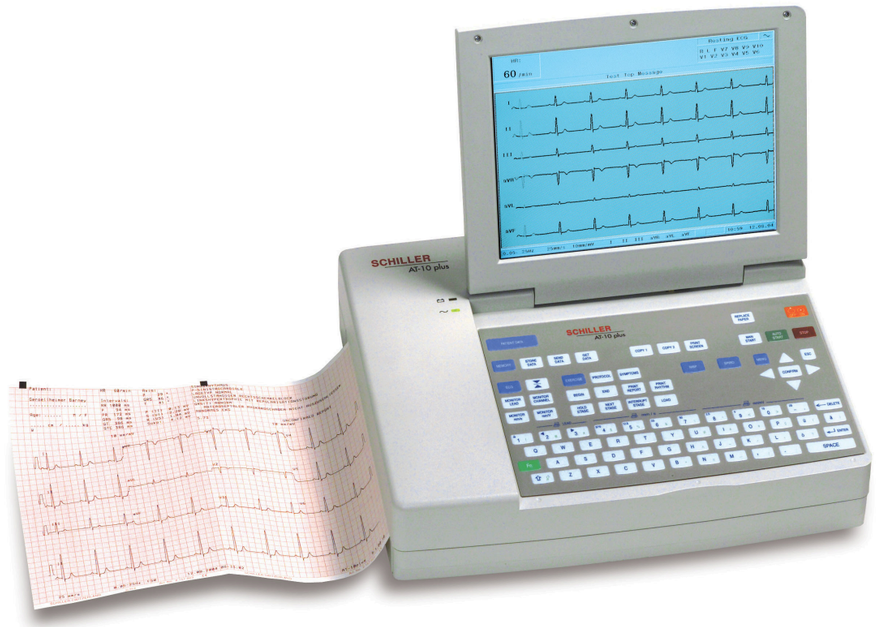
AT-10 plus

12 Channel ECG Unit



User Guide

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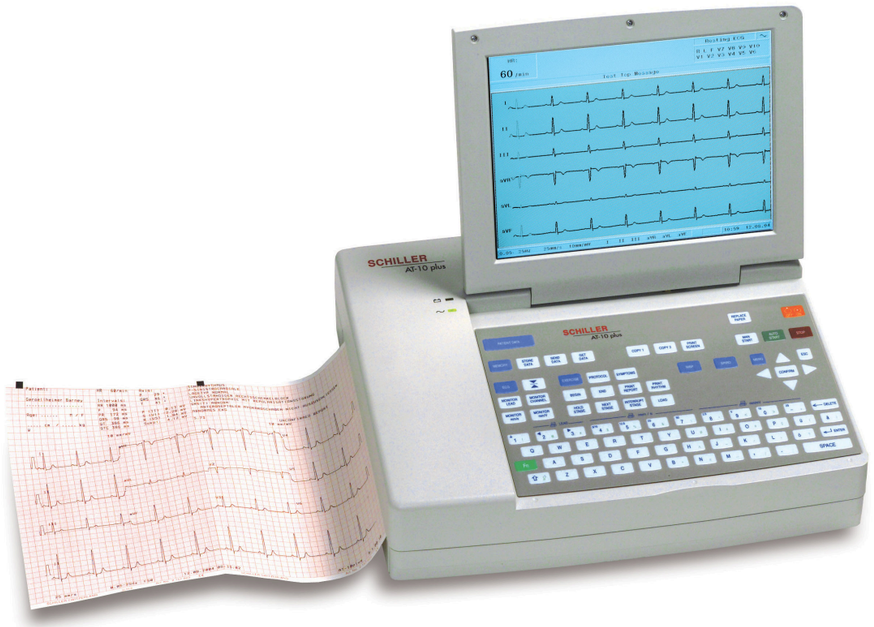
12 Channel ECG Unit



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Sales and Service Information

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

www.schiller.ch

Sales information can also be obtained from:
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1 Safety Notes

1.1 Responsibility of the User

- This device must only be used by qualified doctors or trained medical personnel.
- The numerical and graphical results and any interpretation given must be examined with respect to the overall clinical condition of the patient and the general recorded data quality.
- The indications given by this equipment are not a substitute for regular checking of vital functions.
- Specify the competencies of the personnel for operation and repair.
- Ensure that personnel have read and understood these operating instructions. In particular this section “safety notes" must be read and understood.
- Damaged or missing components must be replaced immediately.

The operator is responsible for compliance with all applicable accident prevention regulations and safety regulations.

1.2 Intended Use

- The AT-10 plus is a 12-channel, ECG device used for the recording, analysis and evaluation of ECG Recordings. Recordings made with the AT-10 plus can be used as a diagnostic aid for heart function and heart conditions. It is designed for indoor use and can be used for all patients of both sexes, all races, and all ages.
- The diagnostic applications for which the AT-10 plus is intended is in the diagnosis of cardiac abnormalities in the general population, detecting acute miocardial ischemia, and infarction in chest pain patients, etc.
- The AT-10 plus is intended for use in hospitals, cardiological units, out-patient clinical units, and general physicians offices.
- The AT-10 plus includes a low sensitivity setting. Low sensitivity will suppress certain non-specific ECG diagnoses; this can be used for screening high-specificity program intended for low-risk patients. The high sensitivity setting is used for detecting cardiac abnormalities in all and high risk patients including those taking thrombosis medication.
- There is no danger for patients with pacemaker.
- Only operate the device in accordance with the specified technical data.
- The device is not designed for sterile use nor is it designed for outdoor use.
- Do not use this unit in areas where there is any danger of explosion or in the presence of flammable gases such as anaesthetic agents.
- This unit is CF classified and defibrillation protected only when the original patient cable is used. However, as a safety precaution when possible, remove electrodes before defibrillation.
- This product is not designed for internal use.This product is not designed for direct cardiac application.

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1.3 Organisational Measures

- ▲ Before using the unit, ensure that an introduction regarding the unit functions and the safety precautions has been provided by a medical product representative.
- ▲ Keep these operating instructions in an accessible place for reference when required. Make sure that they are always complete and legible.
- ▲ Observe the operating instructions and maintenance instructions.
- ▲ These operating instructions do not override any statutory or local regulations, or procedures for the prevention of accidents and environmental protection.

1.4 Safety-conscious Operation

- ▲ Make sure that the staff have read and understood the operating instructions - particularly this "Safety Notes" section.
- ▲ Do not touch the unit casing during defibrillation.
- ▲ To ensure patient safety, none of the electrodes including the neutral electrode, nor the patient or any person with simultaneous patient contact, must come in contact with conductive parts, even when these are earthed.
- ▲ Immediately report any changes that impair safety (including operating behaviour) to the person responsible.
- ▲ Do not place any liquids on the unit. If liquid should be spilled over the device, immediately disconnect the device from the mains and wipe it. The device must be serviced before reusing.
- ▲ Only connect the original SCHILLER patient cable to the patient socket.

1.5 Safety Facilities

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

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1.6 Operation with other Devices

- Only use accessories and other parts recommended or supplied by SCHILLER AG. Use of other than recommended or supplied parts may result in injury, inaccurate information and/or damage to the unit.
- Ancillary equipment connected to any analogue and/or digital interface of the unit must be certified according to the respective IEC standards (e.g. IEC/EN 60950 for data processing equipment and IEC/EN 60601-1 for medical equipment). Furthermore all configurations shall comply with the valid version of the system standard IEC/EN 60601-1-1. Everybody who connects additional equipment to the signal input part or signal output part configures a medical system, and is therefore responsible that the system complies with the requirements of the valid version of the system standard IEC/EN 60601-1-1. If in doubt, consult the technical service department or your local representative.
- Any other equipment used with the patient must use the same common earth as the AT-10 plus.
- Precautions must be observed when using high frequency devices. Use the special high frequency SCHILLER patient cable to avoid possible signal interference during ECG acquisition.
- There is no danger when using the ECG unit simultaneously with electrical stimulation equipment. However, the stimulation units should only be used at a sufficient distance from the electrodes. If in doubt, the patient should be disconnected from the devic6e.
- If the patient cable should become defective after defibrillation, an electrode becomes displaced, or an electrode resistance is too high, a lead-off indication is displayed in the upper right part of the screen and an acoustic alarm given.
- If the device is a part of a medical system, the original SCHILLER patient cable must only be used with, and connected to, the patient connector on the AT-10 plus.

1.7 Maintenance

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

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1.8 Safety Symbols and Pictograms

1.8.1 Symbols used in this document

The safety level is classified according ANSI Z535.4. The following overview shows the used safety symbols and pictograms used in this manual.

⚠ DANGER

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

⚠WARNING

For a possibly dangerous situation, which could lead to serious bodily injury or to death.

⚠ CAUTION

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

For general safety notes as listed in this chapter.

Used for electrical dangers, warnings and other notes in regarding operation with electricity.

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

Reference to other guidelines.

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1.8.2 Symbols used on the device

Potential equalization

CF symbol. This unit is classified safe for internal and external use. However, It is only defibrillation protected when used with the original SCHILLER patient cable.

Symbol for the recognition of electrical and electronic equipment

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

The unit/component can be recycled.

CE 0123

Notified body of the CE certification (TÜV P.S.).

Attention: Consult accompanying documents.

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1.9 Terms of Warranty

The SCHILLER AT-10 plus is warranted against defects in material and manufacture for the duration of one year (as from date of purchase). Excluded from this guarantee is damage caused by an accident or as a result of improper handling. The warranty entitles free replacement of the defective part. Any liability for subsequent damage is excluded. The warranty is void if unauthorised or unqualified persons attempt to make repairs.

In case of a defect, send the apparatus to your dealer or directly to the manufacturer. The manufacturer can only be held responsible for the safety, reliability, and performance of the apparatus if:

- assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by him, and
- the SCHILLER AT-10 plus and approved attached equipment is used in accordance with the manufacturers instructions.

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

This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to both Part 15 of the FCC (Federal Communications Commission) rules and the radio interference regulations of the Canadian Department of Communications. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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2 Introduction

2.1 Features

The SCHILLER AT-10 plus is a 12-channel ECG unit designed to record, display, and measure resting ECGs. The AT-10 plus has the following features:

2.1.1 Standard

- Pacemaker Detection
- Manual (real time) mode - (leads, speed and amplitude can be changed as required)
- Auto mode with user defined presentation formats
- Rhythm recording with user defined formats (planned)
- Measurements

2.1.2 Options

- Interpretation
- Thrombolysis (with C version (interpretation) only)
- Stress testing with standard test protocols and user defined protocols, analysis program with ST measurement, average complexes and trends (EXEC)
- Extended Memory (planned option)
- Full disclosure of all 12 leads (planned option)
- Spirometry (planned option)
- Pacemaker measurement (planned option)
- Heart rate variability (planned option)
- Late potential analysis (planned option)

2.1.3 Connectors

- VGA interface for the connection of an external monitor
- DC input connector for on-screen presentation or printout of external signals
- DC Output connector for output of recorded signals
- RS-232 interfaces for control of digital treadmills and digital bikes
- Analogue interface for control of an analog ergometer
- RS-232 interface for a spiro flow sensor or data transmission / reception

Schiller Communication Module (SCM)

- Analogue Modem connecter (with optional internal modem)
- RS-232 interface for external blood pressure unit.
- RJ-45 ethernet connector (network)
- Two USB connectors
- SDCARD slot (with 64MB SD Card) for removable storage of recordings

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2.2 Operating Philosophy

2.2.1 User and User Rights

There are two user level as follows:

Physician / Nurse

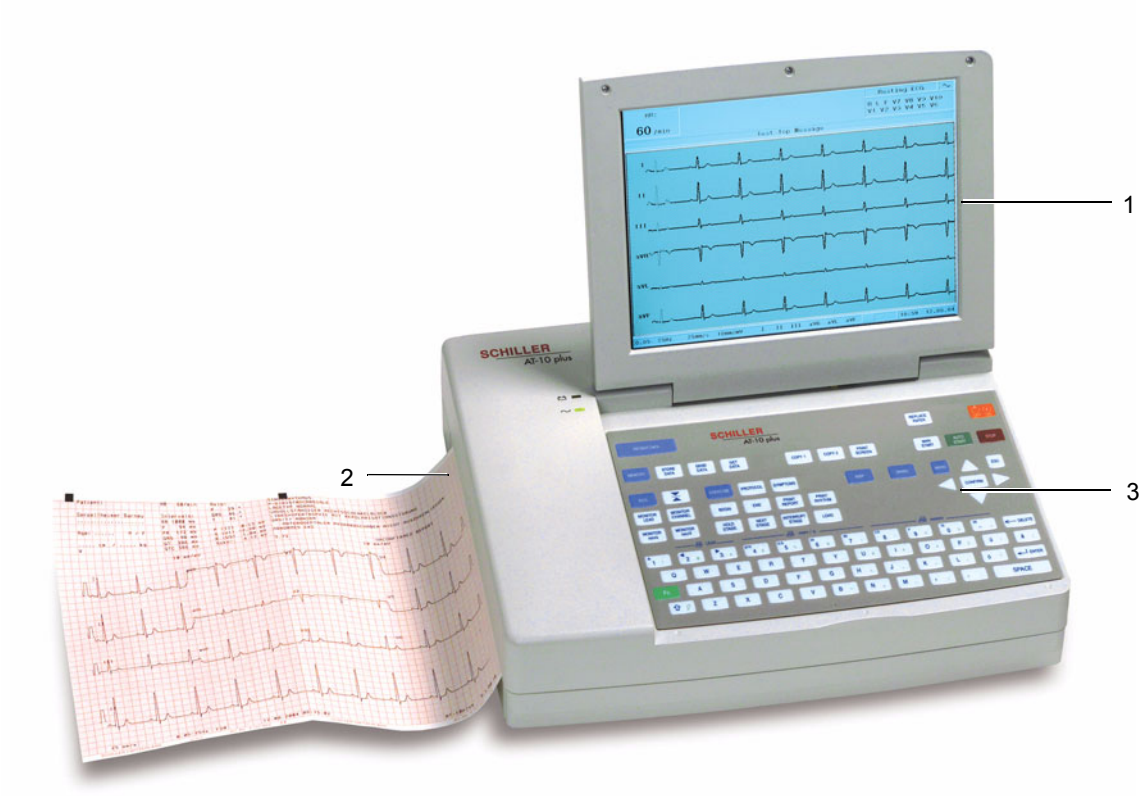
The Physician / Nurse level is the default setting and is entered as soon as the unit is switched on. At this level the user can:

- define and edit patient data
- take resting and exercise ECGs
- enter and edit patient data
- view and validate recordings
- access, send, receive and store recordings
- define all general and medical settings

Administrator / Service

The administrator level allows access to all ‘technical‘ settings including extra system screens, test screens, software updates, etc., and is accessed by a code. Details are given in the service handbook.

2.3 Main Components of the AT-10 plus



(1) LCD screen.
(2) Integrated thermal printer and paper tray.
(3) Water resistant keyboard.

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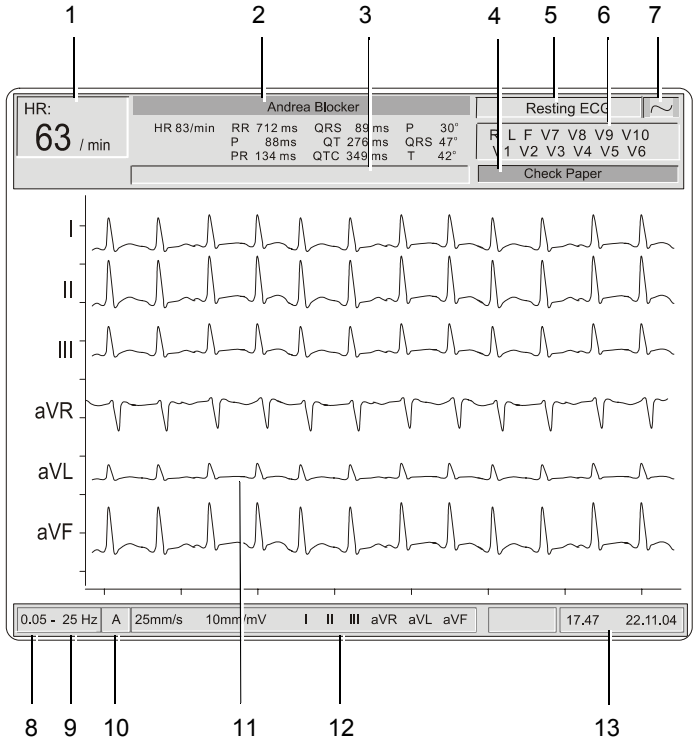
2.3.1 LCD Screen

The display will vary according to the current task being carried out. In all screens however, the top, middle and bottom areas always display the same information groups. The following is an example of a typical resting ECG screen (for the exercise screen see page 27).



(1) The heart rate (HR) - averaged over the last 4 beats.

(2) The patient name - below is the last auto mode recording intervals (if an auto mode recording has been taken).

(3) Message field - this area displays any status messages.

