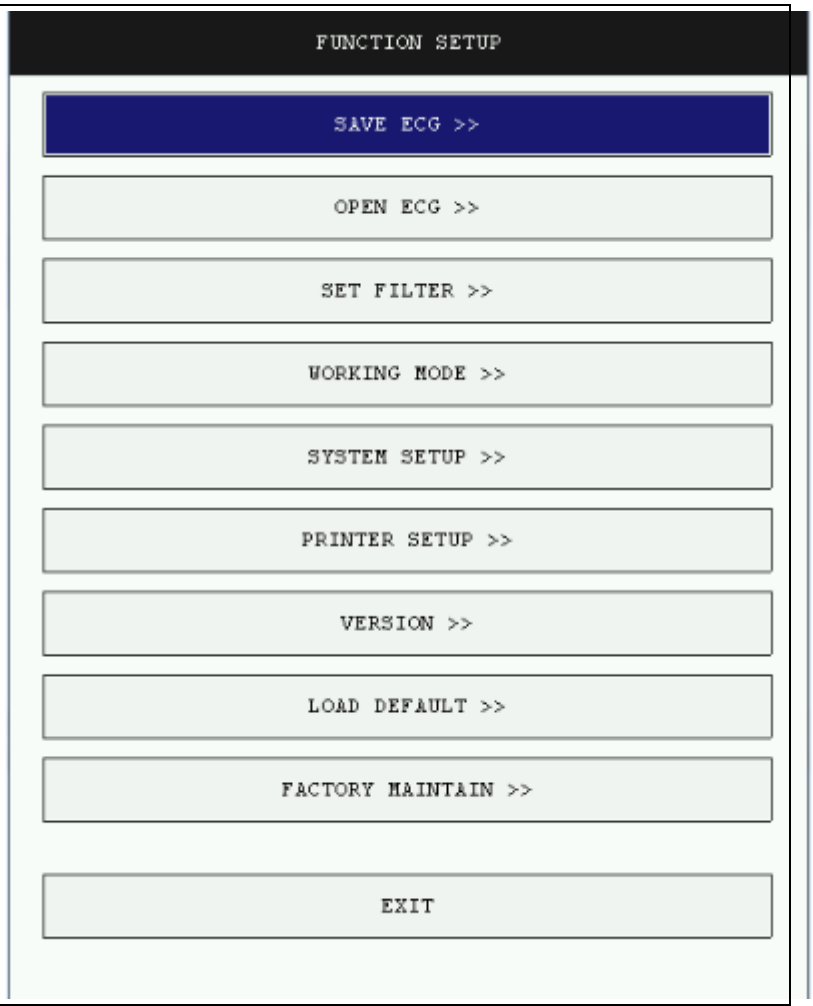
- Press  arrow key to select the leads to be recorded.
- Press  during recording to stop recording at any time. Record ECG after starting to collect 48s data ▲按“  ”键，开始采集 48s 数据后记录心电图。
- Automatic stop after printing. During printing, the operator can press  key to stop recording any time.

5.1.4 Rhythm Mode

- Press  key to choose “Rhythm Mode”, which will be displayed in the lower left corner of the LCD screen.
- Set the recording format of the “Rhythm Mode” mode in the menu.
- Press the “Rhythm Mode” to select the sensitivity (wave gain), filter according to the requirement before recording.
- Press  arrow key to select the leads to be recorded.
- Press  during recording to stop recording at any time. Record ECG after starting to collect 48s data 按“  ”键，开始采集 240s 数据后记录心电图。
- Automatic stop after printing. During printing, the operator can press  key to stop recording any time.

5.2 Operation Menu

5.2.1 Function Setup



Press  or touch “Function Setup” in the lower right corner of the LCD screen go to main menu. Touch the corresponding position of the screen then go to the submenu.

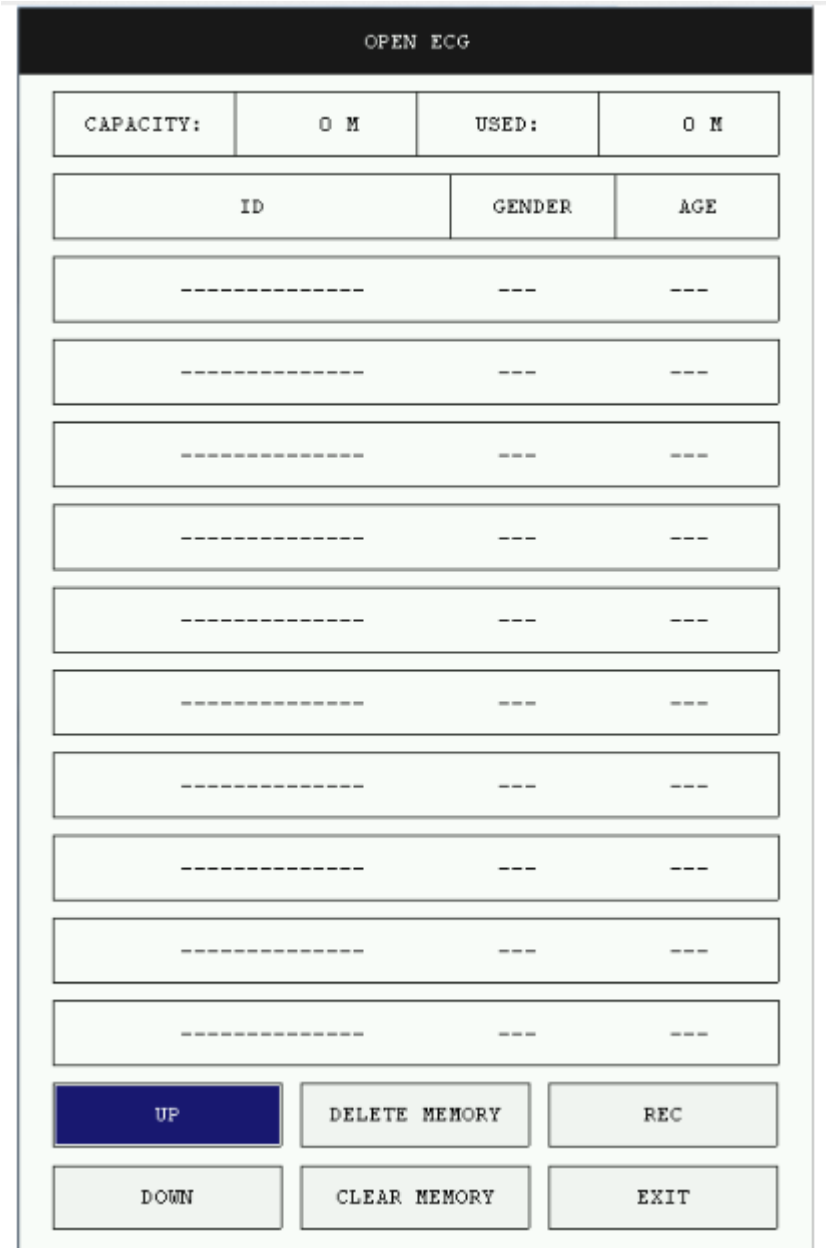
5.2.2 Save ECG

Extended storage support. Select "SAVE ECG" from the Function setup. Only the ECG which has been printed out the report normally can be saved. The saved cases can be played back or print it out.

Enter the corresponding patient information to save the ECG report.

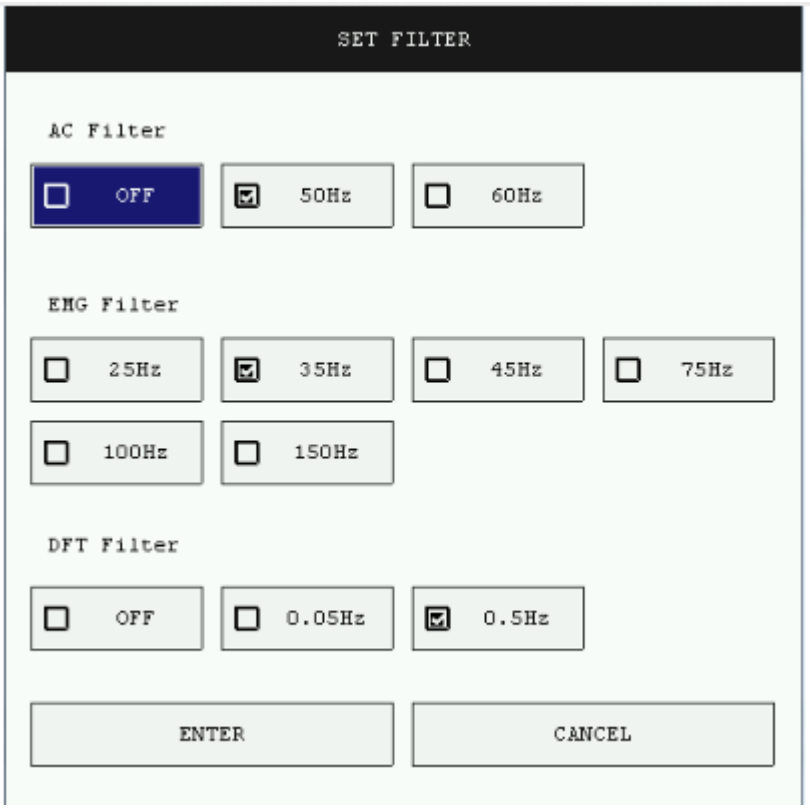
5.2.3 Open ECG

Press " Open ECG", all saved ECG reports can be viewed, printed, and deleted.



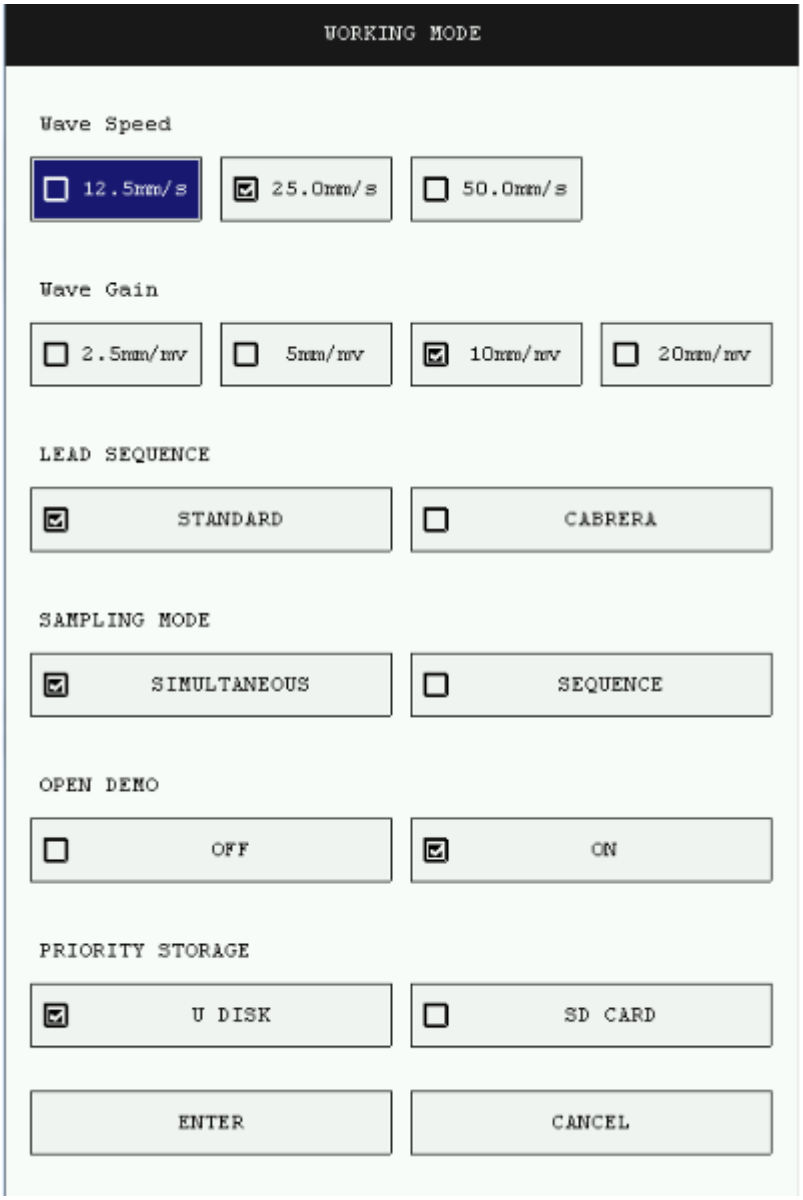
5.2.4 Set filter

Press “Set filter”, AC Filter, EMG Filter and DFT Filter can be setup.



5.2.5 Working Mode

Press “Working Mode”, wave speed, wave gain, load sequence, sampling mode, open demo and priority storage can be setup.

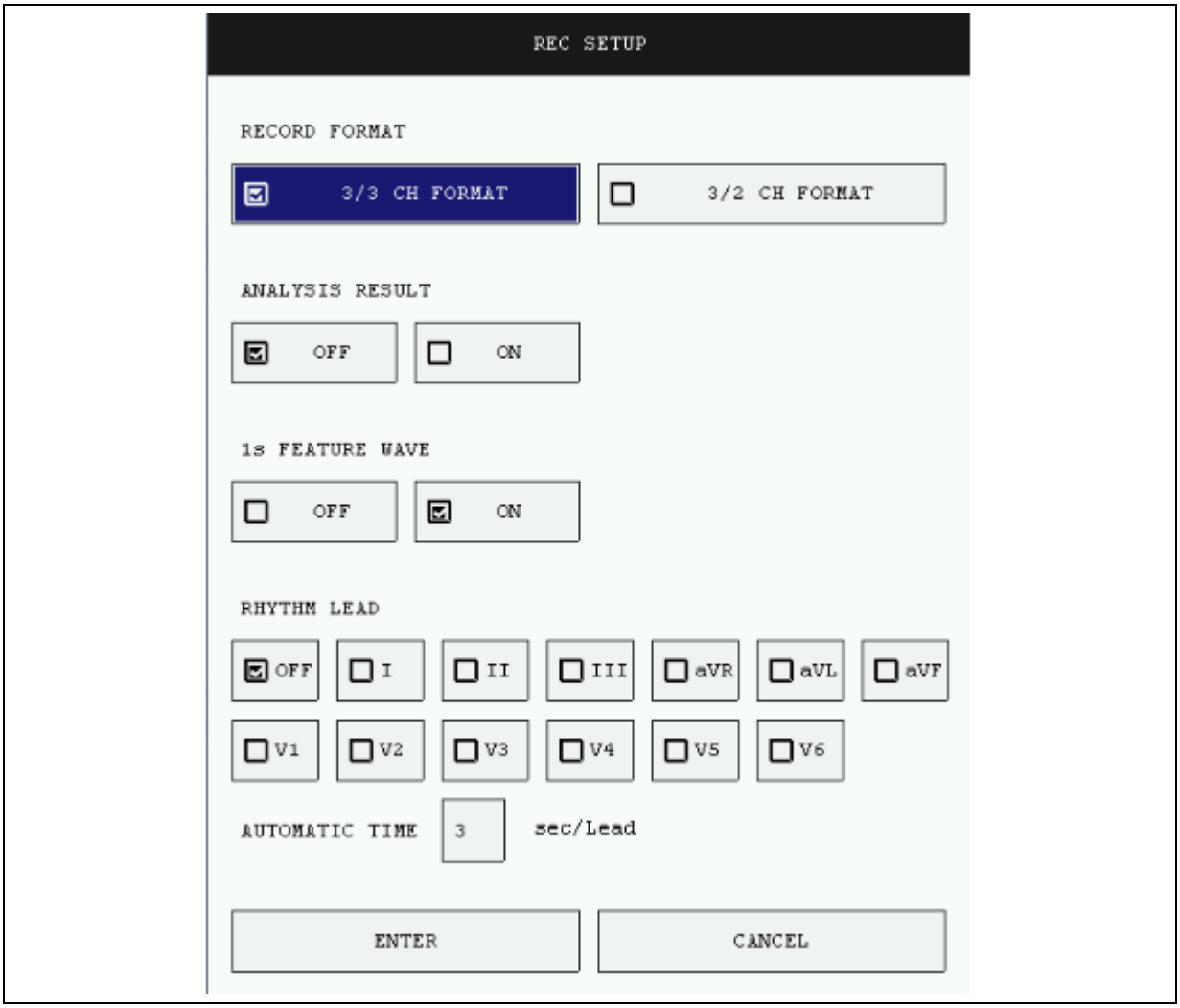


5.2.6 System setup

Press “System setup”, beat vol, language, server IP and local IP can be setup.