(4) Message Field - this area displays technical and system error messages.

(5) Current mode of operation (resting, stress, spiro).

(6) Electrode lead status - when an electrode indication flashes (an audible indication is also given), it indicates that the electrode resistance is too high. The electrode(s) must be re-applied - see page 30.

(7) Current power source - mains (~), or battery ( ) - see page 21.

(8) Selected baseline frequency (0.05, 0.15, 0.30, or 0.60 Hz) - see page 40.

(9) Myogram filter cut-off frequency (25Hz, 35Hz or 150Hz (off)) - see page 39.

(10) Auto sensitivity reduction on ('A' in box), or off (box empty) - to help reduce overlapping traces - see page 40.

(11) The central section of the screen displays the measured ECG traces.

(12) Manual Print settings - see page 35.

- speed in mm/s
- sensitivity in mm/mV
- selected leads

(13) System time and date.

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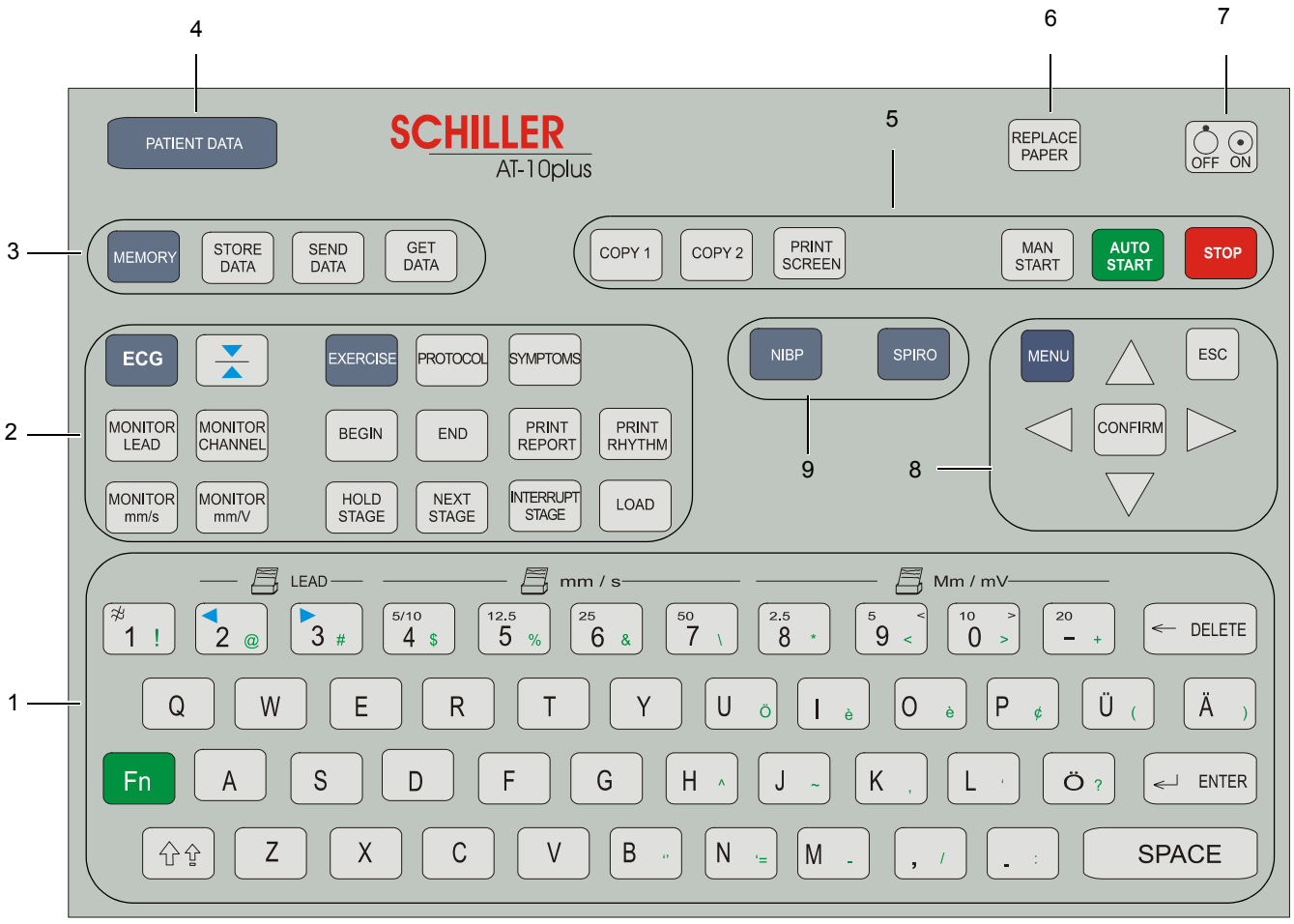
2.3.2 Keypad



The keyboard is divided into the following functional areas:

(1) **Alphanumeric** and **Dual Purpose Keys**. The numerical keys are dual purpose as follows:

- Key **1** - switch myogram filter on or off
- The following keys change the speed, amplitude and lead group **during manual printing:**
- Key **2** and **3** - changes to next / previous lead group
- Key **4** to **7** - printout speed
- Keys **8** to **'-'** - printout Amplitude (sensitivity)

(2) **Display, ECG** and **Stress ECG Function Keys**:

- **Display and ECG Keys**
  - **ECG** key - select ECG menu settings
  - **Monitor Lead** key - display next lead group
  - **Monitor Channel** key - change the number of leads displayed
  - **Monitor mm/s** key - toggle display speed
  - **Monitor mmV** key - toggle display sensitivity
  - **Cal** key - reset ECG signal to baseline and insert calibration signal on the screen or on the printout

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- **Exercise Keys**
  - **Exercise** key - exercise ECG settings and function
  - **Protocol** key - display/select/ edit exercise protocols
  - **Symptoms** key - manual input of symptoms
  - **Begin** key - start exercise test (beginning of warm-up phase) according to protocol set
  - **End** key - stop exercise test (start of recovery phase)
  - **Print Report** key - print final report (end of recovery phase)
  - **Print Rhythm** key - print rhythm strip
  - **Hold Stage** key - hold current stage
  - **Next Stage** key - switch to next stage
  - **Interrupt Stage** key - interrupts the test i.e. releases load on bike/stops treadmill - this function can be used, for example, to administer medication - when this key is again pressed, the test resumes from the same position
  - **Load** key - overwrite protocol and define load

(3) **Memory, Storage and transmission Keys**:

- **Memory** key - gives access to the stored recordings.
- **Store Data** key - initiates data storage to internal memory of the current recording - the location where the recording is stored in defined in the system settings.
- **Send Data** key - initiates transmission over the defined interface of the current recording - the location where the recording is sent is defined in system settings
- **Get Data** key - initiates data reception from another location - the location from where the data is received is defined in the system settings

(4) **Patient Data** key - Input of patient data

(5) **Direct function keys** including:

- **Print Screen** key - print the displayed screen
- **Copy 1** and **Copy 2** keys - print a copy of current recording in format 1 or format 2
- **Man Start** key - imitate real time printout
- **Auto Start** key - take auto recording
- **Stop** key - stop real time printout / advance paper to beginning of new page

(6) **Replace Paper** key - extend or retract the paper tray for paper replacement

(7) **On/Off** key - switch the unit on or off

(8) **Menu navigation keys** including:

- **Menu** key - give access to system settings
- **Confirm** key - confirm current / displayed setting
- **Left arrow** key - move cursor to the left / select next menu option
- **Right arrow** key - move cursor to the right / select previous menu option
- **Up arrow** key - move cursor or menu bar up
- **Down arrow** key - move cursor or menu bar down

(9) Further **Function Keys** for:

- **NIPB** key - enter non-invasive blood pressure measurements
- **SPIRO** key - spirometry program (requires spiro sensor connected to the spiro RS-232 interface)

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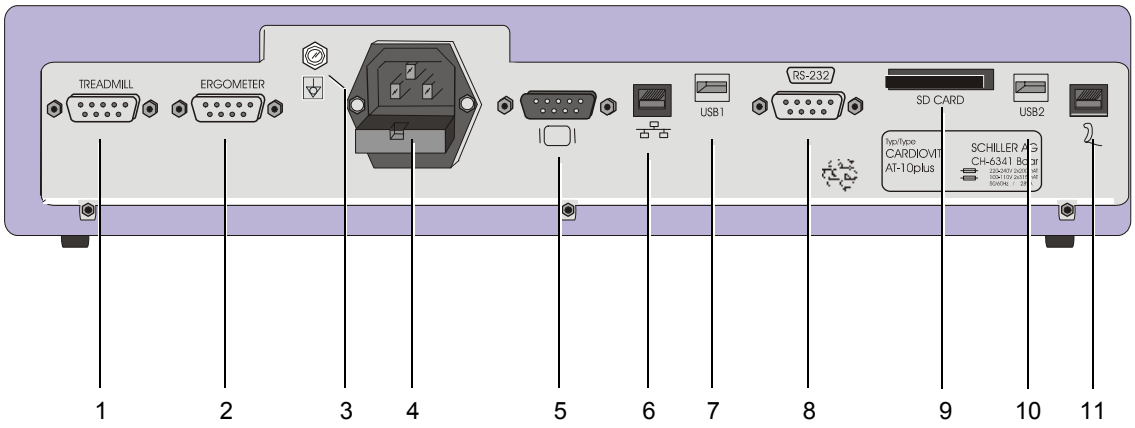
2.4 External Connections

⚠ CAUTION

▲ All externally connected hardware must be approved by SCHILLER. Connection of any hardware not approved by SCHILLER is at the owner's risk. The unit guarantee may also be invalid.

2.4.1 Back Panel



(1) RS-232 connector for Treadmill.

(2) RS-232 connector for Ergometer.

(3) Potential equalisation stud. The potential equalisation stud is used to equalise the ground potential of the unit to that of any nearby mains powered equipment. Use the hospital or building common ground for all mains powered units.

⚠ CAUTION

▲ If an external printer, monitor or ergo device is connected to the AT-10 plus, the potential equalisation stud must be connected to common ground when the AT-10 plus is working on battery power i.e. when the mains lead (with grounding lead) is not connected to the unit - see page 20.

(4) Mains connector and fuse box (fuses: 2 x T 160 mA / 250 V).

(5) VGA connector for external monitor. Note that before an external monitor can be used, the VGA output must be enabled in system settings, see page 63.

The following connectors are situated on the communications module.

(6) RJ-45 Ethernet LAN connector (Local Area Network).

(7) USB connector for an external printer.

(8) RS-232 for an external BP unit.

(9) SD card slot for (removable) data storage (64MB).

(10) USB connector.

(11) RJ-11 telephone connector (with optional internal modem).

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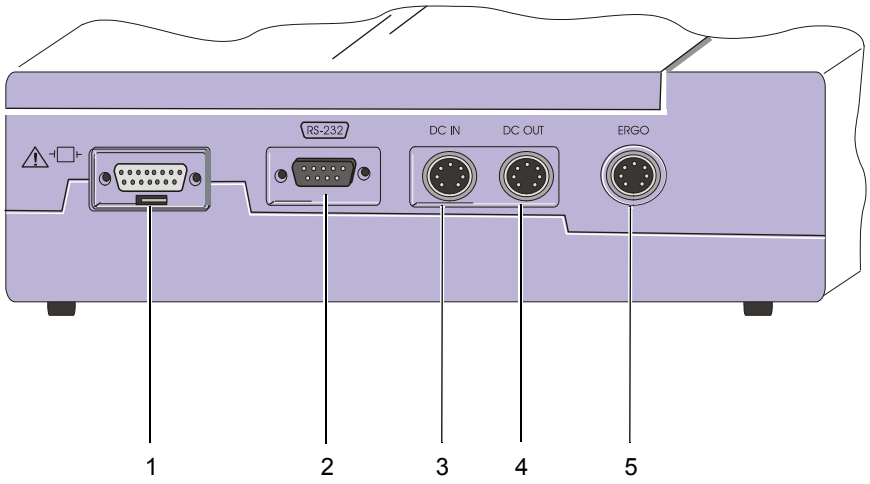
2.4.2 Side Panel



(1) EKG/ECG patient cable input socket.

- The patient cable and connector is CF ⊣♥⊢ rated, that is fully floating and isolated, defibrillation protected, suitable for intra-cardiac application.
- The unit is only CF rated and defibrillation protected if used with the original SCHILER patient cable.

(2) The RS-232 connector is used for
  – connecting a pneumotach sensor (SP-250/SP-260) for pulmonary function testing.
  – connecting a PC or modem for data transfer.

(3) DC input DCIN 1, 0.5 V/cm.

(4) DC output DCOUT, 0.5 V/cm.

(5) ERGO connector for connection of analogue ergometers.

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3 Operation

3.1 Start-up and Initial Preparation

⚠ DANGER

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

3.1.1 Location

- Do not keep or operate the unit in a wet, moist, or dusty environment. Avoid exposure to direct sunlight or heat from other sources.
- Do not allow the unit to come into contact with acidic vapours or liquids.
- The AT-10 plus should not be placed in the vicinity of X-ray or diathermy units, large transformers or electric motors. It must also be positioned at least one meter from the mains supply.

3.1.2 Connection of External Cable Assemblies and Ancillary Equipment

1. Check the voltage setting (115V or 230V) - see page 72.
2. Connect the power cable at the rear of the unit. The Mains indicator lamp is lit. Leave the AT-10 plus connected to the mains for 7 hours to fully charge the battery - see page 21.
3. Connect the patient cable (side panel).
4. Connect any ancillary and optional equipment - see page 18. These may include the following:
   - Ergometer (analogue or digital) for exercise testing
   - Blood pressure unit
   - Spiro sensor (for spirometry)
   - External monitor
   - Network cable
   - External printer

3.1.3 Potential Equalisation

The potential equalisation stud at the rear of the unit is used to equalise the ground potential of the AT-10 plus to that of all mains powered equipment in the vicinity. Use the hospital or building common ground. A yellow/green ground cable is supplied as an option (Article number 2. 310 005).

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To avoid possible interference from the ergometer when carrying out an exercise test, it is recommended that both the AT-10 plus and the ergometer are connected to the same common ground.

⚠ CAUTION

▲ To prevent the possibility of leakage current when an external printer, external monitor, or ergo device is connected, always ensure that the mains lead (with earth grounding connection), and / or the potential equalisation, is attached to the AT-10 plus.

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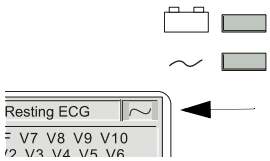
3.1.4 Switching ON and OFF

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

3.1.5 Power Supply and Battery Operation



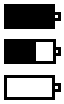
The unit can be operated either from the mains supply or from the built-in rechargeable battery. The power source is indicated on the top line of the LCD and a mains and battery indicator on the unit. The mains indicator lamp is lit all the time the unit is connected to the mains supply. The mains symbol is also displayed in the top right corner of the screen when the unit is switched on.

Mains and battery LED Indicators

The LED indicators on the unit casing indicate the power operation as follows:

Function	Battery LED	Mains LED
Mains Connected:		
Battery Charging	• On	• On
Battery Full	• Off	• On
Battery Working:		
Battery Capacity OK	• On	• Off
Battery Capacity Limited (reconnect mains)	• Blinking	• Off

Battery Capacity



The internal battery provides power for up to four hours. When the unit is running on battery power a battery symbol replaces the mains symbol and indicates the battery status. When the battery is full, the symbol is solid.

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

3.1.6 Isolating the Mains Supply

To isolate the power supply, remove the mains plug from the wall socket.

3.1.7 System and ECG Settings

- The System Settings (time, date, user ID, etc.), and other general settings (macros, ergometer, etc.), are found in the System Settings section - see page 63.
- Resting ECG settings (auto format, user defined leads, print options, lead test, QRS beep, interpretation, rhythm lead definition, etc.), are found in the Resting ECG Section, see page 40.
- Exercise settings (Heart rate target, protocol HR target, treadmill settings, recovery settings etc.) are found in the Exercise Section - see page 53.

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3.2 Changing the Printing Paper

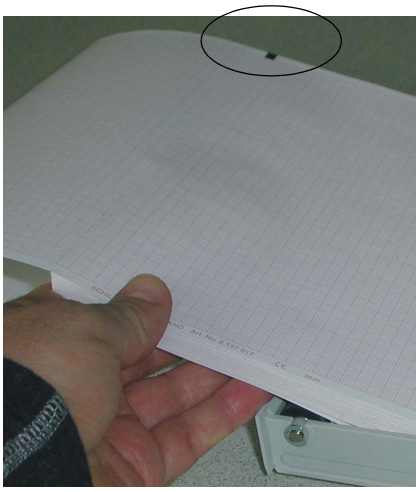
Important

The device is delivered without printing paper installed. The thermo-paper is sensitive to heat, humidity and chemical vapours.The following points apply to both storage, and when archiving the results.