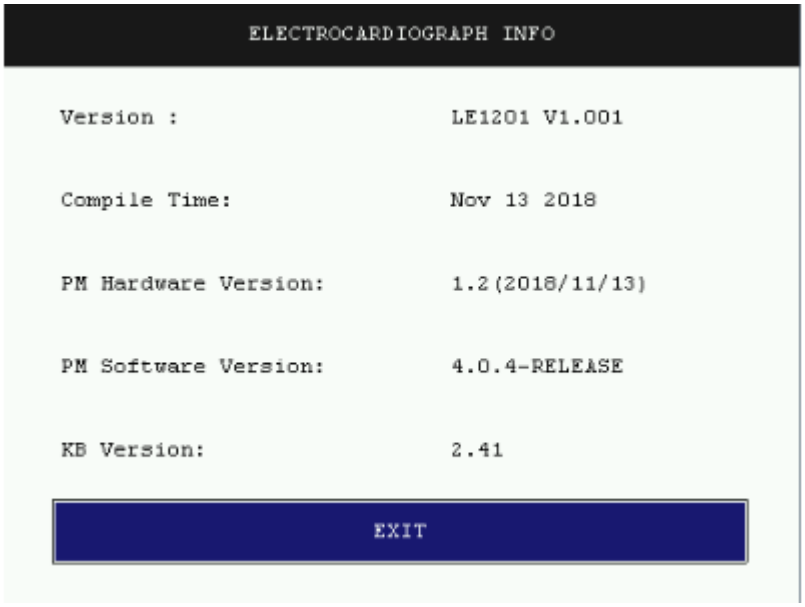
5.2.7 Printer setup

Press “Printer setup”, auto REC format, analysis result, avg wave, rhythm lead can be setup.



5.2.8 Version

Press “Version” can check the ECG info.



5.2.9 Load default

Press “Load default” can restore the factory settings.

6. Daily maintenance

6.1 Battery charging, capacity indicator and replacement

ECG device is built in rechargeable battery to realize AC/DC operation. The illustration on charging, indicating capacity and replacement are as follows:

- Charging battery

  ECG device is designed with a charger and protector for the rechargeable battery. It is required to charge & discharge the battery at least every 3 months, and device is in spare condition. Charging indicator will blink while charging, and keep in light when charging is completed.

- Capacity indicator

  Whenever the machine is powered by DC battery, there will be a prompt, in the middle of first line on the LCD screen, to indicate battery capacity as follows.

 Sufficient battery capacity

 Insufficient battery capacity, charging is required.

 Battery capacity is running out, immediate charging is demanded.

- Battery replacement

  Battery replacement shall be carried out by a service engineer as follows.

  a. Power switches off and disconnects power cable.

  b. According to the bottom figure of device, open the cover of battery cabinet.

  c. Pull out the plug of battery and remove the damaged battery.

  d. Replace the battery with a new one and plug in the battery socket to connect well.

  e. Reassemble the instrument.

Notice:

- Don’t connect directly anode and cathode of the battery with lead otherwise may cause fire hazard.
- Don’t put battery near to open fire, otherwise may cause explosion hazard.
- Don’t disassemble battery without allowance.
- Please take and put battery gently, don’t fall it to the ground or strike on other items.

6.2 Recording paper

For the sake of recording quality of ECG trace, please use the recommended or provided thermal paper. If purchase other thermal paper, maybe shorten the life time of thermal lattice printing head, cause recording trace to blur, or bad paper running.

Please do notice!

a. Avoid use of grayish and blackish paper or with wax; otherwise may cause printer head damaged.

b. High temperature, high humidity and direct sunshine will cause paper color to change. Please keep the paper in a dry and cool place;

c. Do not expose the paper in fluorescent light for a long time, otherwise will have influence on recording quality.

d. Do not store the paper with PVC to avoid color change;

e. Do not pile up the recorded paper for a long time to avoid waveform transfer.

f. Please pay highly attention to the specification of recording paper. The thermal lattice printing head or the silicon-rubber axis will damage by the wrong paper.

6.3 Maintenance Following Operation

After using ECG device, please notice:

a. Turn key “ON/OFF” to power off the control panel before turning off the power switch.

b. While pulling out the leads and power cable, please grasp the plug to pull out, don’t grasp the cable.

c. Clean the machine as well as accessories and cover the instrument with a shade.

d. Place the device in a dry and shading environment. Vibration in the process of transportation should be avoided.

e. Don’t immerse the device into cleaner while cleaning the device, please cut off power supply while cleaning the shell of device. Please use neutral solvent to clean which doesn’t contain alcohol or bactericide.

6.4 Patient cable maintenance

- Check the patient cable continuity with a multi-meter. The resistance should be less than 10 ohms.

  Following table is the continuity of the patient cable.

Electrode	R	L	F	RF	C1	C2	C3	C4	C5	C6
Patient Lead	9	10	11	14	12	1	2	3	4	5

  Please periodic inspecting patient cable to keep it well, any piece of the cable is damaged will occur corresponding or all lead to appear false wave. Patient cable can be cleaned with water or soap, or disinfected by 75% alcohol. (Don’t immerse patient cable into the liquid).

- Curve or tie patient cable will shorten its life time, please make it in line and then connect with electrodes.
- All the electrodes should be kept well, after being used for a long time, the surface of electrodes will be oxidized to effect on recording the trace, and please renew electrodes.

6.5 Silicon rubber axis maintenance

Silicon rubber axis should be kept smooth and clean, otherwise will have an influence on the effect of ECG record. Please use clean and soft cotton with few alcohols to clean the smear on the silicon rubber axis along portrait, and rotate to the direction of conveying the recording paper until make it clean.

6.6 Thermal Printer Maintenance

Residue and dirt on the thermal printer could affect the clarity of printing out ECG trace.

To clean the thermal printer, you are required to open the paper magazine and clean the printer with cotton dipped with alcohol. It is not permitted to operate on the printer with a sharp object. Otherwise, permanent damage could be resulted. After the alcohol is volatilized completely, close the cabinet. Thermal printer maintenance should be done at least once a month.

6.7 Fuse Replacement

Switch on AC power, turn on the power switch on the right device, the power indicator doesn't light up and press the ON/OFF button on the control panel but cann't realize boot-strap or the signal of battery is showed like"▬"after boot-strap . This may be caused by a burnt fuse.

- Disconnect the power cable.,switch off the power .
- Discover the fuse holder with a screw-driver.
- Take out the damaged or burned fuse.
- Install a new fuse before recovering the fuse holder as shown in the following figure.

Notification

If a newly replaced fuse is burnt again, please power off the device and contact our service department or appointed maintenance center.

⚠Attention

Don't use undefined fuse.

Specification of fuse：AC220V±10% 2*Φ5×20mm,T2A/250V AC time lag
AC110V±10% 2*Φ5×20mm,T4A/125V AC time

⚠Danger

Please ensure to pull out power cable and then replace fuse.

7. Troubleshooting and solution

7.1 Some lead without waveform

- When the cables are connected well with the patient, the device usually needs several seconds to get ready.Press RESET and start recording after 2~3 seconds to solve the problem.
- Patient cabel is at fault.checking the patient cable according to 5.4,if patient cable breaks down,please connect with our after-sale department or appointed maitenance center.
- Excluded the above cause,the device still exist problem,normally it is resulted from the problem of signal channel, please connect with our after-sale department or appointed maitenance center.