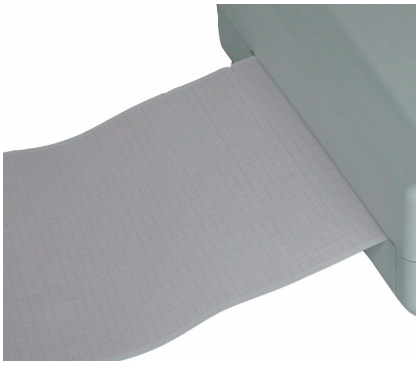
- Before use, keep the paper in its original cardboard cover. Do not remove the cardboard cover until the paper is to be used.
- Store in a cool, dark and dry area.
- Do not store near chemicals e.g. sterilisation liquids.
- In particular do not store in a plastic cover.
- Certain glues can react with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

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

1. Press the **Replace Paper** key to open the paper tray (remove any remaining paper from the paper tray if replacing paper.



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



3. Place the beginning of the paper over the black paper roller on the paper tray cover.

4. Press the **Replace Paper** key to return the paper tray in position.

5. Press the **Stop** key to transport the paper to the start position.

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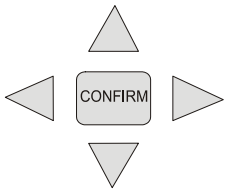
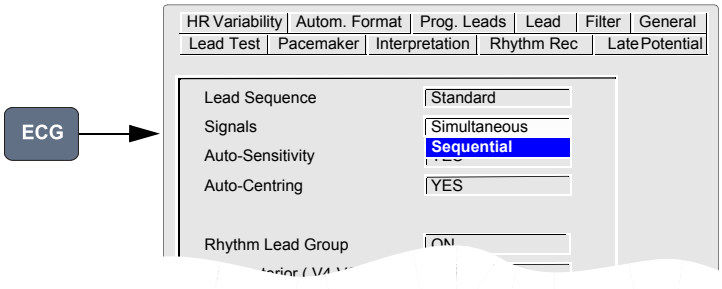
3.3 Selecting Menu Options using the Arrow Keys

When any of the setting keys are pressed (ECG, Exercise, NIBP, Menu etc.), menu tabs are displayed and menu options displayed, as given in the example below when the ECG key is pressed.

The general principal of navigating and option selection is the same for all menu keys as follows:



1. Press the **left /right** keys to select (highlight) the tab on the top of the screen.
2. Use the **up/down** keys to select the field/icon - the entry field is highlighted (as shown in the example below for ‘signals‘).



3. Press **Confirm** to select.
4. Use **up**/**down** keys to toggle through the options available.
5. Press **Confirm** to set.

When all entries are made, press the **Esc** key to exit and register the entered data.

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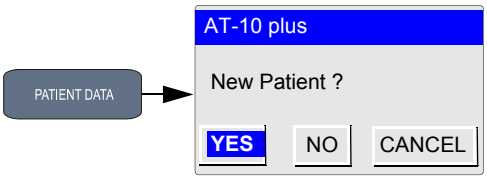
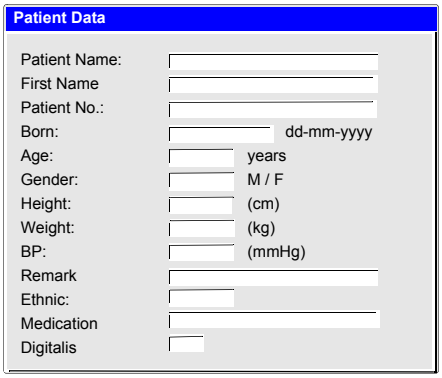
3.4 Entering Patient Data



In the patient data screen, new patients can be entered and previously stored patient data, can be edited. Press the 'Patient data' key to display the patient screen.

You can edit the current patient (select 'no'), or enter the details of a new patent (select 'yes').

Press the **Confirm** key to display the patient data field:



Patient Name — Enter patients name (maximum 20 characters).

First Name — Enter patients first name (maximum 20 characters).

Pat. No. — The patient number is an easily identifiable short form of identifying a patient - a maximum of 20 characters can be entered.

Born — Enter patient's date of birth dd-mm-yy.

Age — Patients' age calculated from the entered date of birth.

Gender — Enter the patient's sex - M or F.

Height — Enter patient's height 20..250cm (10..80 inches).

Weight — Enter patient's weight 0.5..250kg (5..500 lbs).

BP — Enter the patient's systolic (or diastolic) blood pressure.

Remark — Area for entry of any remark(s) about the patient.

Ethnic — The setting made here is mainly used by the Spiro option when calculating norm values. Enter C (Caucasian), H (Hispanic), B (Black) or (A) Asian. Details of these settings are provided in the Spirometry section (not available at time of print).

Medication — Up to 23 characters can entered for medication notes.

Digitalis — Select yes or no.

- Extra /different field combinations can be displayed in the patient data screen. These can be defined by the user and are selected in system settings > **Config > Patient Data Input** (see page 63).

- A resting ECG can be taken directly from the patient screen by pressing the **Auto Start** key (see page 34).

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4 Electrode Placement

4.1 Electrode Identification and Colour Code

The electrode placements shown in this Section are labelled with the colours according to Code 1 requirements. The equivalent Code 2 colours are given below.

	CODE 1 (usually European)		CODE 2 (usually American)	
System	Electrode identifier	Colour code	Electrode identifier	Colour code
Limb	R	Red	RA	white
	L	Yellow	LA	Green
	F	Green	LL	Red
Chest according to Wilson	C	white	V	Brown
	C1	White/red	V1	Brown/red
	C2	White/yellow	V2	Brown/yellow
	C3	White/green	V3	Brown/green
	C4	White/brown	V4	Brown/blue
	C5	White/black	V5	Brown/orange
	C6	White/violet	V6	Brown/violet
Position according to Frank	I	Light blue/red	I	Orange/red
	E	Light blue/yellow	E	Orange/yellow
	C	Light blue/green	C	Orange/green
	A	Light blue/brown	A	Orange/brown
	M	Light blue/black	M	Orange/black
	H	Light blue/violet	H	Orange/violet
	F	Green	F	Green
Neutral	N	Black	RL	Green

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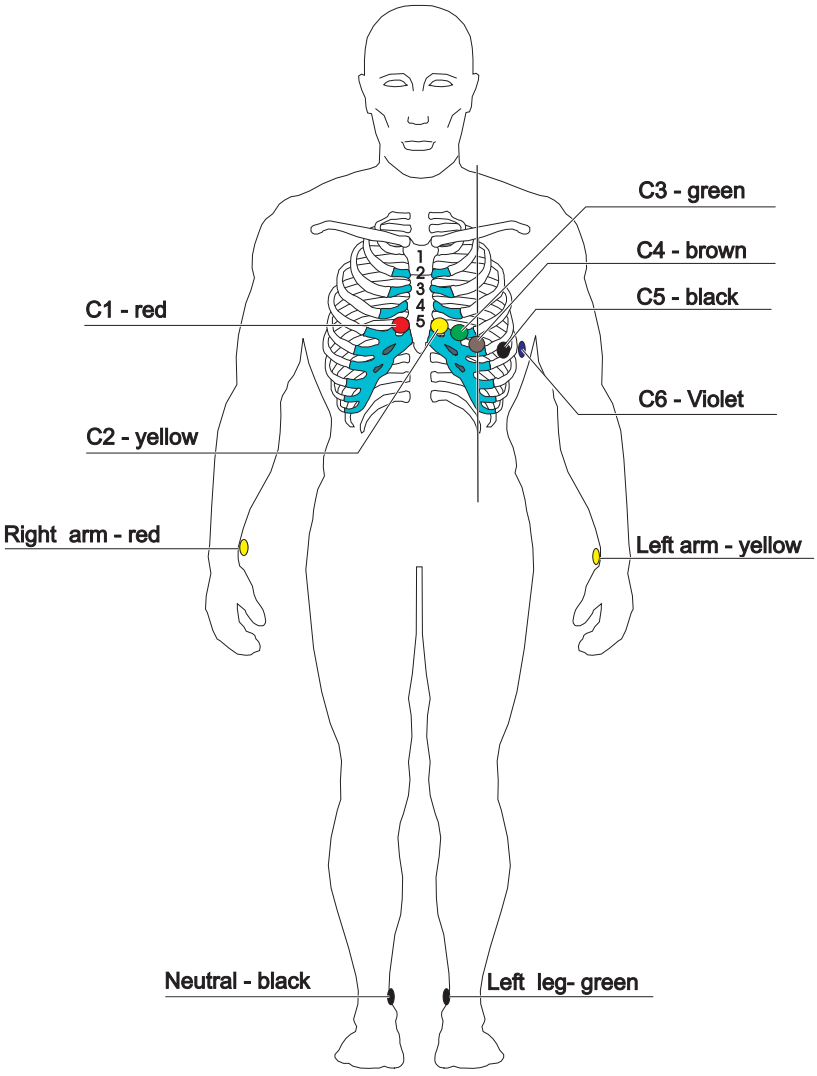
4.2 Standard 10-lead Resting ECG



4.2.1 Placing the Electrodes

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

1. Ensure that the patient is warm and relaxed.
2. Shave electrode area before cleaning.
3. Thoroughly clean the area with alcohol.
4. When applying the electrodes, ensure that a layer of gel is between the electrode and the skin.
5. Place the C4 electrode first - in the 5th intercostal space (ICS) so that it lines up approximately with the middle of the clavicle.
6. Then place:
   - C1 in the 4th ICS parasternal right
   - C2 in the 4th ICS parasternal left
   - C3 between, and equidistant to, C4 and C2
   - C6 on the patient‘s side and aligned with C4
   - C5 between, and equidistant to, C4 and C6

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7. Then place the following:
   – RA and LA (right arm and left arm), on the inside arm just above the wrist
   – LL (left leg), on the left inside lower leg, just above the ankle
   – N (Neutral), on the right inside lower leg, just above the ankle

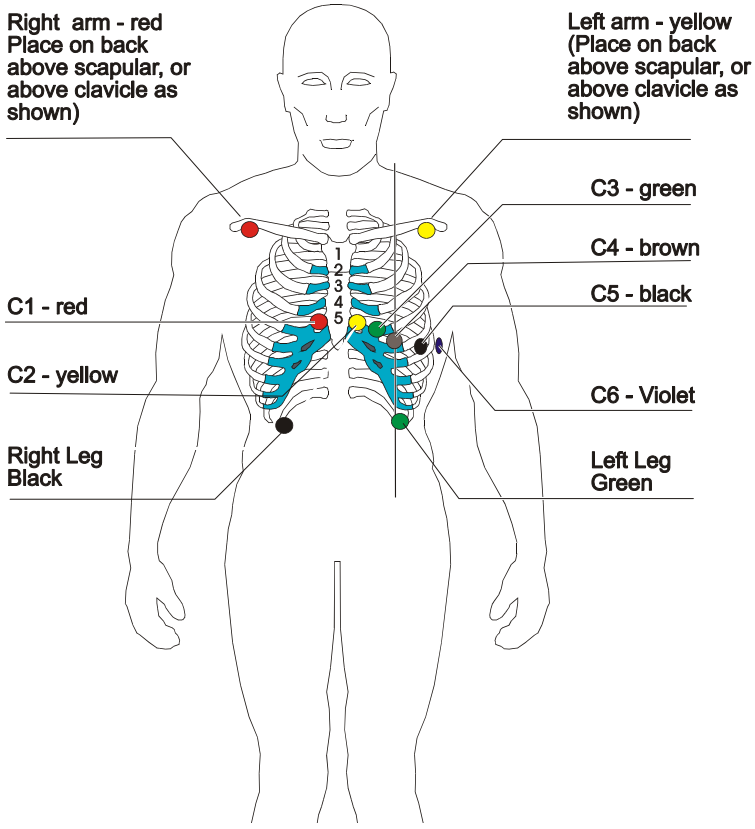
The electrode resistance can be checked in the recording screen -see page 30.

When making an ECG with a child it is sometimes physically difficult to place all electrodes. When this is the case electrode V4 can be placed on the right side of the chest.

WARNING

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

4.2.2 Exercise ECG



Place electrodes C1 to C6 in the same positions as for resting ECG detailed previously. Then place the RA, LA, LL and N electrodes as follows:

- LL, on the left torso at the bottom of the rib cage
- RL (N), on right torso at the bottom of the rib cage
- LA and RR, place either on the back above the scapular or on the front just below the clavicle

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4.3 Further Lead Combinations

4.3.1 Nehb Leads

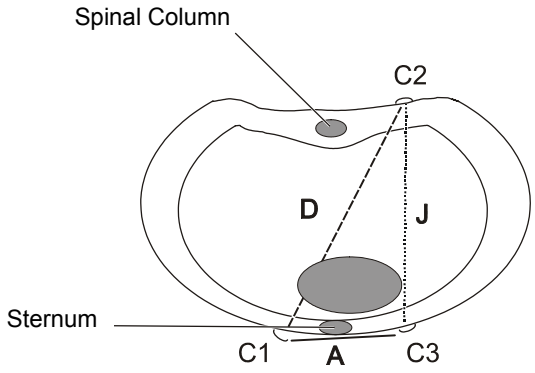
The Nehb leads are bipolar chest leads. They are of special interest for the diagnosis of changes in the posterior ventricle wall. Three leads are arranged in the form of a triangle, also called the “small cardiac triangle”. Nehb dorsal (D) is measured between the electrode positions Nax and Nst; Nehb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

Place the electrodes as follows:

Colour Code	Electrode identifier	Applied to position
Red	C1 (Nst)	2nd rib at the right sternal border
Yellow	C2 (Nax)	directly opposite (on the back, posteriorly) from 3 (Nap)
Green	C3 (Nap)	5th intercostal space medioclavicular line (cardiac apex)

All other electrodes can be placed in their normal position - see page 26.

.



The user defined lead order must be set in the ECG menu (see page 40).

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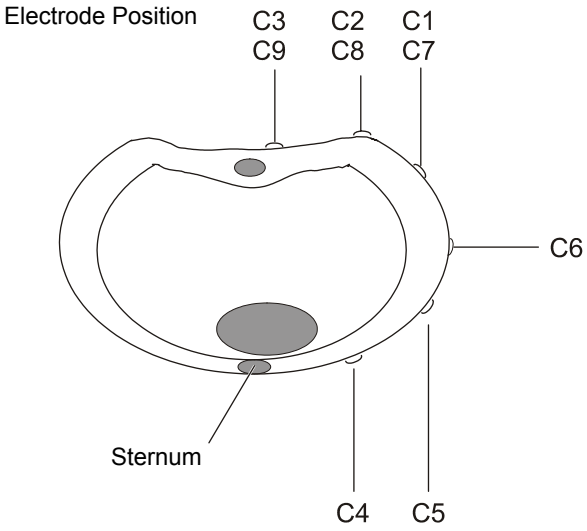
4.3.2 Additional Leads

The clips from the chest electrodes C1 through C3 have to be removed and connected to the electrodes C7 through C9 placed on the patients back in the appropriate positions. All other electrodes can be placed in their normal position.



The additional leads C7 through C9 can only be recorded in manual mode.

The user defined lead order is defined in the ECG menu (see page 40).

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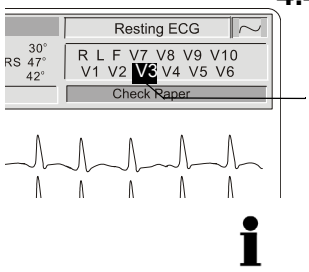
4.4 Skin/Electrode Resistance

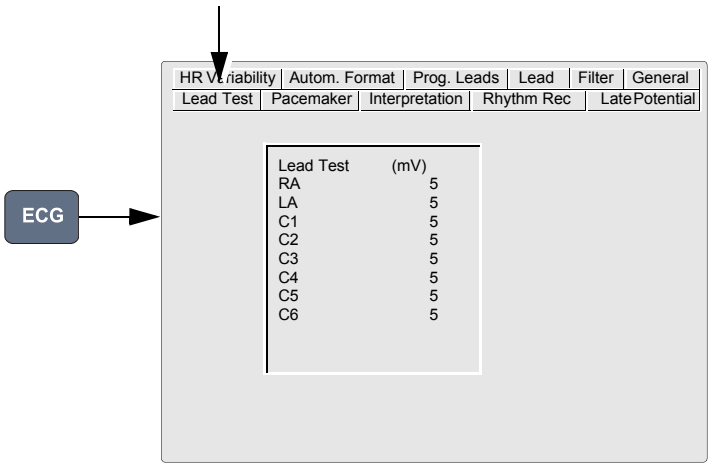


4.4.1 Electrode and Patient Cable Check (Lead Test)

The electrode lead status is shown on the LCD in the top right information area. When an electrode indication flashes **(1)**, - an audible indication is also given - it indicates that the electrode resistance is too high. The electrode(s) must be re-applied.

The electrode resistance check is provided as an integrity check for the electrode resistance and patient cable if suspected of being faulty.

To check the electrode resistance and the integrity of the cable, press the ECG key and select ‘Lead Test‘.