7.2 Vertical broken track of printed waveform

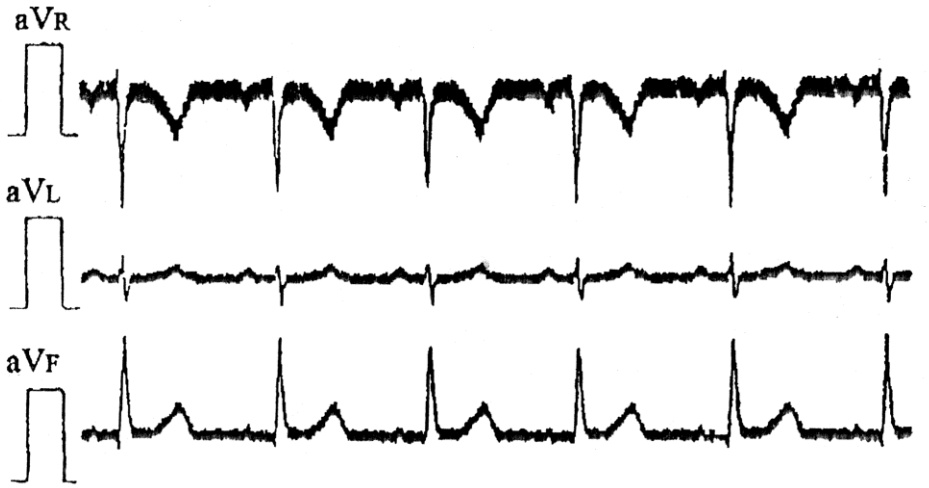
Whenever a printer fault occurs, which manifests itself as not continuous trace on the recording paper; you are required to clean the thermal printer with soft cotton with alcohol. If this action does not work, certain thermal emitting component is probable damaged, and you are required to contact the manufacturer or the local agent for help.

7.3 Control Panel Failure

Control panel failure is probably caused by bad continuity between the panel and the Keyboard Control Module due to transportation or vibration. If a reconnection of the control panel to the Keyboard Control Module does not work, you are required to contact a service engineer.

7.4 AC Interference

In the process of recording ECG trace,there are some interference and apparent wobble of baseline as follows:



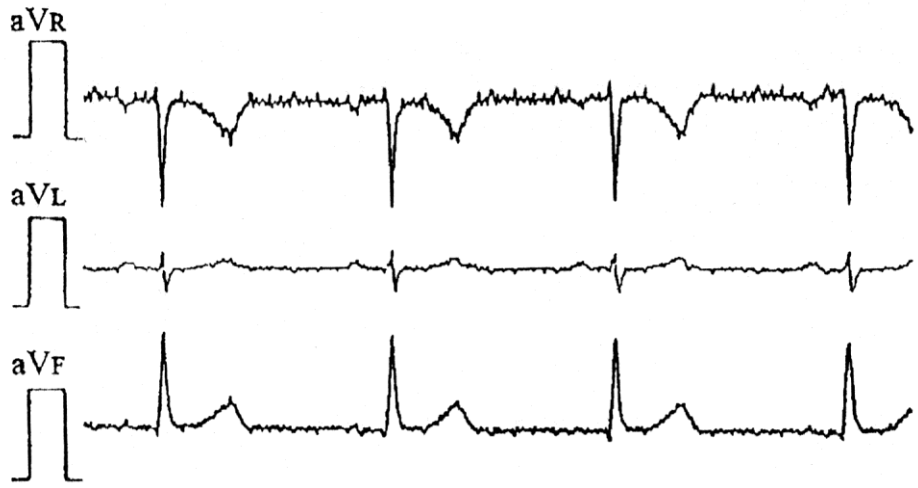
Please check the following:

1. Make sure that the unit is properly grounded according to instructions.
2. Check for good electrode attachment and patient cable connection.
3. Check the cleaning of electrode and patient body surface.
4. Make sure that the exam bed is properly grounded.
5. The patient shall not be in touch with the metal parts of the exam bed.
6. The patient shall not be in touch with anybody else.
7. There shall be no large power electric equipment working nearby.
8. The patient shall put off such things as ring and the like.

Please use AC filter if still exists above-mentioned interference.

7.5 EMG interference

EMG interference may cause irregular wobble of waveform.



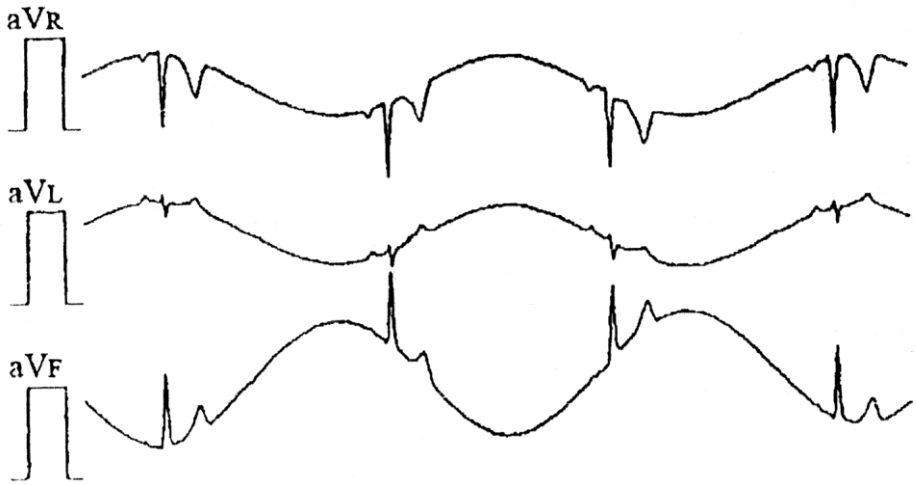
Please check the following:

- Make sure that the exam room is comfortable for examination.
- Soothe the patient from irritation or excitement.
- Make sure the exam bed shall be in suitable size.
- Never have talks with the patient during ECG trace is recorded.

Please apply EMG filter if still exists above-mentioned interference. The waveform will be weakened a little more, which will decline obviously on R wave.

7.6 Baseline drift

There is irregular movement on the baseline of wave, shown as below:



Check the following:

- Verify the electrode attachment and lead wire performance.
- Check the connection between patient cable and electrodes.
- Check the cleaning of electrode and patient body surface.
- Is there enough ECG cream on skin and electrodes?
- Keep the patient from motion or hyperventilation.

- Old electrodes and new ones mixed up

If still exists, Please contact with our service department or appointed maitenance center.

8. Specifications

Main technical specification

Items	specification
Lead	standard 12 leads
lead acquisition	synchronously 12 leads
Input circuit	Floating; Protection circuit against Defibrillator effect
Input Impedance	≥50MΩ
Input circuit current	≤0.0.05μA
Record mode	Automatic: 3CH×4+1R, 3CH×4, 3CHx2+2CHx3,3CHx2+2CHx3+1R,6CHX2; Manual: 3CH, 2CH, 3CH+1R, 2CH+1R; Rhythm: Any lead selectable.
Filter	EMG Filter: 25 Hz / 30 Hz / 40Hz/75 Hz / 100 Hz / 150Hz DFT Filter: 0.05 Hz/ 0.15 Hz AC Filter: 50 Hz / 60Hz
CMRR	>100dB
Patient current leakage	＜10μA
Input Circuit Current	＜0.05μA
Frequency Response	0.05Hz~150Hz (-3dB)
Sensitivity	2.5mm/mV, 5 mm/mV, 10 mm/mV, 20 mm/mV
Anti-baseline Drift	Automatic
Time constant	≥3.2s
Noise level	＜15μV_{p-p}
Paper speed	12.5 mm/s, 25 mm/s, 50 mm/s
Recording mode	Thermal printing system
Paper specification	80mmx20m paper roll
LCD display	7” graphic LCD
Safety classification	IEC60601-1 class I, type CF
Power supply	AC: 100~240V, 50/60Hz, 30VA~100VA
	DC: 14.8V/2200mAh, built-in lithium battery
Fuse	AC220V±10%　2*Φ5×20mm,T2A/250V　AC time lag