This gives electrode dc offset and is the voltage drop in the patient cable and electrodes. The result column gives the detected voltage for each electrode in millivolts measured between the electrode on the left leg and each of the individual electrodes. It can indicate any faults in the patient cable or patient electrode. The measured voltage value will depend on where the electrodes are connected. The voltage readings that can be expected are as follows:

With patient connected	± 100mV: Good connection, low resistance. An offset of up to ±150mV will give an acceptable recording.
With patient simulator connected	± 20 mV: This will depend on the patient simulator used and must be taken as a flexible measurement.
With all electrodes shorted together	± 20 mV.
No patient cable connected	-350 to -500mV.

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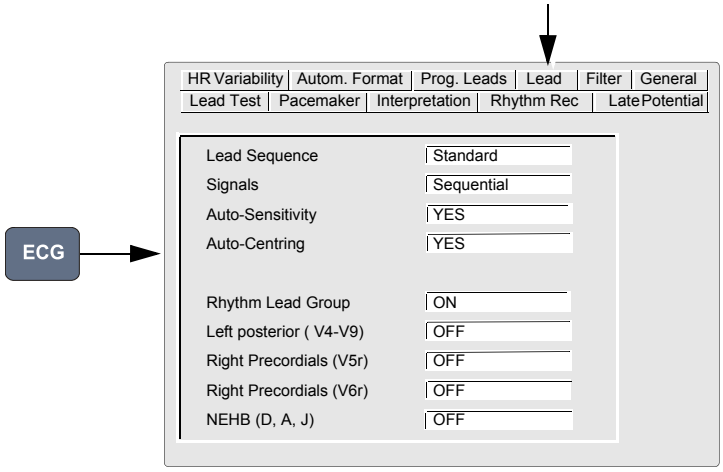
4.5 Lead Sequence

4.5.1 Setting Standard, Cabrera or User Defined Lead Sequence



The lead sequence is defined under in system settings **ECG key > Lead tab > Lead Sequence.**

The above screen is an example of a settings screen in the ECG menu. All other ECG settings and formats are given in the ECG settings section (see page 40).

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5 Resting ECG

⚠ CAUTION

- ▲ The Safety notices at the beginning of this book must be read and fully understood before taking an ECG Recording.
- ▲ The AT-10 plus is CF ⊣♥⊢ rated. The patient connection is fully isolated. Make sure that during the recording neither the patient nor the conducting parts of the patient connector nor the electrodes come into contact with other persons or conductive objects (even if these are earthed).
- ▲ Do not use the unit if the earth connection is suspect or if the mains cable is in any way damaged.
- ▲ When the mains lead is not connected to the AT-10 plus, and any external mains powered unit(s) (e.g printer, monitor etc.,) are connected, use the potential equalisation stud for grounding protection.

i

Note that the auto mode formats are independent of the current screen display. For the two auto mode formats, the following can be freely programmed (before recording).

- Lead Format
- Chart Speed
- With the optional interpretation program it is also possible to select the rhythm lead(s), measurement table, average cycles with optional markings and interpretation statements for the printout.

For further information and to define the auto formats see page 40.

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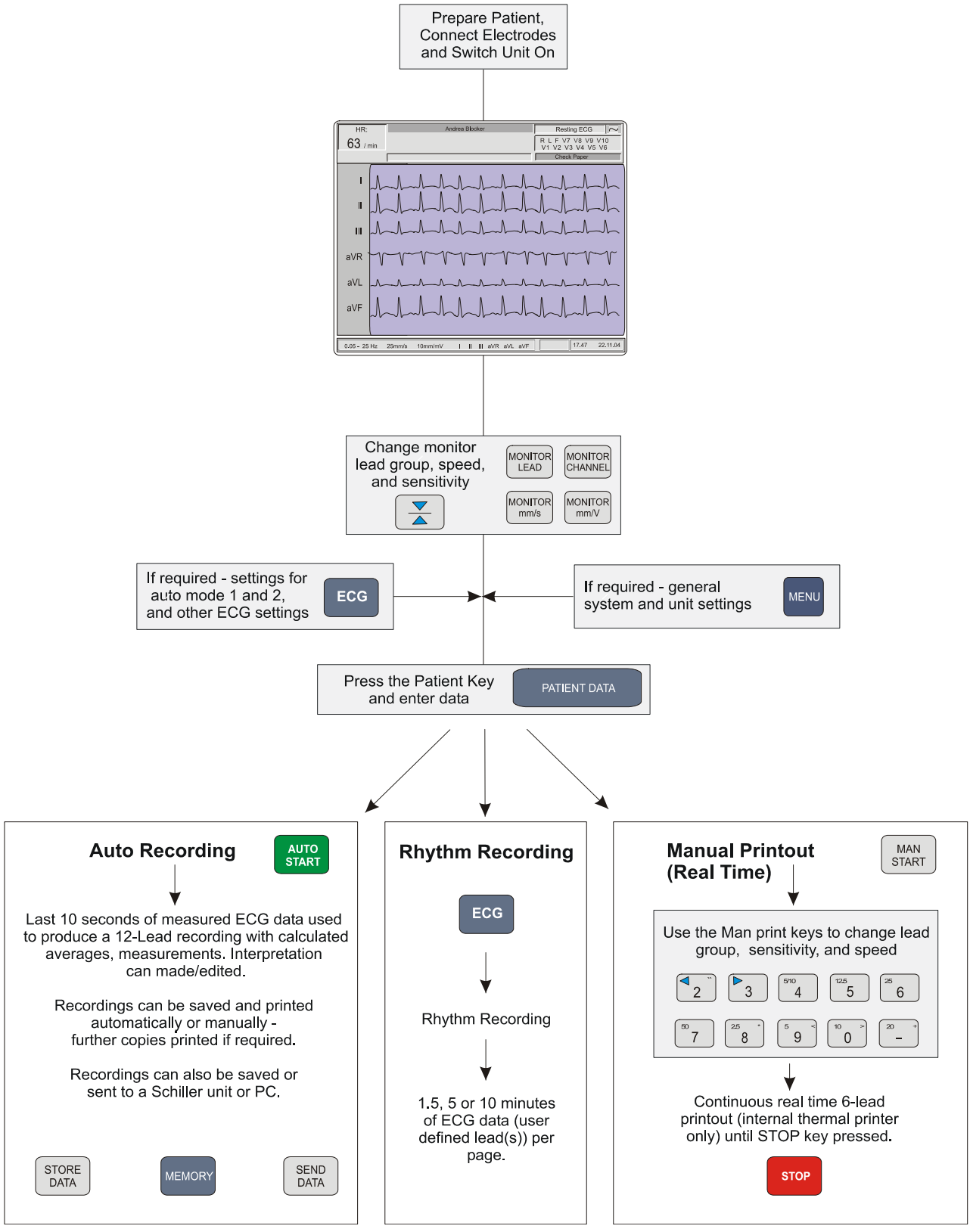
5.1 Procedural Flow Diagram



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5.2 Automatic Mode Recording

AUTO START

To take an automatic ECG recording, press the **Auto Start** key.

After approximately 10 seconds the recording is analysed and the result displayed on the screen.The interpretation statements can be edited and further printouts obtained in different formats. The ECG data remains in the temporary unit memory until it is overwritten by another recording or the unit is switched off. A recording can be:

- printed
- saved locally
- transmitted to a remote location
- printed

The options depend on the user settings and can be carried out manually or automatically after the recording has been made. Details of these settings are given ECG settings (**ECG key > General tab** - see page 40).

ECG

➜ To edit the interpretation **ECG key > Interpretation**

COPY 1 COPY 2

➜ To obtain a copy in format 1 press the **Copy 1** key
➜ To obtain a copy in format 2 press the **Copy 2** key

STORE DATA

➜ To store the recording manually press the **Store Data** key

SEND DATA

➜ To Transmit the recording manually press the **Send Data** key

5.2.1 The Auto Mode Printout

The printout gives the following:

- User ID
- Department
- Name and ID of Patient
- Time and Date
- Heart Rate
- Sensitivity
- Speed
- Filter Settings

And any combination of the following (for printout settings, see page 40):

- ECG recording of all leads in either Standard or Cabrera format according to selection
- Interpretation statements
- Average Cycles
- Intervals
- Markings (on the average cycles)
- Thrombolysis
- Axis
- Sokolow Index (ECG index for hypertrophy)
- Detailed Measurement Table

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5.3 Manual Mode (Rhythm Printout) Recording

Manual mode provides a direct printout of the real-time ECG with full control of parameter selection.

Manual real-time printout is not available on an external printer because the data processing of inkjet and laser printers is too slow for real time print. When a continuous real-time printout of the ECG is required, it is always printed on the internal thermal printer.

→ To start the manual recording of a real-time ECG, press the **Man Start** key.

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

5.3.1 The Manual Mode Printout

The printout provides you with the following:

- Six (selected) leads with lead identification.
- On the lower edge, the chart speed, user identification and the mains filter setting (50 or 60 Hz) and the Myogram filter cutoff frequency (if filter applied) 25Hz or 35Hz.
- At the top, the heart rate as current average of 4 beats, trace sensitivity, and the time and date.

The lead group, the sensitivity, and the speed of the printout are changed using the display/printout keys (see page 38).

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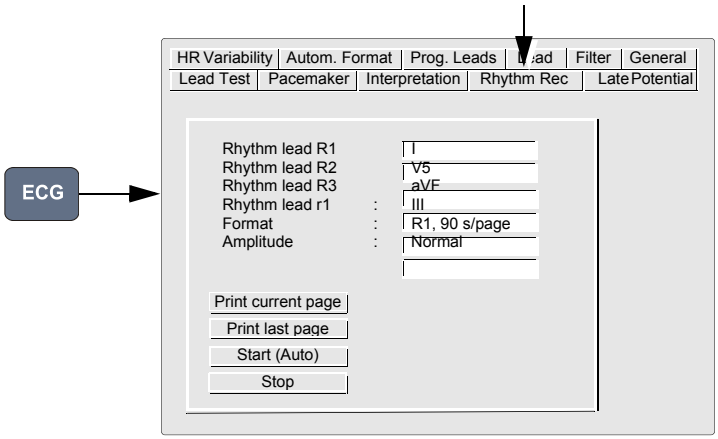
5.4 Rhythm Mode Recording

At the time of print this function was not available.

Rhythm monitoring of ECG signals allows the constant recording of one or two specified leads for an unlimited length of time (limited only by the amount of paper).



To navigate through the menus see page 23.

5.4.1 Taking a Rhythm Mode Recording

1. Select Rhythm Leads R1, R2, R3 and r1
2. Select the printout format. Select between:
   – 90 sec/page - printout every 90 seconds
   – 5 min./page - printout every 5 minutes
   – 10 min./page - printout every 10 minutes
3. Select Amplitude. Select between:
   – **Normal**
   – **Low** (half amplitude)
4. Select Mode:
   – Icon ‘Print Current Page‘ prints a page before enough data has been recorded for the printout at the preset interval.
   – Icon ‘Print Last Page‘ prints the last complete page.
   – Icon ‘Start (Auto) starts the rhythm recording. The printout is started after enough data for one page is available, i.e. after 90 seconds, 5, or 10 minutes depending on the selected format.
   – Icon ‘Stop‘ stops the rhythm recording and immediately starts a printout with the data that is currently available.

5.4.2 The Rhythm Printout

The printout gives the following:

- Selected lead(s) with lead identification.
- On the lower edge, the chart speed, user identification and the mains filter setting (50 or 60 Hz) and the Myogram filter cutoff frequency (if filter applied) 25Hz or 35Hz.
- At the top, the heart rate as current average of 4 beats, trace sensitivity, and the time and date.

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5.5 Recording External Signals (Using the DC Inputs)

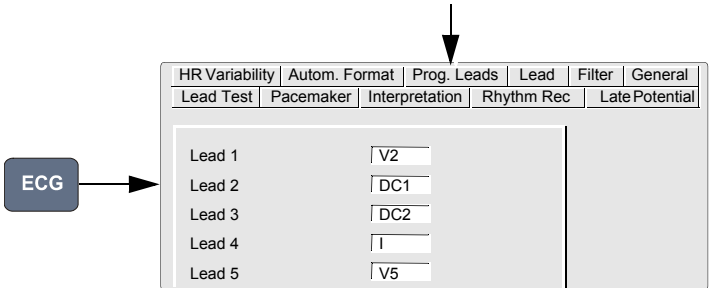
At the time of print this function was not available.

The DC inputs enable the signals from an external unit to be displayed on the AT-10 plus screen and to be printed out via the unit's printer. This can be done alone or in conjunction with an ECG recording.

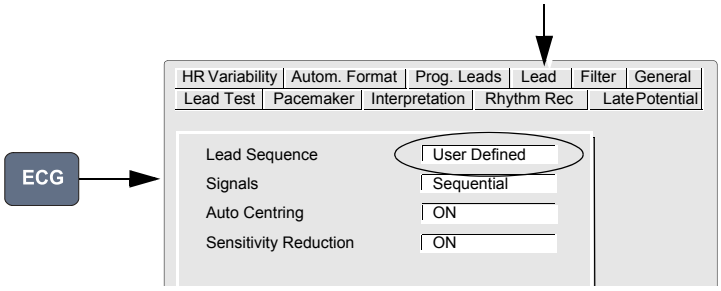
An example of an external device which could be connected, is a phonopulse recording unit or a small ECG unit (e.g. SCHILLER MS-3).

5.5.1 Procedure

1. Connect the external unit to the DC input socket (on the side panel - see page 19).
2. Set the programmable leads for the position where the DC input is to be displayed in the lead group.



3. Set the Lead group to user defined.



MONITOR LEAD MONITOR CHANNEL

4. Select monitor channels and lead group for display.

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5.6 Changing Lead Group, Amplitude and Speed

WARNING

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

The following can be freely chosen during data acquisition for the display and for a manual printout.

Different lead groups, speed and sensitivity are defined for the display and for the manual printout. To change the display presentation use the keys next to the ECG key. To change the manual printout use the top line of keys of the keypad.

5.6.1 On the Screen

Monitor Channel*

MONITOR CHANNEL Change the screen presentation to one of the following:

- 3 leads
- 6 leads
- 8 leads
- 8 leads split in two columns simultaneous display
- 6 leads split in two columns parallel display, with two rhythm leads

Monitor lead

MONITOR LEAD Change the screen presentation to the next lead grouping.

Sensitivity (Amplitude)

MONITOR mm/V Change the screen amplitude to 10 or 20 mm/V.

Speed

MONITOR mm/s Change the screen speed to 5, 10, or 20 mm/s.

5.6.2 On the Manual Printout

Lead Group*

2 3

Sensitivity (Amplitude)

2.5 8 5 9 10 0 20 -

Speed

5/10 4 12.5 5 25 6 50 7

*The Standard and Cabrera Lead Groupings are as follows:

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

The lead group selection is made in ECG settings (see page 40).

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5.6.3 Re-centring the trace, 1mV reference pulse

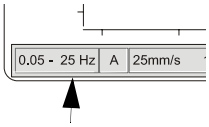
Occasionally the trace can wonder from the baseline.

To re-centre the ECG trace, and to display / print a 1mV reference pulse, press the **1mV** key.

5.6.4 Myogram Filter

The Myogram filter suppresses disturbances caused by strong muscle tremor.

The filter is toggled on/off by pressing the **Filter** key.



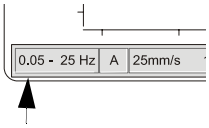
When the Myogram filter is on, the cutoff frequency **0.5 - 25Hz** (or 35Hz) is displayed in the information box. When the Myogram filter is 'off', **0.5 - 150Hz** is displayed.

- The cutoff frequency is user defined at 25Hz or 35Hz (see page 40).
- An ECG recorded in auto mode is stored unfiltered. It is therefore possible to print the stored ECG either with or without passing the myogram filter.

5.6.5 Other Filters

Further filters can be applied to both resting and exercise ECG recordings as follows:

Baseline Filter



The cutoff frequency (0.05, 0.15, 0.30 or 0.60 Hz) is displayed in the information box. We recommend that the frequency is set to the IEC recommendation of 0.05Hz.

Smoothing Filter

Suppress high frequency artefacts between the QRS complexes. SSF is printed on an auto mode printout when this filter is applied.

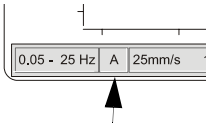
Baseline Stabiliser

Reduces baseline fluctuations without affecting the ECG. SBS is printed on an auto mode printout when this filter is applied.

Mains Filter

Prevents recording interference due to mains frequency oscillation. F50(50Hz) or F60(60Hz) is shown on the printout.

5.6.6 Auto Sensitivity



If amplitudes are high and the QRS waveforms would overlap, the sensitivity can be reduced automatically to 5 mm/mV. This is set in ECG settings (Lead option > auto sensitivity > on/off). When this is on an 'A' appears in the information line on the bottom of the screen.

The settings for all of the above filters and the auto sensitivity are defined in ECG settings (see next page).