	AC110V±10%　2*Φ5×20mm,T4A/250V　AC time lag

Environment requirement

Storage

Temperature	-10℃～+40℃
Humidity	30％～80％
Pressure	700hPa~1060hPa

Operation

Temperature	+5℃~+40℃
Humidity	25％～95％
Pressure	860hPa~1060hPa

EXT & CRO (if required)

EXT

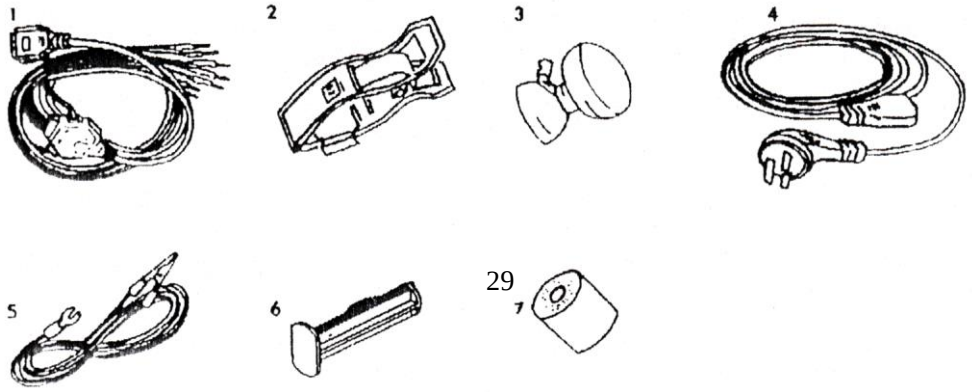
Input impendence	> 100kΩ
Sensitivity	10mm/V (±5%)

CRO

Output impendence	≤100Ω
Sensitivity	1V/mV (±5%)

9. Accessory List

In order to obtain a good ECG trace, you are required to use the accompanying accessories of this unit. Following is the demonstration of the standard accessories for the unit.



Item	Description	Quantity
1	Patient Cable	1
2	Limb Electrode	4pcs/set
3	Chest Electrode	6pcs/set
4	Three plugged power cable	1
5	Grounding Cable	1
6	Paper Shaft	1
7	Thermal Recording Paper	1

Responsibility of Manufacturer

Advance Medical Technology Co.,Ltd only takes the responsibility on reliability and security of the device under the below conditions:

1. **The device is assembled and maintained by the service engineer which is appointed by Advance Medical Technology Co.,Ltd.**
2. **The device is strictly operated according to user manual.**

Appendix A

The Minnesota Code Classification System for Electrocardiographic Findings Q and QS Patterns
(Do not code in the presence of WPW code 6-4-1.) To qualify as a Q- or QS-wave, the deflection should be at least 0.1 mV (1 mm in amplitude).

Anterolateral site (leads I, aVL, V6)

1-1-1 Q/R amplitude ratio ≥ 1/3, plus Q duration ≥ 0.03 sec in lead I or V6.
1-1-2 Q duration ≥ 0.04 sec in lead I or V6.
1-1-3 Q duration ≥ 0.04 sec, plus R amplitude ≥ 3 mm in lead aVL.
1-2-1 Q/R amplitude ratio ≥ 1/3, plus Q duration ≥ 0.02 sec and < 0.03 sec in lead I or V6.
1-2-2 Q duration ≥ 0.03 sec and < 0.04 sec in lead I or V6.
1-2-3 QS pattern in lead I. Do not code in the presence of 7-1-1.
1-2-8 Initial R amplitude decreasing to 2 mm or less in every beat (and absence of codes 3-2, 7-1-1, 7-2-1, or 7-3 between V5 and V6. (All beats in lead V5 must have an initial R > 2 mm.)
1-3-1 Q/R amplitude ratio ≥ 1/5 and < 1/3, plus Q duration ≥ 0.02 sec and < 0.03 secin lead I or V6.
1-3-3 Q duration ≥ 0.03 sec and < 0.04 sec, plus R amplitude ≥ 3 mm in lead aVL.

Posterior (inferior) site (leads II, III, aVF)

1-1-1 Q/R amplitude ratio ≥ 1/3, plus Q duration ≥ 0.03 sec in lead II.
1-1-2 Q duration ≥ 0.04 sec in lead II.
1-1-4 Q duration ≥ 0.05 sec in lead III, plus a Q-wave amplitude ≥ 1.0 mm in the majority of beats in lead aVF.
1-1-5 Q duration ≥ 0.05 sec in lead aVF.
1-2-1 Q/R amplitude ratio ≥ 1/3, plus Q duration ≥ 0.02 sec and < 0.03 sec in lead II.
1-2-2 Q duration ≥ 0.03 sec and < 0.04 sec in lead II.
1-2-3 QS pattern in lead II. Do not code in the presence of 7-1-1.
1-2-4 Q duration ≥ 0.04 sec and < 0.05 sec in lead III, plus a Q-wave ≥ 1.0 mm amplitude in the majority of beats in aVF.
1-2-5 Q duration ≥ 0.04 sec and < 0.05 sec in lead aVF.
1-2-6 Q amplitude ≥ 5.0 mm in leads III or aVF.
1-3-1 Q/R amplitude ratio ≥ 1/5 and < 1/3, plus Q duration ≥ 0.02 sec and < 0.03 sec in lead II.
1-3-4 Q duration ≥ 0.03 sec and < 0.04 sec in lead III, plus a Q-wave ≥ 1.0 mm amplitude in the majority of beats in lead aVF.
1-3-5 Q duration ≥ 0.03 sec and < 0.04 sec in lead aVF.
1-3-6 QS pattern in each of leads III and aVF. (Do not code in the presence of 7-1-1.)

Anterior site (leads V1, V2, V3, V4, V5) 1 2 3 4 5

1-1-1 Q/R amplitude ratio ≥ 1/3 plus Q duration ≥ 0.03 sec in any of leads V2, V3, V4, V5.
1-1-2 Q duration ≥ 0.04 sec in any of leads V1, V2, V3, V4, V5.
1-1-6 QS pattern when initial R-wave is present in adjacent lead to the right on the chest, in any of leads V2, V3,V4,V5, V6.
1-1-7 QS pattern in all of leads V1-V4 or V1-V5.
1-2-1 Q/R amplitude ratio ≥ 1/3, plus Q duration ≥ 0.02 sec and < 0.03 sec, in any of leads V2, V3, V4, V5.
1-2-2 Q duration ≥ 0.03 sec and < 0.04 sec in any of leads V2, V3, V4, V5.
1-2-7 QS pattern in all of leads V1, V2, and V3. (Do not code in the presence of 7-1-1).
1-2-8 Initial R amplitude decreasing to 2.0 mm or less in every beat (and absence of codes 3-2, 7-1-1,

7-2-1, or 7-3)between any of leads V2 and V3, V3 and V4, or V4 and V5. (All beats in the lead immediately to the right on the chest must have an initial R > 2 mm.)

1-3-1 Q/R amplitude ratio ≥ 1/5 and < 1/3 plus Q duration ≥ 0.02 and < 0.03 sec in any of leads V2, V3, V4, V5.

1-3-2 QS pattern in lead V1 and V2. (Do not code in the presence of 3-1 or 7-1-1.)

QRS Axis Deviation(Do not code in presence of low-voltage QRS, code 9-1, WPW 6-4-1, ventricular conduction defects, or 7-1-1, 7-2-1, and7-4.)

2-1 Left.QRS axis from -300 through -900 in leads I, II, III. (The algebraic sum of major positive and major negative QRS waves must be zero or positive in I, negative in III, and zero or negative in II.)

2-2 Right. QRS axis from +1200 through -1500 in leads I, II, III. (The algebraic sum of major positive and major negative QRS waves must be negative in I, and zero or positive in III, and in I must be one-half or more of that in III.)

2-3 Right (optional code when 2-2 is not present). QRS axis from +900 through +1190 in leads I, II, III. (The algebraic sum of major positive and major negative QRS waves must be zero or negative in I and positive in II and III.)

2-4 Extreme axis deviation (usually S1, S2, S3 pattern). QRS axis from -900 through -1490 in leads I, II, and III(The algebraic sum of major positive and major negative QRS waves must be negative in each of leads I, II, andIII.)

2-5 Indeterminate axis QRS axis approximately 900 from the frontal plane. (The algebraic sum of major positive and major negative QRS waves is zero in each of leads I, II and III, or the information from these three leads is incongruous.)

High Amplitude R Waves

3-1 Left: R amplitude > 26 mm in either V5 or V6, or R amplitude > 20.0 mm in any of leads I, II, III, aVF, or Ramplitude > 12.0 mm in lead aVL. (All criteria measured only on second to last complete normal beat.)

3-2 Right: R amplitude ≥ 5.0 mm and R amplitude ≥ S amplitude in the majority of beats in lead V1, when Samplitude is > R amplitude somewhere to the left on the chest of V1 (codes 7-3 and 3-2, if criteria for both arepresent).

3-3 Left (optional code when 3-1 is not present): R amplitude > 15.0 mm but ≤ 20.0 mm in lead I, or R amplitude in V5 or V6, plus S amplitude in V1 > 35.0 mm. (Measured only on second to last complete normal beat.)

3-4 Criteria for 3-1 and 3-2 both present.ST Junction (J) and Segment Depression

ST Junction (J) and Segment Depression

(Do not code in the presence of codes 6-4-1, 7-1-1, 7-2-1 or 7-4. When 4-1, 4-2, or 4-3 is coded, then a 5-code must also be assigned except in lead V1.)

Anterolateral site (leads I, aVL, V6)

4-1-1 STJ depression ≥ 2.0 mm and ST segment horizontal or downward sloping in any of leads I, aVL, or V6.

4-1-2 STJ depression ≥ 1.0 mm but < 2.0 mm, and ST segment horizontal or downward sloping in any of leads I,aVL, or V6.

4-2 STJ depression ≥ 0.5 mm and < 1.0 mm and ST segment horizontal or downward sloping in any of leads I,aVL, or V6.

4-3 No STJ depression as much as 0.5 mm but ST segment downward sloping and segment or

T-wave nadir ≥ 0.5mm below P-R baseline, in any of leads I, aVL, or V6.

4-4 STJ depression ≥ 1.0 mm and ST segment upward sloping or U-shaped, in any of leads I, aVL, or V6.

Posterior (inferior) site (leads II, III, aVF)

4-1-1 STJ depression ≥ 2.0 mm and ST segment horizontal or downward sloping in lead II or aVF.

4-1-2 STJ depression ≥ 1.0 mm but < 2.0 mm and ST segment horizontal or downward sloping in lead II or aVF.

4-2 STJ depression ≥ 0.5 mm and < 1.0 mm and ST segment horizontal or downward sloping in lead II or aVF.

4-3 No STJ depression as much as 0.5 mm, but ST segment downward sloping and segment or T-wave nadir ≥0.5 mm below P-R baseline in lead II.

4-4 STJ depression ≥ 1.0 mm and ST segment upward sloping, or U-shaped, in lead II.

ST Junction (J) and Segment Depression (continued)

Anterior site (leads V1, V2, V3, V4, V5)

4-1-1 STJ depression ≥ 2.0 and ST segment horizontal or downward sloping in any of leads V1, V2, V3, V4, V5.

4-1-2 STJ depression ≥ 1.0 mm but < 2.0 mm and ST segment horizontal or downward sloping in any of leads V1,V2, V3, V4, V5

4-2 STJ depression ≥ 0.5 mm and < 1.0 mm and ST segment horizontal or downward sloping in any of leads V1,V2, V3, V4, V5.

4-3 No STJ depression as much as 0.5 mm, but ST segment downward sloping and segment orT-wave nadir ≥ 0.5 mm below P-R baseline in any of leads V2, V3, V4, V5.

4-4 STJ depression ≥ 1.0 mm and ST segment upward sloping or U-shaped in any of leads V1, V2, V3, V4, V5.T-Wave Items(Do not code in the presence of code 6-4-1, 7-1-1, 7-2-1 or 7-4.)

Anterolateral site (leads I, aVL, V6)

T-Wave Items

(Do not code in the presence of code 6-4-1, 7-1-1, 7-2-1 or 7-4.)

Anterolateral site (leads I, aVL, V)6

5-1 T amplitude negative 5.0 mm or more in either of leads I, V6, or in lead aVL when R amplitude is ≥ 5.0 mm.

5-2 T amplitude negative or diphasic (positive-negative or negative-positive type) with negative phase at least 1.0mm but not as deep as 5.0 mm in lead I or V6, or in lead aVL when R amplitude is ≥ 5.0 mm.

5-3 T amplitude zero (flat), or negative, or diphasic (negative-positive type only) with less than 1.0 mm negative phase in lead I or V6, or in lead aVL when R amplitude is ≥ 5.0 mm.

5-4 T amplitude positive and T/R amplitude ratio < 1/20 in any of leads I, aVL, V6; R wave amplitude must be ≥10.0 mm.

Posterior (inferior) site (leads II, III, aVF)

5-1 T amplitude negative 5.0 mm or more in lead II, or in lead aVF when QRS is mainly upright.

5-2 T amplitude negative or diphasic with negative phase (negative-positive or positive-negative type) at least 1.0mm but not as deep as 5.0 mm in lead II, or in lead aVF when QRS is mainly upright.

5-3 T amplitude zero (flat), or negative, or diphasic (negative-positive type only) with less than 1.0 mm negative phase in lead II; not coded in lead aVF.

5-4 T amplitude positive and T/R amplitude ratio < 1/20 in lead II; R wave amplitude must be ≥ 10.0 mm.

Anterior site (leads V , V , V , V) 2 3 4 5

5-1 T amplitude negative 5.0 mm or more in any of leads V2, V3, V4, V5.

5-2 T amplitude negative (flat), or diphasic (negative-positive or positive-negative type) with negative phase at least 1.0 mm but not as deep as 5.0 mm, in any of leads V2, V3, V4, V5.

5-3 T amplitude zero (flat), or negative, or diphasic (negative-positive type only) with less than 1.0 mm negative phase, in any of leads V3, V4, V5.

5-4 T amplitude positive and T/R amplitude ratio < 1/20 in any of leads V3, V4, V5; R wave amplitude must be ≥10.0 mm.A-V Conduction Defect

A-V Conduction Defect

6-1 Complete (third degree) A-V block (permanent or intermittent) in any lead. Atrial and ventricular complexes independent, and atrial rate faster than ventricular rate, with ventricular rate < 60.

6-2-1 Mobitz Type II (occurrence of P-wave on time with dropped QRS and T).

6-2-2 Partial (second degree) A-V block in any lead (2:1 or 3:1 block).

6-2-3 Wenckebach's Phenomenon (P-R interval increasing from beat to beat until QRS and T dropped).

6-3 P-R (P-Q) interval ≥ 0.22 sec in the majority of beats in any of leads I, II, III, aVL, aVF.

6-4-1 Wolff-Parkinson-White Pattern (WPW), persistent. Sinus P-wave. P-R interval < 0.12 sec, plus QRS duration ≥0.12 sec, plus R peak duration ≥ 0.06 sec, coexisting in the same beat and present in the majority of beats in any of leads I, II, aVL, V4, V5, V6. (6-4-1 suppresses 1-2-3, 1-2-7, 1-2-8, 1-3-2, 1-3-6, all 3, 4, 5, 9-2, 9-4, 9-5codes.)

6-4-2 WPW Pattern, intermittent. WPW pattern in ≤ 50% of beats in appropriate leads.

6-5 Short P-R interval. P-R interval < 0.12 sec in all beats of any two of leads I, II, III,aVL, aVF.