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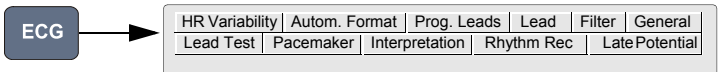
5.7 ECG Settings

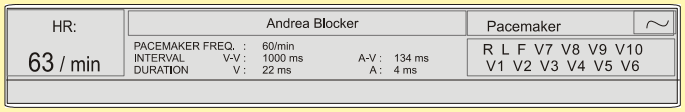
When the ECG key is pressed a screen is shown with a number of tabs at the top. When the tabs are selected further ECG options and settings are available. This section gives an overview of all the settings and tabs available in the following table.



Menu navigation, selection and confirmation is detailed in the Introduction (see page 23).

All changed settings are remembered until the unit is switched off. If you wish to keep the settings as default, the 'save as default' icon (**Menu key > Software > Save as Default**), must be pressed before switch off - see page 63.

5.7.1 Table of ECG Options and Settings

Parameter	Options	Description
Lead Test		Displays the resistance of all leads to ensure good electrode contact and the integrity of the cable (see page 30).
Pacemaker (Not available at time of print)	Start / Stop	Starts/ Stops pacemaker measurement. When started Pacemaker measurements are displayed at the top of the screen.  Two columns of data is are given: Pacemaker Freq — The number of stimulations per minute (pacemaker frequency) Interval VV — The time interval between two stimulations (V-V) Duration — The duration of each stimulation If a dual-chamber pacemaker is being measured then the right hand column gives the following: A-V — The time interval between atrium and ventricle stimulations A — The duration of the atrium stimulation
Interpretation	Interpretation Screen	Edit/ Enter interpretation.
	Write Unconfirmed Report	Yes or No. 'Unconfirmed Report' is added/not added to the interpretation statements on the auto ECG printout (if applicable).
	Write Abnormal ECG	Yes or No. 'Abnormal ECG' is added/not added to the interpretation statements on the auto ECG printout (if applicable).
	Sensitivity	**Normal** or **low** sensitivity. Low sensitivity will suppress certain non-specific ECG diagnoses; this may be advisable when carrying out ECGs for screening.
	Thrombolysis (option)	On or Off. Thrombolysis is the breaking up of a blood clot. When Thrombolysis option is off, the interpretation text "**possible infarct or other abnormality**" is disabled.

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Parameter	Options	Description
Rhythm Rec (not available at time of print)	Rhythm Lead R1, R2, R3 and r1	Defines the rhythm leads used for rhythm recording
	Format	Defines the printout format (and by default the speed of the trace). Select between: • 90 sec/page - printout every 90 seconds • 5 min./page - printout every 5 minutes • 10 min./page - printout every 10 minutes
	Amplitude	Defines the amplitude of the trace. Select between: • Normal • Low (half amplitude)
	Print current page	For Rhythm recording see page 36.
	Print last page	For the recording procedure see page 36.
	Start / Stop	Starts / Stops Rhythm recording. For the recording procedure see page 36.
Signal Average (Late Potentials) (Not available at time of print)	High Pass Filter	Select between 25Hz, 40Hz and 80Hz - late potential analysis RR is a future option and not available for this release
	No. of QRS	
RR Variability (Not available at time of print)	Window Type	RR variability is a future option and not available for this release
	No of RR	
	FFt Type	
	Phase - space plots	
	Correction of RR	
	Lower bound of VLF	
	Lower bound of LF	
	Lower bound of HF	
	Upper bound of HF	
	Signal Acquisition Start / Stop	

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Parameter	Options	Description	
Autom. Format (Automatic mode for formats 1 and 2)	ECG Printout	No Printout	No printout of the ECG given at the end of an auto mode recording (the recording can be stored in the memory and printed at a later time if required).
		4*3 + 1 Rhythm (r1)	Leads are printed in a 4 * 3 format at 25mm/s, with the selected rhythm lead (r1)at the bottom of the page at 25mm/s.
		1*12 at 25 mm/s	Leads are printed in a 1 * 12 format at 25mm/s.
		8*5 + 4*10s	Five seconds of 8 Leads, and 10 seconds of four leads are printed at 25mm/s.
		2*6, 25mm/s, 1page	Leads are printed in a 2*6 format at 25mm/s (one page).
		2*6, 50mm/s, 1page	Leads are printed in a 2*6 format at 50mm/s (one page).
		2*6, 25mm/s, 2pages	Leads are printed in a 2*6 format at 25mm/s (two pages).
		2*6, 50mm/s, 2pages	Leads are printed in a 2*6 format at 50mm/s (two pages).
	Average Cycles	No Printout	No printout of average cycles.
		4*3, 25mm/s + 2 Rhy	Leads are averaged over the entire 10 second recording and printed in 4 groups of 3 leads at 25mm/s, with the two selected rhythm leads (R1, R2) at the bottom of the page at 25mm/s.
		4*3, 50mm/s + 2 Rhy	Four groups of 3 leads at 50mm/s, with the two selected rhythm leads (R1, R2) at the bottom of the page at 50mm/s.
		2*6, 50mm/s + 2 Rhy	Two groups of 6 leads at 50mm/s, with the two selected rhythm leads (R1, R2) at the bottom of the page at 50mm/s.
	Rhythm Lead R1	Select lead for the first rhythm lead on the screen and printout.	
	Rhythm Lead R2	Select lead for the second rhythm lead on the screen and printout.	
	Measurements	Select yes or no to print a detailed table of measurement results.	
	Markings	Select yes or no to print reference markings on the ECG average cycle print. A vertical marker shows the beginning and end of P wave and QRS, and the end of the T wave.	
	Interpretation	Select yes or no to print interpretation statement (C version only).	
Programmable Leads (not available at time of print)	Lead 1 to Lead 12	In addition to the conventional lead order (Standard or Cabrera), you can define an individual lead sequence (user defined). The screen lead display (and printout) is changed in the **Lead** tab (next tab) . Also see page 31.	
Lead	Lead Sequence	This sets the lead sequence for manual and auto printouts as well as on the screen. Set to **Standard, Cabrera.** or **User Defined** (not available at time of print).	
	Signals	**Sequential** of **Simultaneous**.	
	Auto Centring	Yes or No. Printer trace alignment affects both the manual as well as the automatic printout. A change of the current setting is only valid on the printout after a new number of printer channels is selected by pressing the key during or before printing, or after a new lead group is selected by pressing the lead keys during printing.	

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Parameter	Options	Description
	Auto Sensitivity (Reduction)	Yes or No. In auto mode a default recording sensitivity of 10 mm/mV is set. However, if the amplitudes are high meaning that the QRS peaks would overlap, the sensitivity is reduced automatically to 5 mm/mV. When this is set an 'A' appears in the information line on the bottom of the screen see page 18.
	Rhythm Lead Group	Print/ don't print (On or Off)
	Left Posterior (V4-V9)	Print/ don't print (On or Off)
	Right Pectoral (V5r)	Print/ don't print (On or Off)
	Right Pectoral (V6r)	Print/ don't print (On or Off)
	Nehb (D, A, J)	Print/ don't print (On or Off)
Filter	Baseline Filter	The cutoff can be set for 0.05Hz, 0.15Hz, 0.30Hz or 0.60Hz, for both resting and Exercise recording. NOTE: The 'standard value set is 0.05 Hz. The higher settings should only be used when absolutely necessary because it could affect the original ECG signal, especially the ST segment.
	Myogram Filter	 The Myogram filter suppresses disturbances caused by strong muscle tremor. The filter is applied by pressing the **Filter** key (or programmed on as default when the unit is switched on). The cut off frequency is displayed in the information box -see page 39. The cutoff frequency is user defined at 25Hz or 35Hz. **Note**: An ECG recorded in auto mode is stored unfiltered. It is therefore possible to print the stored ECG either with or without passing the myogram filter.
	Mains Filter	The mains filter is an adaptive digital interference filter designed to suppress ac interference without attenuating or distorting the ECG. Set the mains filter in accordance with the frequency of your local mains supply.
	SBS Filter (baseline)	The baseline stabiliser greatly reduces the baseline fluctuations without affecting the ECG signal. The purpose of the stabilizer is to keep the ECG signals on the baseline of the printout. This filter is only effective in auto mode printout. The Baseline Stabiliser is applied to a recording (on), or not applied to a recording (off). The cutoff frequency is set above.
	SSF Filter (smoothing)	The smoothing filter (SSF: SCHILLER smoothing filter) is a low pass filter to suppress high frequency artefacts between the QRS complexes. When this filter is switched on, `SSF` is shown on the bottom line of the automatic printout.
General	QRS Beeper	On or Off
	Show Results on Display	At the end of an Auto test, display the results on the screen (Yes) or don't display (No).
	Inv. ECG Monitor	Inverse the screen display. Select Yes or No.
	PM Detection	On or Off. When On is selected and a PM pulse is detected a vertical line is shown on the ECG trace. Note that this pulse is relative of time but is not representative of either pulse amplitude, polarity or duration. When Off is selected a detected pacemaker pulse is shown as measured. A pacemaker measurement option is also available (see beginning of this table).
	Autom. printout	At the end of an Auto test, print the results (Yes) or don't print (No).
	Autom. storage	At the end of an Auto test, store the results (Yes) or don't store (No).
	Autom. transmission	At the end of an Auto test, transmit the results (Yes) or don't transmit (No). The transmission settings are defined in system settings - menu key > comm. tab (see page 63).

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6 Exercise ECG

⚠WARNING

- ▲ The AT-10 plus is CF rated. The patient connection is fully isolated. Always ensure however, that during the recording neither the patient nor the conducting parts of the patient connector nor the electrodes come into contact with other persons or conductive objects (even if these are earthed).
- ▲ Do not use the unit or the ergo device, if the earth connection is suspect or if the mains cable is in any way damaged.
- ▲ The operating instructions supplied with the ergometer must be read and understood before commencing an exercise test. Instructions given in this book do not override those given for the ergometer.
- ▲ Ensure that the resting ECG confirms that the patient is able to carry out an exercise ECG.
- ▲ Ensure a charged defibrillator is to hand when carrying out an exercise test.

- ▲ To avoid possible interference from the Ergometer when carrying out an exercise test, it is recommended that both the AT-10 plus and the Ergometer are connected to the same common ground.
- ▲ The potential equalisation connector is situated on the rear of the unit. A yellow/ green ground cable is supplied as an option (Article number 2. 310 005).

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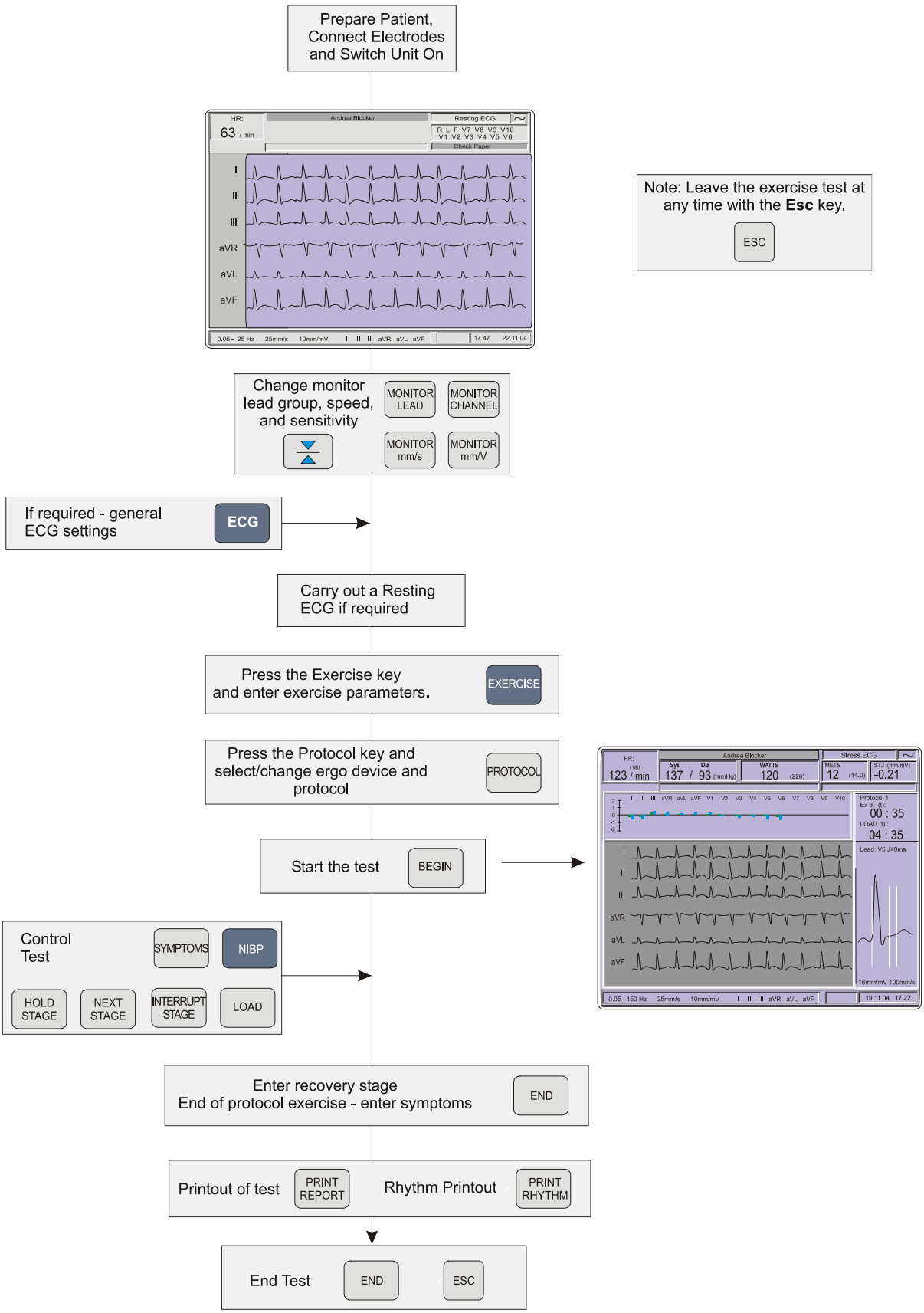
6.1 Exercise Flow Diagram



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6.2 Test Procedure Overview

- Ensure that the ergo device is connected to the AT-10 plus, and is powered up ready for use, please read the ergometer documentation.
- Ensure that the external NIBP unit (if used), is connected and powered up.
- The bicycle and/or treadmill and the blood pressure unit must be defined in system settings (**Menu key > peripherals** - see page 63). For peripheral connection details see page 18.

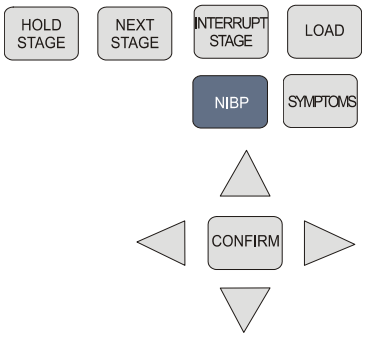
1. Connect the electrodes (see page 27).

2. Enter patient data and check the resting ECG (see page 24).

3. Define the exercise settings, heart rate target, ST segment measurement etc., (see page 53).

4. Select ergo device (bicycle or treadmill) and select exercise protocol (see page 55).

5. Warn the patient that the test is about to start, and press the **Begin** key. The test begins with the initial load defined (bicycle), or speed set (treadmill), in the protocol selected. During the test the user can:



- hold the current protocol stage **(Hold Stage)**
- go to next stage **(Next Stage)**
- Interrupt a stage **(Interrupt Stage)**
- change load (**Load**)
- manually initiate a blood pressure measurement (**NIBP**)
- enter symptoms (**Symptoms**)
- change the ST measuring point (**left / right arrow** keys)
- change the enlarged lead (**up / down arrow** keys)
- change the graphical representation at the top of the screen (**confirm** key or **enter** key)
- (these functions are described on the following pages).

6. Enter the recovery stage by pressing the **End** key (see page 52). The end of test symptoms screen is displayed. Enter up to three end of test symptoms.

7. Press **Print Report** to obtain a complete printout of the test.

8. Press **Print Rhythm** to obtain a complete printout of the defined rhythm lead.

9. Press **End or Esc** to exit the recovery stage and end the test.

⚠ CAUTION

When the test is ended, all exercise data is lost and not further printouts can be obtained.

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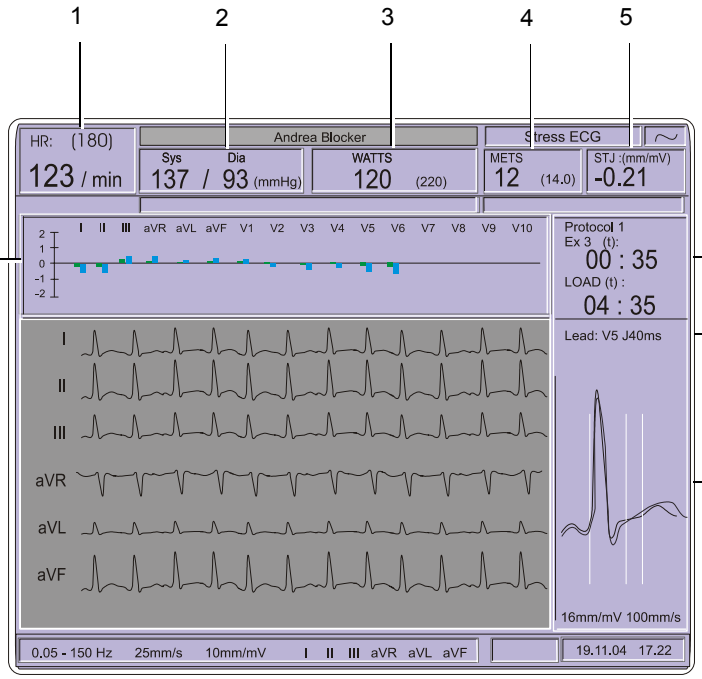
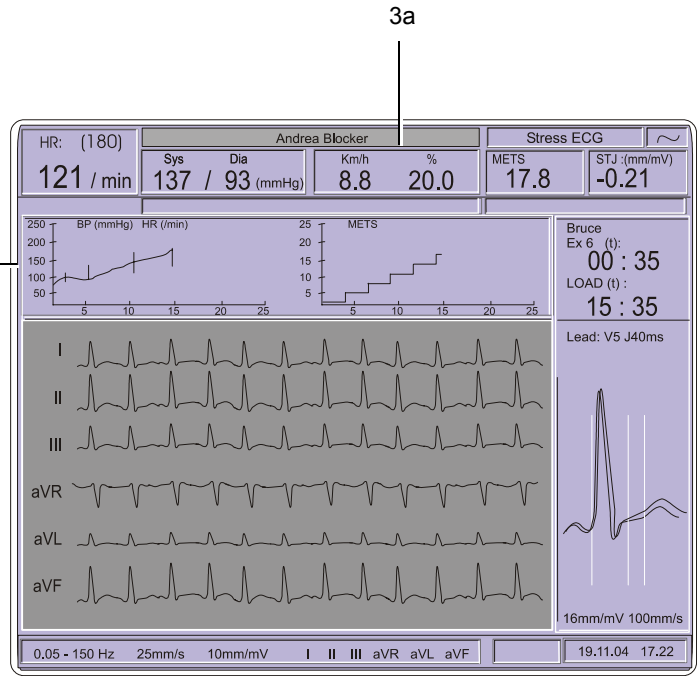
6.3 During the Test

The following is an example of the screen during an exercise ECG when using a bicycle or a treadmill.



Typical Display for a Bicycle Protocol



Typical Display for a Treadmill Protocol

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In addition to the resting ECG display and control (see page 38), the following test information is displayed:

(1) The target heart rate is shown in brackets next to the heart rate. The target HR is defined in exercise settings (see page 53).

(2) The last recorded blood pressure (either entered manually or taken automatically, see page 51).

(3) Current load in Watts (bicycle) **(3)** or, speed and elevation (treadmill) (**3a).**

(4) The current METs rate (see page 48).

(5) The elevation of the reference lead at the measuring point (in mV). The lead measured lead and the ST measuring point is indicated by J20, J40, J60 or J80 (measuring point in ms after the j-point.) in the enlarged complex **(8)**.

(6) Two graphical displays can be shown in this area. The same two displays are given for both treadmill and bicycle protocols.

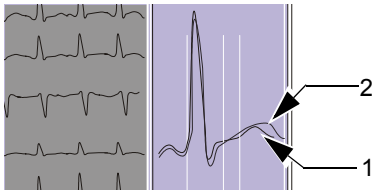
– Graphical representation of the ST elevation for every lead. The green bar shows the reference ST elevation taken at the beginning of the test, and the blue bar displays the current elevation.
– Two trend graphs **(6a).** The first graph shows heart rate trend, and BP (shown as vertical line at the time of measurement giving systolic and diastolic measurements). The second graph displays the METs rate against time.
– Toggle between the two displays with the **Enter** key (or the **Confirm** key).

(7) The test information:

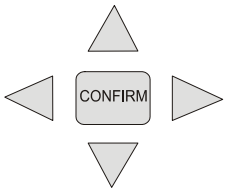
– Protocol identification.
– Current stage and the time in that stage. Pre = pre-exercise (warm-up), Ex1, Ex2 .. etc. is exercise stage, and Recov = recovery.
– Accumulative time that the patient has been under load (from the start of the test).

(8) The reference lead identification on which the slope ST slope and elevation is taken **(5 and 6)** at the measuring point (J point + ms)

(9) Enlarged QRS of reference lead.



➜ The green reference curve **(1)** is the curve recorded during the warm-up phase and the red curve **(2)** is the current curve (updated every 15 seconds, averaged over 10 seconds).



➜ The enlarged lead is changed during the test with the **up / down** arrows keys
➜ The measuring point is changed during the test with the **left / right** arrows keys

The default for the enlarged lead and the measuring point for ST elevation and slop is set in exercise settings (**exercise key > QRS settings -** see page 53). Any lead can be selected and the measuring point can be set to 20, 40, 60 or 80 ms after the J-point.

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Metabolic Equivalents (METS)

The metabolic equivalents, or METS, provides a simple means of determining energy expenditure during exercise.

The provision of a MET value for each stage of an exercise test assists in determining the exercise tolerance of a patient in conjunction with factors such as weight, degree of fitness, sex and age.

Definition of METS

1 METS = 3.5 ml of O_2 per minute per kilogram of body weight

One Met is defined as the resting metabolic rate, i.e. the amount of oxygen consumed by the patient while seated at rest. As such, an individual exercising at two METS requires twice the oxygen requirement compared to the resting metabolism - at three METS, three times as much oxygen etc.

For a standard stress test without gas exchange measurements, the METS value is calculated on the basis of an approximation formula. The calculated value may thus differ from the actually measured value.

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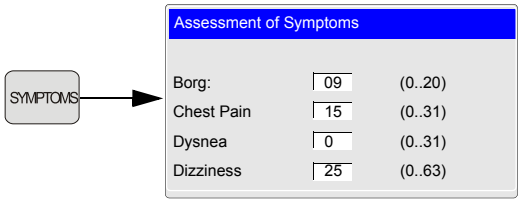
6.3.1 Entering Symptoms

During the test, subjective patient symptoms can be entered according to their severity. To enter this data, press the Symptoms Key



Enter a judgement between the given scale for all values. Enter the desired values and confirm by pressing the **Enter** key or **Confirm** key

The values entered here will appear both on the screen, on the periodic printout, and on the final printout.

To display the symptoms along with their assigned values both on the screen and on the printout, it is necessary that at least for one symptom a value has been entered.

Symptoms entered here are displayed and stored for printing with the final report. At the end of the test, you are also prompted to assess final symptoms, along with other data, see page 52.

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6.3.2 NIBP

The BP measurement is printed with every exercise stage, and the current BP measurement is displayed on the screen. The BP can be entered manually, or taken automatically as follows:

- BP taken with an external unit and entered manually in two ways:
  - The BP entry screen is displayed one minute before the end of every stage for manual entry (the screen remains on display for 30 seconds).
  - The BP entry screen is only displayed when the NIBP key is pressed.

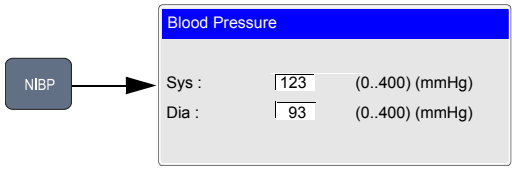
- BP taken with a digital BP unit connected to the AT-10 plus and recorded automatically:
  - Measurements are taken at preset intervals one minute before the end of each stage. During recovery the BP is taken at the interval defined for recovery printout and is taken approximately one minute before the printout.

The BP measurement method is defined in system settings **(Menu key > peripherals** - see page 63).

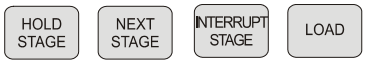
Only one BP measurement is stored per stage i.e. the last BP recorded (either manually or automatically) during the stage.

Manually entering the BP

The BP can be entered manually at any time by pressing the **NIBP** key



6.3.3 Controlling the Ergometer during the Test



Use the Ergometer control keys to advance to the next stage, hold current stage and define load/speed elevation.

- The **Hold Stage** function holds the current stage (speed/elevation or load), until **Next Stage** is pressed. The test clock continues to count during the period that the stage is held.
- The **Interrupt Stage** function interrupts the test (treadmill stops or the patient stops pedalling). This function is, for example, to enable the physician to administer medication. During this period the test clock stops counting. The test is resumed by again pressing the **Interrupt Stage key** - the test recommences from where it was stopped and the test clock recommences.

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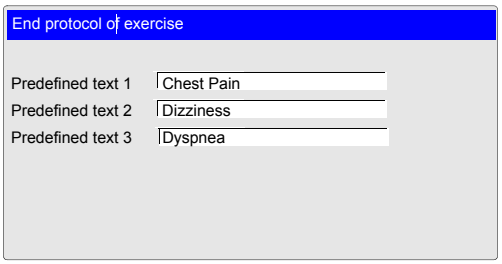
6.4 At the End of the Test

END

Press the **End** key to enter the **recovery** phase as defined in the protocol.

When the **End** key is pressed the recovery stage is entered immediately. If you wish to continue to the end of the current stage before entering the recovery stage, press the **Fn** key followed by the **End** key.

The end test symptom screen is displayed. Enter patient symptoms:



Symptoms can be selected for the predefined text 1, 2 and 3 as follows:

- Chest pain
- Dizziness
- Dyspnea
- ECG Changes
- Arrhythmia
- Fatigue
- Target HR attained
- BP behaviour
- Decrease of HR during exercise
- Decrease of BP

This data is stored with the recording and printed on the printout.

PRINT REPORT

Press **Print Report** to obtain a printout of the test. The data to be printed is defined in the exercise settings (**Exercise key > Final report** - see next page).

PRINT RHYTHM

Press **Print Rhythm** to obtain a printout of the rhythm lead over the entire recording. The lead, speed and sensitivity must be defined before the test begins and is defined in the exercise settings (next page).

END ESC

Press **End or Esc** to end the test.

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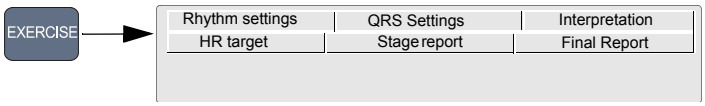
6.5 Exercise Settings

6.5.1 General Exercise Settings

When the **Exercise** key is pressed a screen is shown with a number of tabs at the top. When the tabs are selected further ECG options and settings are available. This section gives an overview of all the settings and tabs available in the following table.



Menu navigation, selection and confirmation are detailed in the Introduction, see page 23.

All changed settings are remembered until the unit is switched off. If you wish to keep the settings as default, the 'save as default' icon (**Menu key > Software > Save as Default**), must be pressed before switch off - see page 63.

6.5.2 Table of Exercise Settings and Options

Parameter	Options	Description
HR target	Heart Rate Target Mode	An audible and visual target (heart rate indication flashes) is initiated if the HR target is breached. The target setting is shown in parenthesis after the HR measurement. The HR target can be automatically set or manually defined as follows. • Off - no HR target set • '**Use formula below**': This option allows for any heart rate target setting to be defined. • 90% of 220 – age • 220 – age • 200 - age **The following options are available when the 'use formula below' option is selected:**
	Percent of Target HR	This factor is applied to the defined target HR, or the Target HR - age, as defined below.
	HR Target	Define a target HR within the range of 100 to 250 beats/min.
	Age	Age - yes or no - the patient's age is/is not subtracted from the target HR. **Notes**: • The age is calculated from the patient data. • The heart rate target limit is calculated for any new patient for which data is entered. • The HR target is used in the final report to give the percentage that the maximum heart rate achieved during the test, against the maximum calculated heart rate.

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Parameter	Options	Description
Stage Report	Print Resting ECG	Select Yes or No to print the resting ECG format (auto format 1).
	Stage print format	During the exercise and recovery phase, periodic printouts can be obtained at preset intervals defined below. The format of the printout can be: – 4*3 + 1 rhythm (R1) – 1*12, 25mm/s – 2*6 at 25mm/s, 1 page – 2*6 at 50mm/s, 1 page – 2*6 at 25mm/s, 2 pages – 2*6 at 50mm/s, 2 pages
	Average cycles	Do not print the average cycles (no) or print in the format: – 4*3, 50mm/s, 2Rhy, (R1, R2) – 2*6, 50mm/s, 2Rhy, (R1, R2)
	Stage printout Interval	Set the writing report print interval to any of the following, (applies to bicycle and treadmill): – Off - no stage printout – Between one and nine minutes (in one minute intervals)* – Printout at the end of every stage * Note that the stage interval printout must be ≤ the stage duration (defined in the protocol) or no printout will be given.
	Recovery print interval	Define the print interval as for the stage printout or select ‘Non cyclic‘ and define the time intervals (below).
	Printout after	Select the time interval for up to 5 printouts in the recovery phase (when set to ‘non cyclic‘ above.
Final Report	ST Value Table	Print a table of all ST values (Yes) or don‘t print (No).
	ST Trends (not available at time of print)	A graph of the ST amplitude and slope. Select Yes to print, or No to suppress printing.
	ST-HR Diagram (not available at time of print)	A graph of the ST amplitude against heart rate. Select Yes to print, or No to suppress printing.
	Interpretation	Yes (print) or No (suppress printing).
	Print Rhythm (R4)	Print rhythm lead R4 Yes or No.
Rhythm settings	Rhythm record lead (R4)	Select the lead for rhythm recording (for rhythm strip when Rhythm (R4) selected in **Final Report** above) - select either I, II, III, aVR, aVL, aVF, V1 - V6.
	Speed	Select Rhythm strip printing speed. Set to 6.25 mm/s or 12.5 mm/s.
	Sensitivity	Select Rhythm strip sensitivity (amplitude). Set to 5 mm/mV or 2.5 mm/mV.
QRS Settings	ST Amplitude Measurement	During the exercise test, the ST amplitude is measured on the enlarged lead (see next entry) and is measured continuously. The measuring point can be changed at any time during the test. The default position of the amplitude measurement point can be set here to 20, 40, 60 or 80 ms after the j-point. .
	Lead for Enlarged QRS	Select the default lead for the zoom view. The enlarged QRS complex appears to the right of the screen during exercise testing and can be changed at any time during the test. The red enlarged lead is averaged over 10 seconds and updated every 15 seconds. The green lead is the resting reference taken during the warm-up phase.
	Unit of ST Measurement	Select between mm or mV.
Interpretation		Enter / Edit exercise interpretation.

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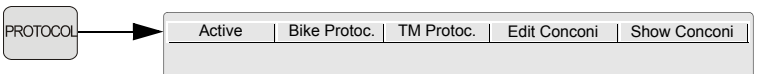
6.6 Defining a Protocol

When the **Protocol** key is pressed a screen is shown with a number of tabs at the top. When the tabs are selected further protocol options and settings are available. This section gives an overview of all the settings and tabs available in the following table.



Menu navigation, selection and confirmation is detailed in the Introduction, see page 23.

Parameter	Options	Description
Active Protocol	Active Ergo device	Select Bike or Treadmill. Note that the specific device types must be defined in the system settings, see page 63.
	Protocol Bike	Select between protocols 1 to 4 or Conconi.
	Protocol Treadmill	Select between protocols Bruce, Balke, Naughton, Ellestad, Cooper, or one of three user defined protocols. The standard protocols are shown on the following page.
Bike Protocol	Choose Protocol	Select a protocol (from 4).
	Change Protocol Name	Define any suitable name (not available at time of print).
	Pre Load:	Define the pre-exercise ‘warm-up‘ load.
	Pre Time	Define the pre-exercise ‘warm-up‘ time.
	Exercise Base load	This is the load which is applied at the beginning of the test (after pre-exercise warm-up).
	Exercise Stage load	The 'load step' determines the load increase for each step. Depending on the type of ergometer, the exercise test will continue to apply load steps (unless manually interrupted) up to a maximum load of 900 W. However, although 900 W may be indicated on the unit, the actual load may be less, dependent on the load capacity of the bicycle.
	Exercise Stage time	The 'step interval' determines the length of time a load step is maintained before moving on to the next one.
	Exercise Ramp	Yes or No. When ramp is selected the load is increased gradually over the complete period of the stage.
	Recovery load	The 'recovery load' is the load which is set during the recovery phase when the exercise test is ended.