6-6 Intermittent aberrant atrioventricular conduction. P-R > 0.12 sec (except in presence of 6-5 or heart rate greater than 100); wide QRS complex > 0.12 sec; normal P-wave when most beats are sinus rhythm. (Do not code in the presence of 6-4-2.)

6-7 Artificial pacemaker.

Ventricular Conduction Defect

7-1-1 Complete left bundle branch block (LBBB). (Do not code in presence of 6-1, 6-4-1, 6-8, 8-2-1 or 8-2-2.) QRS duration ≥ 0.12 sec in a majority of beats in any of leads I, II, III, aVL, aVF, plus R peak duration ≥ 0.06 sec in amajority of beats (of the same QRS pattern) in any of leads I, II, aVL, V5, V6. (7-1-1 suppresses 1-2-3, 1-2-7, 1-2-8, 1-3-2, 1-3-6, all 2, 3, 4, 5, 9-2, 9-4, 9-5 codes. If any other codable Q-wave coexists with the LBBB pattern,code the Q and diminish the 7-1-1 code to a 7-4 code.)

7-1-2 Intermittent left bundle branch block. Same as 7-1-1 but with presence of normally conducted QRS complexes of different shape than the LBBB pattern.

7-2-1 Complete right bundle branch block (RBBB). (Do not code in the presence of 6-1, 6-4-1, 6-8, 8-2-1 or 8-2-2.)QRS duration ≥ 0.12 sec in a majority of beats in any of leads I, II, III, aVL, aVF, plus: R' > R in V1 or V2;or QRS mainly upright, with R peak duration ≥ 0.06 sec in V1 or V2; or S duration >R duration in all beats in lead I or II. (7-1 suppresses 1-2-3, 1-2-7, 1-2-8, 1-3-2, 1-3-6, all 2, 3, 4, 5, 9-2, 9-4, 9-5 codes.

7-2-2 Intermittent right bundle branch block. Same as 7-2-1 but with presence of normally conducted QRS complexes of different shape than the RBBB pattern.

7-3 Incomplete right bundle branch block. QRS duration < 0.12 sec in each of leads I, II, III, aVL, aVF, and R' > R in either of leads V1, V2 .(Code as 3-2 in addition if those criteria are met. 7-3 suppresses code 1-2-8.)

7-4 Intraventricular block. QRS duration ≥ 0.12 sec in a majority of beats in any of leads I, II, III, aVL, aVF. (7-4 suppresses all 2, 3, 4, 5, 9-2, 9-4, 9-5 codes.)

7-5 R-R' pattern in either of leads V1, V2 with R' amplitude ≥ R.

7-6 Incomplete left bundle branch block. (Do not code in the presence of any codable Q- or QS-wave.) QRS duration≥ 0.10 sec and < 0.12 in the majority of beats of each of leads I, aVL, and V5 or V6.5 6

7-7 Left anterior hemiblock (LAH). QRS duration < 0.12 sec in the majority of beats in leads I, II, III, aVL, aVF, plus Q-wave amplitude ≥ 0.25 mm and < 0.03 sec duration in lead I, plus left axis deviation of -450 or more negative.(In presence of 7-2, code 7-8 if axis is < -450 and the Q-wave in lead I meets the above criteria.)

7-8 Combination of 7-7 and 7-2.

Arrhythmias

8-1-1 Presence of frequent atrial or junctional premature beats (10% or more of recorded complexes).

8-1-2 Presence of frequent ventricular premature beats (10% or more of record complexes).

8-1-3 Presence of both atrial and/or junctional premature beats and ventricular premature beats (so that individual frequencies are < 10% but combined premature beats are ≥ 10% of complexes).

8-1-4 Wandering atrial pacemaker.

8-1-5 Presence of 8-1-2 and 8-1-4.

8-2-1 Ventricular fibrillation or ventricular asystole.

8-2-2 Persistent ventricular (idioventricular) rhythm.

8-2-3 Intermittent ventricular tachycardia. Three or more consecutive ventricular premature beats occurring at a rate≥100. This includes more persistent ventricular tachycardia.

8-2-4 Ventricular parasystole (should not be coded in presence of 8-3-1).

8-3-1 Atrial fibrillation (persistent).

8-3-2 Atrial flutter (persistent).

8-3-3 Intermittent atrial fibrillation (code if 3 or more clear-cut, consecutive sinus beats are present in any lead).

8-3-4 Intermittent atrial flutter (code of 3 or more clear-cut, consecutive sinus beats are present in any lead).

8-4-1 Supraventricular rhythm persistent. QRS duration < 0.12 sec; and absent P-waves or presence of abnormal P-waves (inverted or flat in aVF); and regular rhythm.

8-4-2 Supraventricular tachycardia intermittent. Three consecutive atrial or junctional premature beats occurring at arate ≥ 100.

8-5-1 Sinoatrial arrest. Unexpected absence of P, QRS and T, plus a R-R interval at a fixed multiple of he normal interval, + 10%.

8-5-2 Sinoatrial block. Unexpected absence of P, QRS and T, preceded by progressive shortening of P-P intervals. (R-R interval at a fixed multiple of the normal interval, + 10%.

8-6-1 A-V dissociation with ventricular pacemaker (without capture). Requires: P-P and R-R occur at variable rates with ventricular rate as fast as or faster than the atrial rate, plus variable P-R intervals, plus no capture beats.

8-6-2 A-V dissociation with ventricular pacemaker (with capture).

8-6-3 A-V dissociation with atrial pacemaker (without capture).

8-6-4 A-V dissociation with atrial pacemaker (with capture).

8-7 Sinus tachycardia (over 100/min).

8-8 Sinus bradycardia (under 50/min).

8-9 Other arrhythmias. Heart rate may be recorded as a continuous variable.

ST Segment Elevation

Anterolateral site (leads I, aVL, V6)

9-2 ST segment elevation ≥ 1.0 mm in any of leads I, aVL, V6.

Posterior (inferior) site (leads II, III, aVF)

9-2 ST segment elevation ≥ 1.0 mm in any of leads II, III, aVF.

Anterior site (leads V 1, V2 , V3 , V4 , V5)

9-2 ST segment elevation ≥ 1.0 mm in lead V5 or ST segment elevation ≥ 2.0 mm in any of leads V1, V2, V3, V4.

Miscellaneous Items

9-1 Low QRS amplitude. QRS peak-to-peak amplitude < 5 mm in all beats in each of leads I, II, III, or < 10 mm in all beats in each of leads V1, V2, V3, V4, V5, V6. (Check calibration before coding.)

9-3 P-wave amplitude ≥ 2.5 mm in any of leads II, III, aVF, in a majority of beats.

9-4-1 QRS transition zone at V3 or to the right of V3 on the chest. (Do not code in the presence of 6-4-1, 7-1-1, 7-2-1 or 7-4.)

9-4-2 QRS transition zone at V4 or to the left of V4 on the chest. (Do not code in the presence of 6-4-1, 7-1-1, 7-2-1 or 7-4.)

9-5 T-wave amplitude > 12 mm in any of leads I, II, III, aVL, aVF, V1, V2, V3, V4, V5, V6. (Do not code in the presence of 6-4-1, 7-1-1, 7-2-1 or 7-4.)

9-8-1 Technical problems which interfere with coding.

9-8-2 Technical problems which do not interfere with coding.

Incompatible Codes

The codes in the left column suppress codes in the right column.

Code	**Suppress this code(s)**
All Q-, QS-codes	7-6
Q > 0.03 in lead I	7-7
3-1	1-3-2
3-2	1-2-8, 7-3
6-1	All other codes except 8-2
6-4-1	All other codes
6-8	All other codes
7-1-1	1-2-3, 1-2-7, 1-2-8, 1-3-2, 1-3-6, all 2-, 3-, 4-, and 5- codes, 7-7, 9-2, 9-4, 9-5
7-2-1	1-2-8, all 2-, 3-, 4-, and 5-codes, 9-2, 9-4, 9-5
7-3	1-2-8
7-4	All 2-, 3-, 4-, and 5-codes, 9-2, 9-4, 9-5
8-1-2	8-2-4
8-1-4	8-1-1, 9-3
8-2-1	All other codes
8-2-2	All other codes
8-2-3	8-1-2

8-3-1	8-1-1, 8-1-2
8-3-2	6-2-2, 8-1-1, 8-1-2
8-3-3	8-1-1, 8-1-2
8-3-4	6-2-2
8-4-1	6-5
8-4-1 + heart rate≧140	All other codes except 7-4 or 6-2
Heart rate > 100	6-5
8-4-2	8-1-1
9-1	All 2-codes

Categories of Minnesota ECG Abnormalities

Diagnostic ECG:

(any ECG may be used for this classification)

D1. An ECG record with any Diagnostic Q-code (Minn. code 1-1-1 through 1-2-5 plus 1-2-7).

D2. An ECG record with ST-segment elevation code 9-2 PLUS (T-wave inversion code 5-1 or 5-2 in the absence of 7-2-1 or 7-4).

Equivocal ECG:

(any ECG may be used for this classification)

E1. An ECG record with an Equivocal Q-code [(Minn. code 1-2-8 in the absence of a 7-1-1 or 7-3 or (any 1-3-code)].

E2. An ECG record with ST-segment depression (code 4-1-x or 4-2 or 4-3 in the absence of 7-2-1 or 7-4), or 1-3-x.

E3. An ECG record with T-wave inversion (code 5-1 or 5-2 or 5-3 in the absence of 7-2-1 or 7-4).

E4. An ECG record with ST-segment elevation code 9-2.

Other ECG:

01. Reference ECG coded 7-1-1.

02. Any ECG coded 7-1-1.

03. Normal ECG(s), defined as 1 in “clear” field of all ECGs.

04. Other findings including 1-2-6.

Uncodable ECG:

U1. Technical errors coded 9-8-1 by Minnesota Code.

Absent ECG:

A1. No ECG available for coding.

Prineas R, Crow R, Blackburn H. The Minnesota Code Manual of Electrocardiographic Findings. John Wright-PSG, Inc. Littleton, MA, June 1982.

Appendix B

Diagnosis Code Table

Code	Item
SR	Sinus Rhythm
SR-1	Sinus Arrhythmia
SR-2	Sinus Tachycardia
SR-3	Sinus Bradycardia
SR-0	Sinus Rhythm
ER	Ectopic rhythm(refer to M-code-8)
AE	Atrial Enlargement
LAE-1	Left Atrial Enlargement
LAE-2	Possibly Left Atrial Enlargement
RAE-1	Right Atrial Enlargement
RAE-2	Possibly Right Atrial Enlargement
BAE-1	Biatrial Enlargement
BAE-2	Possibly Biatrial Enlargement
PA	P-wave Axis Abnormality
PA-1	Probably Leads Reversed
PA-2	Probably Dextrocardia
AD	Axis Deviation
LAD-1	Mild Left Axis Deviation
LAD-2	Marked Left Axis Deviation
RAD-1	Mild Right Axis Deviation
RAD-2	Right Axis Deviation
RAD-3	Marked Right Axis Deviation
AD?	Indeterminate Axis
S1S2S3	S1-S2-S3 Pattern
LOWV	Low Voltage
LOWV-1	Low Voltage(Limb Leads)
LOWV-2	Low Voltage(Chest Leads)
LOWV-3	Low Voltage(All Leads)
VH	Ventricular Hypertrophy

RVH -1	Right Ventricular Hypertrophy
RVH-2	Possibly Right Ventricular Hypertrophy
LVH-1	Left Ventricular High Voltage
LVH-2	Left Ventricular Hypertrophy
LVH-3	Possibly Left Ventricular Hypertrophy
BVH-1	Biventricular Hypertrophy
BVH-2	Possibly Biventricular Hypertrophy
W	Pre-exciting Syndrome
S-PR	Shortened PR Internal
W-1	W-P-W Syndrome(Type A)
W-2	W-P-W Syndrome(Type B)
W-3	W-P-W Syndrome
AVB	A-V Block
AVB-1	A-V Block(Type I)
AVB-2-1	A-V Block(Type II)(Mobitz)
AVB-2-2	A-V Block(Type II)(Wenckbach)
AVB-3	A-V Block(Type III)
LBBB	Left Bundle Branch Block
LBBB-1	Complete Left Bundle Branch Block
LBBB-2	Incomplete Left Bundle Branch Block
RBBB	Right Bundle Branch Block
RBBB-1	Complete Right Bundle Branch Block
RBBB-2	Incomplete Right Bundle Branch Block
AFB	Left Anterior Fascicular Block
PFB	Left Posterior Fascicular Block
RSR’	RSR’(QR) Pattern InV1/V2, Right Ventricular Conduction Delay
MI	Myocardial Infarction
AMI-1	Can’t Exclude Anterior Myocardial Infarction
AMI-2	Anterior Myocardial Infarction
AMI-3	Possibly Anterior Myocardial Infarction
SMI-1	Can’t Exclude Septal Myocardial Infarction
SMI-2	Septal Myocardial Infarction
SMI-3	Possibly Septal Myocardial Infarction
ASMI-1	Can’t Exclude Anteroseptal Myocardial Infarction
ASMI-2	Anteroseptal Myocardial Infarction
ASMI-3	Possibly Anteroseptal Myocardial Infarction
ALMI-1	Can’t Exclude Anterior-Lateral Myocardial Infarction

ALMI-2	Anterior-Lateral Myocardial Infarction
ALMI-3	Possibly Anterior-Lateral Myocardial Infarction
LMI-1	Can't Exclude Lateral Myocardial Infarction
LMI-2	Lateral Myocardial Infarction
LMI-3	Possibly Lateral Myocardial Infarction
EAMI-1	Can't Exclude Extensive Anterior Myocardial Infarction
EAMI-2	Extensive Anterior Myocardial Infarction
EAMI-3	Possibly Extensive Anterior Myocardial Infarction
IMI-1	Can't Exclude Inferior Myocardial Infarction
IMI-2	Inferior Myocardial Infarction
IMI-3	Possibly Inferior Myocardial Infarction
PMI-1	Can't Exclude Posterior Myocardial Infarction
PMI-2	Posterior Myocardial Infarction
PMI-3	Possibly Posterior Myocardial Infarction
-	MI Age
-A	Acute
-B	Subacute
-C	Obsolete
-?	Undetermined
STE	ST Elevation
STE-1	ST Elevation (Consider Early Repolarization, Injury or Acute Pericarditis)
STE-2	ST Elevation (Consider Early Repolarization)
STE-3	Early Repolarization
STE-4	ST Elevation (Consider Acute Pericarditis)
STE-5	Acute Pericarditis
STE-?	ST Elevation(Nonspecific)
STD	ST Depression
STD-1	ST Depression(Possibly Subendocardial Injury, Anterior)
STD-2	ST Depression(Possibly Subendocardial Injury, Septal)
STD-3	ST Depression(Possibly Subendocardial Injury, Anterior-Septal)
STD-4	ST Depression(Possibly Subendocardial Injury, Lateral)
STD-5	ST Depression(Possibly Subendocardial Injury, Anterior-Lateral)
STD-6	ST Depression(Possibly Subendocardial Injury, Inferior)
STD-?	ST Depression (Nonspecific)
T	Myocardial Ischemia
T-1	T-wave Abnormality, Possibly Myocardial Ischemia(Anterior)

T-2	T-wave Abnormality, Possibly Myocardial Ischemia(Lateral)
T-3	T-wave Abnormality, Possibly Myocardial Ischemia(Anterior-Lateral)
T-4	T-wave Abnormality, Possibly Myocardial Ischemia(Inferior)
T-5	High T-wave, Possibly Hyperkalemia
T-?	T-wave Abnormality(Nonspecific)
ST-T	ST-T Abnormality
ST-T-1	Abnormal QRS-T Angle
ST-T-2	ST-T Abnormality, Probably Digitalis Effect
ST-T-3	Digitalis Effect
ST-T-?	ST-T Abnormality(Nonspecific)
QT	QT Interval Abnormality
QT-1	Shortened QT
QT-2	Prolonged QT