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Parameter	Options	Description
Treadmill Protocol	Choose Protocol	Select a protocol (from the standard protocols or from previously user defined protocols).
	Change Protocol Name	Define any suitable name (not available at time of print).
	Pre Exercise:	Define the pre-exercise speed (between 2km/h and 9.9km/h, 1.2mph and 9.9mph).
	Exercise:	Up to 12 stages can be defined. For each stage the following is defined: **Duration:** Length of the stage in minutes - select between 1 and 9 minutes. **Speed:** Up to the maximum speed of the treadmill - select between 2km/h and 25km/h. **Elevation**: Up to the maximum elevation of the treadmill - select between 0% and 25%.
	Recovery	Define the recovery speed.
Edit Conconi (not available at time of print)	Start Load/Speed	The Conconi test is based on a constant work output over each stage. When the speed of the treadmill/ bicycle load is increased, the stage time is decreased so that the work output coefficient remains constant (as calculated on the first stage). Enter the start speed (between 2.5 km/h and 18.0 km/h) or start load (between 25W and 100W).
	Duration	Enter the duration of the first stage in seconds.
	Load/Speed Augmentation	Speed / Load increase (from 0.1 km/h to 2.0 km/h or 10W to 50W) in steps of 0.1 km/h (1W) from stage to stage is defined. Once the increase has been entered, the time for each following stage is automatically calculated by the unit.
	Report at stage end	To obtain an ECG printout at the end of each stage set to On.
	Recovery Load/Speed	Enter the recovery load / speed.
	Recovery end of stage (end of test)	Recovery stage at end of test Yes or No

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6.6.1 Standard Treadmill Protocols

Some of the proven protocols are as follows:

6.6.2 Bruce

Stage	Duration [minutes]	Speed [km/hr] / [mph]	Elevation [%]
1	3	2.7 (1.7)	10
2	3	4.0 (2.5)	12
3	3	5.4 (3.4)	14
4	3	6.7 (4.2)	16
5	3	8.0 (5.0)	18
6	3	8.8 (5.5)	20
7	3	9.6 (6.0)	22

6.6.3 Balke

Stage	Duration [minutes]	Speed [km/hr] / [mph]	Elevation [%]
1	2	5.0 (3.0)	2.5
2	2	5.0 (3.0)	5.0
3	2	5.0 (3.0)	7.5
4	2	5.0 (3.0)	10.0
5	2	5.0 (3.0)	12.5
6	2	5.0 (3.0)	15.0
7	2	5.0 (3.0)	17.5
8	2	5.0 (3.0)	20.0
9	2	5.0 (3.0)	22.5
10	2	5.0 (3.0)	25.0

6.6.4 Naughton

Stage	Duration [minutes]	Speed [km/hr] / [mph]	Elevation [%]
1	3	3.0 (2.0)	0.0
2	3	3.0 (2.0)	3.5
3	3	3.0 (2.0)	7.0
4	3	3.0 (2.0)	10.5
5	3	3.0 (2.0)	14.0
6	3	3.0 (2.0)	17.5

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6.6.5 Ellestad

Stage	Duration [minutes]	Speed [km/hr] / [mph]	Elevation [%]
1	3	2.7 (1.7)	10.0
2	3	4.8 (3.0)	10.0
3	3	6.4 (4.0)	10.0
4	3	8.0 (5.0)	10.0
5	3	8.0 (5.0)	15.0
6	3	9.6 (6.0)	15.0

6.6.6 Cooper

Stage	Duration [minutes]	Speed [km/hr] / [mph]	Elevation [%]
1	1	5.3 (3.3)	0.0
2	1	5.3 (3.3)	2.0
3	1	5.3 (3.3)	3.0
4	1	5.3 (3.3)	4.0
5	1	5.3 (3.3)	5.0
6	1	5.3 (3.3)	6.0
7	1	5.3 (3.3)	7.0
8	1	5.3 (3.3)	8.0
9	1	5.3 (3.3)	9.0
10	1	5.3 (3.3)	10.0
11	1	5.3 (3.3)	11.0
12	1	5.3 (3.3)	12.0

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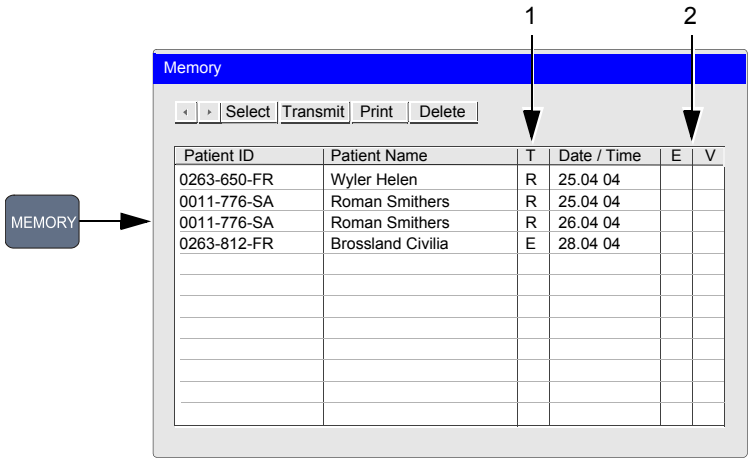
7 Memory and Transmission

Recordings can be stored locally, and/or transmitted to a PC. This can be carried out either automatically or manually after a recording has been taken. Recordings stored in memory can also be transmitted at any time.

7.1 Memory

Up to approximately 50 recordings can be stored in the memory. Note that at the time of print it was not possible to store exercise recordings.

When the **Memory** key is pressed, stored recordings are displayed:



The recordings are listed by Patient ID. The type of recording is indicated in the T column **(1)**, as follows:

- R = Resting (ECG)
- E = Exercise (ECG) (not available at the time of print)

A tick in the status columns **(2)** means that the recording has been:

- E = Exported
- V = Validated (not available at the time of print)

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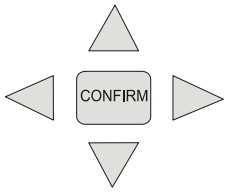
7.1.1 Transmitting, Printing and Deleting Stored Recordings



1. Highlight the selected file by moving the cursor with the **up /down arrow keys**.
2. Press the **Confirm key** to select the recording. The recording is highlighted with a black background when selected (deselect a recording by pressing the confirm key again).
3. Repeat steps 1 and 2 to select further recordings.
4. Use the left / right arrows keys to select function -
   – Transmit
   – Print
   – Delete
5. Press the **Confirm key** to carry out the selected function for the highlighted recording(s).

To select all recordings press the function key (Fn) and key A.

Fn + A = select all.

To deselect all, press Fn + A again.

7.2 Storing a Recording

7.2.1 Automatic Storage

The auto storage setting is defined in ECG settings:

- **ECG Key > General tab** - **Autom**. **storage** (yes/no) - see page 40

When auto storage is defined a recording is stored automatically after it has been taken.

7.2.2 Manual Storage

To store an auto mode recording manually, press the **Store Data** key.

7.3 Transmitting/ Receiving Data

Transmission is possible over the following:

RS-232 connector on the side panel

Transmission to a computer (with for example the SEMA-200 installed) connected directly to the RS-232 interface on the side of the AT-10 plus.

SCHILLER Communication Module (SCM) option

When the SCM option is installed transmission is possible over a network or telephone system.

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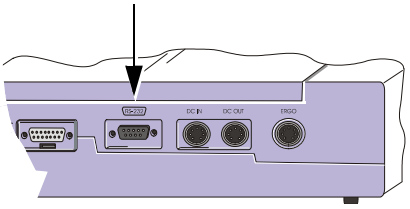
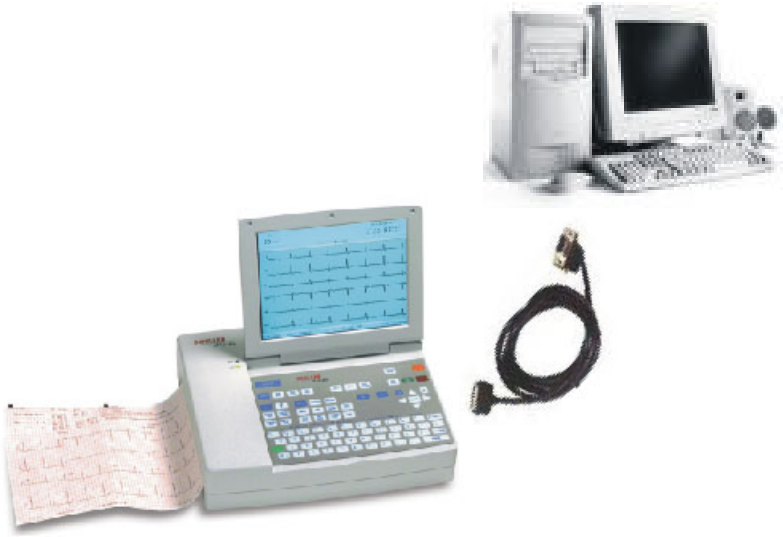
7.3.1 Setup

RS-232 connector to a computer

Using the RS-232 cable assembly, attach the RS-232 connector on the side panel of the AT-10plus to the RS-232 connector of your PC - consult your computer documentation for details.

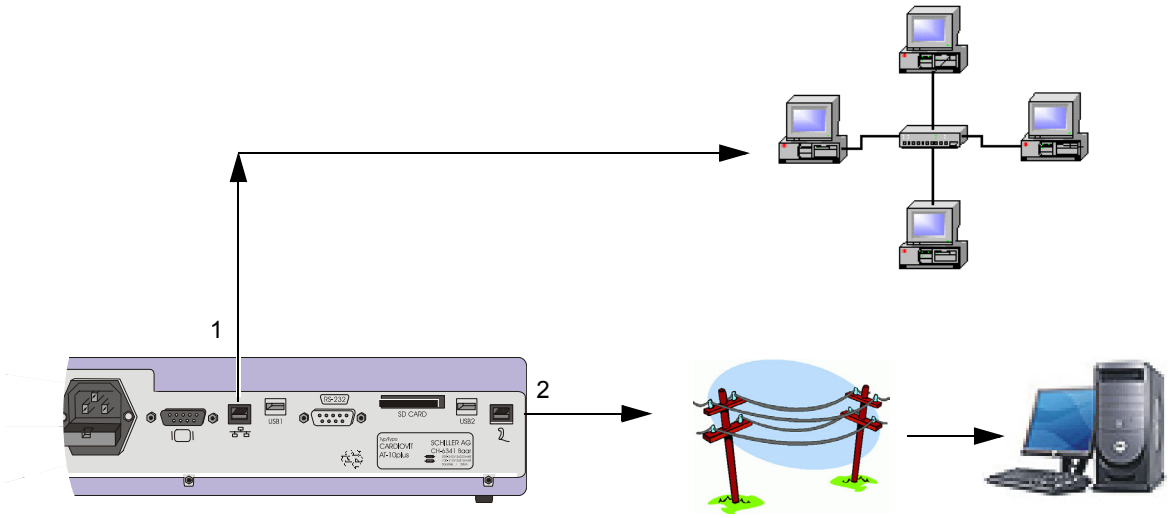




Ensure the SEMACOMM program is open on the PC

Network or telephone (with SCM Module)

- For an ethernet (network) connection connect the cable assembly to the RJ-45 connector **(1).**
- For a telephone connection connect the telephone cable assembly to the RJ-11 connector **(2)** (not available at time of print).



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7.3.2 Automatic Transmission

The auto transmission setting is defined in ECG settings:

ECG Key > General tab - **Autom**. **transmission** (yes/no)- see page 40)

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

7.3.3 Manual Transmission

SEND DATA

To Transit an auto mode recording after being taken, press the **Send Data** key.

7.3.4 Receiving Data from the PC

At the time of print this function was not available.

GET DATA

To receive data from a remote location, press the **Get Data** key.

- Transmission over the telephone system uses a modem - the internal modern option (in the SCHILLER Communications module option), must be installed.
- When transmitting to SEMA-200 the SEMACOMM program must be installed on the computer.
- The Baud rate, telephone number, interface definition, and all other communication settings are defined in system settings (see page 67).

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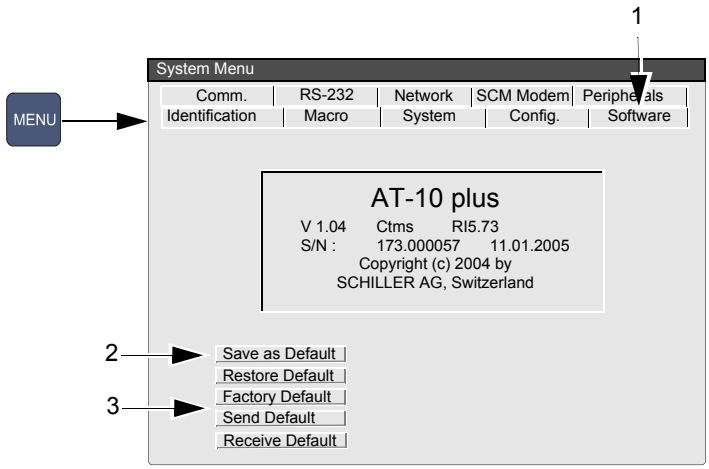
8 General and System Settings

8.1 System Settings

When the **Menu** key is pressed a screen is shown with a number of tabs at the top. When the tabs are selected further options and settings are available. This section gives an overview of all the settings and tabs available in the following table.

All changed settings are remembered until the unit is switched off. If you wish to keep the settings as default, the software screen must be entered **(1)**, and the 'save as default' icon **(2)**, pressed before the unit is switched off.



The **Factory Default, Send Default** and **Receive Default** icons **(3)**, are detailed in the following unit settings table.

8.2 Table of Unit Settings

Parameter	Options	Description
Identification	MTA Identification	This function is to register the name of the medical assistant or doctor carrying out the recording. The MTA is identified on each automatic printout. The maximum number of characters is 23.
	User Identification	This function is to register the name of the practice, department, or hospital, clinic etc. It is identified on each automatic printout.The maximum number of characters is 23.
Macro (not available at time of print)		Enables a series of key stokes or actions, to be stored and recalled by pressing a single key.
System	Language	Select required language between German, English, French, Swedish, American, Italian, Spanish or Portuguese. Note that the difference between 'English' and 'America' is that some of the designations used on the display and prinout are different. For example, American use V1-V6 lead designation, and the heart rate is BPM.
	Time	Set current time.
	Date	Set current date.

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Parameter	Options	Description
System (continued)	Date Format	Set required date format.
	Time Format	Set required time format.
	Colour	Set the display colour to Cyan, Grey, Black or Blue. The colour must be confirmed as default as follows: 1. Set colour in this menu option. 2. Click the **software tab**, and in the software screen confirm **Save as Default.** Exit the menu**.** 3. Switch the unit off, and then on again to confirm. Note that the screen can also give a reverse image. This is defined in ECG > General tab - see page 40.
Config.	Patient Data Input	Add an additional data field in the patient data input menu as follows: • Med./Rem. (Medication / Remarks). • Med./Doc. (Medication / Doctors Name). • Med./Room (Medication / Room No.). • Room/Doc.(Room No. / Doctors Name). • Room/Rem.(Room No. / Remarks). • Doc./Rem.(Doctors Name / Remarks). The selected field will be displayed in the patient data entry (see page 24).
	Units	Define units in cm/kg or inch/lbs.
	Speed	Define speed in k/ph or mph.
	Temperature	Celsius or Fahrenheit.
	Ambient Pressure	mmHg or hPa.
	External Display Output	Set to Yes or No.
Software	Software Version Display	The current software version for the AT-10 plus. Also displayed is the serial number of the unit and any options that are installed as follows: Base configuration (upper case) M = Measurements (Standard) C = Interpretation Options (lower case) m = memory extension t = thrombolysis s = stress for example Cmt is a C unit (interpretation), with memory extension and thrombolysis.
	Save as default	Save current settings as the default.
	Restore default	Restore settings to the defined default.
	Factory default	Restore settings to the factory default.

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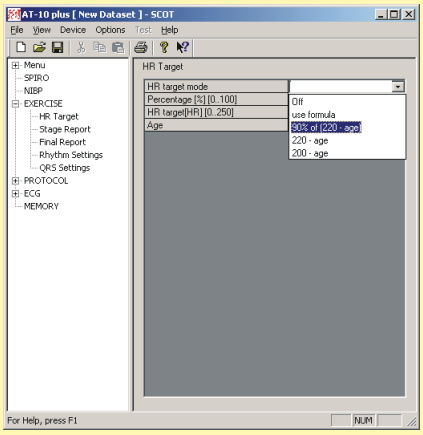
Parameter	Options	Description
	Send default	Store current default setting to a PC (usually a service technician will carry this out). The unit must be connected to a computer (see page 61) with the SCHILLER communication tool (SCOT) installed.  **SCHILLER communication tool** When the **send default** icon is clicked **all unit settings** (ECG and exercise settings, data format, language, communication, etc.,) are sent to the SCOT program where they are stored and can be edited. These settings can then be copied to other unit(s) so that all units have the identical settings.
	Receive default	The unit must be connected to a computer (see page 61) with the SCHILLER communication tool (SCOT) installed. When the **Retrieve default** icon is clicked **all unit settings** in the SCOT program are transferred to the connected AT-10 plus.
Comm. - See following pages		
RS-232	Baudrate	This defines the maximum communication rate for the modem (when Modem is selected in the Mode field (below)).Tick the rate defined in the modem handbook. Select a Baud rate between 57600 and 14400 Baud, according to the modem/computer used. The standard modem speed is 57600 Baud. If problems are experienced during transmission reduce the Baud rate.
	Phone Number (Transmission using a modem was not possible at the time of print)	Enter the telephone number preceded by `T` or `P` (tone or pulse). If it is necessary to enter a pause in the dialling sequence enter a comma (,) in the number. The comma gives a one second pause. If a longer pause is required, two or more commas can be entered. This may be required for example, if you have to wait for an outside line. It is also a good idea to insert a pause after a national or international code.
	Modem Init (Transmission using a modem was not possible at the time of print	The code will be found in the user guide for the modem. If the handbook is not available, the standard Hayes code should work for most modems. This is the default setting. The modem initialisation must contain at the minimum, the following commands with the prefix `AT`. • `Q0`- modem sends response • `V0`- numerical response codes • `E0`- no command echo • The standard modem initialisation code is: ATB0L1V0Q0E0S0=0 If in doubt about any of these settings, please contact your phone company and/or modem supplier.

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Parameter	Options	Description
Network- See following page		
SCM Modem - See following page.		
Peripherals	Blood Pressure unit	The latest BP measurement is displayed on the monitor and all BP measurements are stored with the exercise recording. Select the way the blood pressure will be taken as follows: • **Off** - the BP entry screen is not displayed automatically during the test, however the BP can be entered at any time during the test by pressing the **NIPB** key. • **Manual Input** - the BP is taken by an external BP device and entered during the test. The BP entry screen is displayed one minute before the end of every exercise stage (see page 55). • **Ergo 900** (an external, digitally controlled blood pressure unit). With this unit BP is taken one minute before the end of every exercise stage defined in the protocol.
	Bicycle	Select the type of bicycle connected - analogue or digital as follows: • ERG900 / 911 / Ergosana (digital) • SECA CT100 mod. 545 (digital) • Analogue 1V / 100W Note: the communication protocol for most digital bikes is standard. If you have a bike not specified above, one of these two protocols should work.
	Treadmill	Select the type of treadmill connected - analog or digital as follows: • TM425 / TM400ES km/h • TM425 / TM400ES mph • RAM 770CE km/h • RAM 770CE mph • MTM-1500 km/h • MTM-1500 mph
	Format SDRAM Card (not available at time of print)	Click the START icon to format the card. This can be used when a new card is inserted. **All data on the card is lost when an SD card is re-formulated.**

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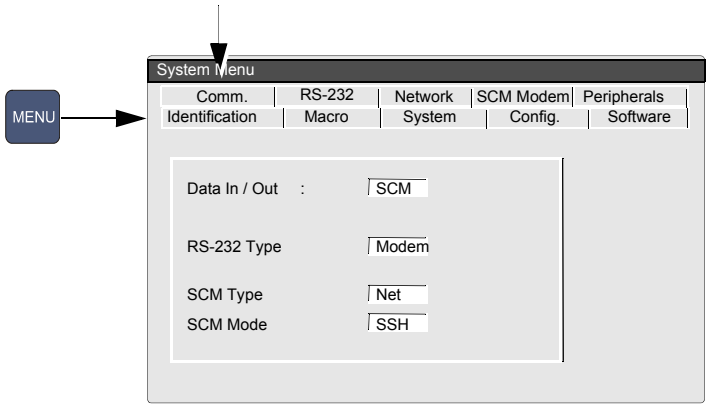
8.2.1 Communication settings

The following settings are available when the comm tab is pressed in the System menu:



The settings are as follows:

Parameter	Options	Description
Data In / Out	RS-232 SCM	• Data transmission via RS-232 port • Data transmission using the SCHILLER communication Module (see following for the settings)
RS-232 Type	Line Modem	• Only active when **RS-232 interface** is chosen above, recordings can be transmitted to a PC / SCHILLER unit connected directly to the RS-232 interface - to do this select **line.** When recordings are to be transmitted to the remote unit via the phones system - select **modem** (not available at time of print.)
SCM Type	Net Modem	• Only active when **SCM** is chosen above. Select **Net** for data transmission over a network e.g. Ethernet. Select **modem** for transmission over the phone network (with optional internal modem)
SCM Mode	--- SSH+ZIP ZIP SSH	• No encryption and data compression selected • Encryption and data compression • Only data compression • Only encryption

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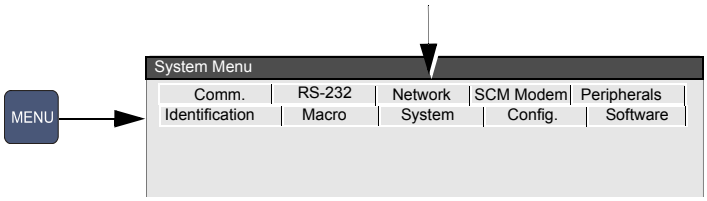
Network Setup

These settings are only applicable when **SCM** and **Net** have been selected (see **Comm** tab previous page).



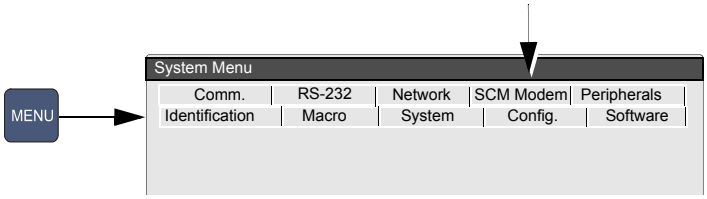
)

Parameter	Options	Description
IP address	xxx.xxx.xxx.xxx.	Identifier address of the device in the TCP/IP network. If set 0.0.0.0 the IP address will be set by the DHCP server.
Net mask	xxx.xxx.xxx.xxx	Network IP address
Gateway	xxx.xxx.xxx.xxx	Gateway IP address
Server	xxx.xxx.xxx.xxx:xxxx	Server IP address
Page	page	Storage address at the Server
User Name	user name	User name entry (Server)
Password	password	Password entry (Server)

SCM Modem

Commuication by modem was not available at time of print.

These settings are only applicable when **SCM** and **modem** have been selected (see **Comm** tab previous page).



Parameter	Options	Description
☎ **Phone No.**	00,41,417664242	Enter telephone number to be dialled. If it is necessary to enter a pause in the dialling sequence enter a comma (,) in the number. The comma gives a one second pause. If a longer pause is required, two or more commas can be entered. This may be required for example, if you have to wait for an outside line. It is also a good idea to insert a pause after a national or international code.
☎ **User Name**	d-username	User name entry (modem dial up)
☎ **Password**	d-password	Password entry (modem dial up)

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9 Unit Maintenance

All maintenance work must be carried out by a qualified technician authorised by SCHILLER AG. Only maintenance procedures given in this book, for example, visual inspection, may be carried out by the user.

The following table indicates the maintenance intervals, the maintenance requirement, and the person authorised to carry out the procedure.

Interval	Service		Responsible
Every 6 months	• Keyboard test. • Visual inspection of the unit and cables (see below).	➜	User
Every 12 months	• All maintenance work performed at the six monthly interval. • Functional tests according to the Service Handbook. • Electrical safety tests according to EN 60601-1, Clause 18 and 19 and the manufacturers instructions.	➜	SCHILLER AG authorised technician
Every 24 months	• All maintenance work performed at the yearly interval. • Every measuring test and calibrations according to the service handbook and the manufacturers instructions.	➜	SCHILLER AG authorised technician

9.1 Visual Inspection

Visually inspect the unit and cable assemblies for the following:

➜ Device casing not broken or cracked.
➜ LCD screen not broken or cracked.
➜ Electrode cable sheathing and connectors undamaged.
➜ No kinks, abrasion or wear in any cable assembly.
➜ Input/output connectors undamaged.

In addition, at the same time as the visual inspection, the AT-10 plus should be switched on, the menu scrolled through, and some sample functions tested. This will:

- Provide a basic software integrity check
- Check the LCD display
- Check basic keyboard function

▲ Defective units or damaged cables must be replaced immediately.

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9.2 Cleaning the Casing and Cable Assemblies

⚠WARNING

▲ Switch the unit off before cleaning and disconnect from the mains by removing the plug. Do not, under any circumstances, immerse the apparatus into a cleaning liquid or sterilise with hot water, steam, or air.

⚠ CAUTION

▲ Do no use abrasive cleaning material on the casing.

▲ The patient cable and other cable assemblies must not be exposed to excessive mechanical stress. Whenever disconnecting the leads, hold the plugs and not the cables. Store the leads in such a way as to prevent anyone stumbling over them or any damage being caused by the wheels of instrument trolleys.

The casing of the AT-10 plus can be cleaned with a soft damp cloth on the surface only. Where necessary a domestic non-caustic cleaner can be used for grease and finger marks.

Wipe the cable assemblies with soapy water. Sterilization, if required, should be done with gas only and not with steam. To disinfect, wipe the cable with hospital standard disinfectant (70% alcohol solution).

9.3 Cleaning the Thermal Print Head

A residue of printers ink (from the grid on the paper) can build up on the print head over a period of time. This can cause the print quality to deteriorate. We recommend therefore that every month the print head is cleaned with alcohol as follows:

Extend the paper tray and remove paper. The thermal print-head is found under the paper tray. With a tissue dampened in alcohol, gently rub the print-head to remove the ink residue. If the print-head is badly soiled, the colour of the paper grid ink (i.e. red or green) will show on the tissue.

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9.4 Battery Maintenance

- The battery requires no maintenance during its life.
- Replace the battery approx. every 4 years (depending upon application) when the battery running time falls substantially under one hour.
- The battery should remain charged during storage. If the storage period exceeds three months, recharge the battery.

9.4.1 Charging the battery

A totally discharged battery requires approximately 3 hours to be 80% charged, and approximately 15 hours to be 100% charged. It is possible to use the unit when the battery is being charged, however the charging time may be extended.

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

1. Connect the device to the mains supply.
2. The green mains LED is lit.
3. Charge the battery for at least 3 hours.

9.4.2 Battery disposal

⚠WARNING

▲ Danger of explosion! Battery must not be burned or disposed of in domestic rubbish.

▲ Danger of acid burns! Do not open the battery.

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

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9.5 Changing the fuse and mains voltage

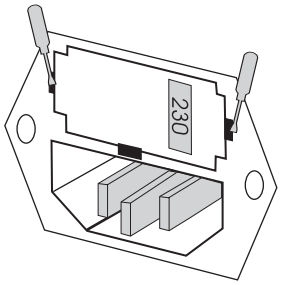
⚠ DANGER

- ▲ The mains voltage may only be changed by qualified personnel.
- ▲ Before the fuse and mains voltage are changed, the device must be disconnected from the mains and the mains plug removed for the wall socket.
- ▲ The fuse may only be replaced by the fuse type the table below.

9.5.1 Fuse types

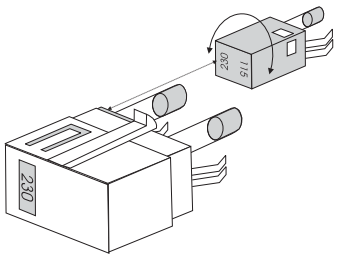
Voltage range	Number	Fuse type
220 - 240 VAC	2	250 V / 160 mA (T = slow blow)
100 - 115 VAC	2	115 V / 300 mA (T = slow blow)

9.5.2 Changing a fuse



1. Disconnect the device from the mains and remove the mains plug.
2. Loosen the fuse inset using a screwdriver and remove it.
3. Replace existing fuses with the same type. See table above.
4. Re-insert the fuse inset.

9.5.3 Changing the mains voltage



1. Disconnect the device from the mains and remove the mains plug.
2. Loosen the fuse using a screwdriver and remove it.
3. Remove the grey inset, turn it by 180° and re-insert it.
4. Check the voltage indication in the window.
5. Replace both fuses with the new value as defined in the table above.
6. Re-insert the fuse assembly.

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10 Trouble Shooting

10.1 Trouble Shooting Table

Fault	Possible Causes and indicators	Remedies and Fault Location
Unit does not switch on, blank screen	• No mains supply, Green mains indicator off.	→ Check mains supply, check fuses. → If mains indictor is lit it indicates that power is reaching the unit and the internal power supply should be OK. Press and hold the On/Off key for 5 seconds. Wait a few seconds and switch on again.
	• Mains supply ok, but the screen is still not lit.	→ If the screen is still not lit it indicates a software fault, monitor problem or internal power supply. Call your local SCHILLER representative.
QRS traces overlap	• Incorrect settings for Patient. • Bad electrode contact.	→ Change sensitivity setting. → Ensure that the automatic sensitivity reduction is not switched off. → Reset signals to baseline - press the 1mV key. → Check electrode contact - Replace electrodes. → If traces still overlap: Call your local SCHILLER representative. → Note: Some patients have very high amplitudes and even on the lowest sensitivity settings, the QRS traces can overlap.
'Noisy' traces	• High resistance electrode contact. • Patient not relaxed. • Incorrect settings.	→ Check electrode contact > ECG key > Lead Test. Resistance readings should be ± 200mV. → Re-apply electrodes. → Ensure that the patient is relaxed and warm. → Check all filter settings > ECG key > Filter. → Activate Myogram filter - press key 1, change cutoff frequency. → Ensure mains filter is correct for mains supply. → If the trace is still 'noisy' call your local SCHILLER representative.
No printout obtained after an auto mode recording	• No paper. • Paper incorrectly loaded. • Incorrect settings.	→ Ensure that paper is loaded. → Reload Paper. → Ensure that the paper has been installed correctly with the paper mark at the top. → Check Settings - ensure that at least one item is selected for print after an auto ECG is recorded. → If the printer still doesn't work: Call your local SCHILLER representative.
Printout fades, is not clear, or the printout is 'patchy'.	• Old paper inserted. • Dirty print head. • Print-head out of adjustment.	→ Ensure that fresh SCHILLER paper is installed. → Note that the thermal paper used for the AT-10 plus is heat and light sensitive. If it is not stored in its original seal, stored in high temperatures or is simply old, print quality can deteriorate. → Over a period of time, the printing ink from the grid on the paper can form a film on the thermal print head. Clean the thermal print head. → Adjust the printhead tension according to the AT-10 plus service handbook. → If the problem persists call your local SCHILLER representative.
No printout of interpretation statement average cycles or measurements	• Incorrect setting.	→ Check that the interpretation and measurement options are enabled for the printout.

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Fault	Possible Causes and indicators	Remedies and Fault Location
No key response, LCD locked	• Software hangs up	➜ Switch off, and switch on again after a few seconds. ➜ Disconnect the mains and leave for 2 hours to force switch off. Re-connect mains and switch on. ➜ If the unit is still not working call your local SCHILLER representative.

10.2 Accessories and Disposables

⚠WARNING

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

Your local representative stocks all the disposables and accessories available for the AT-10 plus. A full list of all SCHILLER representatives can be found on the SCHILLER website (www.schiller.ch). In case of difficulty contact our head office. Our staff will be pleased to help process your order and provide any details for all SCHILLER products.

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11 Technical Data

11.1 System

Dimensions	348 x 288 x 87 mm, approx. 4.2 kg.
Monitor	• Backlit for graphic and LCD alphanumeric representation • Resolution: 800 x 600 dots
Power supply	
Mains Voltage	• 220 - 240 V (nominal), 50 / 60 Hz; 100 - 115 V (nominal), 50 / 60 Hz;
Power consumption	• 14VA to 28VA (Max)
Battery	• Operation with built-in rechargeable battery
Battery	Nickle Cadnium 9.6 V
Capacity	• 2 hours normal use, 3 hours Standby
Battery Life	• Under normal operating conditions, 4 years
Recharging time	• 90 %: approx. 7 hours, 100 %: approx. 15 hours
Printer	High-resolution thermal printing, 8 dots/mm (amplitude axis), 40 dots/mm (time axis), @ 25 mm/s
Frequency range	• 0.05 ... 150 Hz (IEC/AHA)
Chart paper	• Thermo reactive, Z-fold, 14 x 21 cm (DIN A4; letter size)
Chart print-out speed	• 5/12.5/25/50 mm/s (manual print)
Sensitivity	• 5/10/20 mm/ms (manual print)
Recording tracks	• 3 to 12 channels, positioned optimally on 200 mm, automatic baseline adjustment
Interfaces	• RS-232 connector for Treadmill • RS-232 connector for Ergometer • RS232 connector for pneuotach sensor • VGA connector for external monitor • ECG cable Interface • DC input - 0.5V/cm • DC output - 0.5V/cm • Further interface options with the Communications Module
Memory	Storage for up to 40 ECG recordings. Further memory available with the extended memory option.
Environmental conditions	
Operating temperature,	• 10 ... 40 °C
Storage temperature,	• -10 ... 50 °C
Relative humidity	• 25 ... 95 % (no condensation)
Pressure during operation	• 700 ... 1060 hPa

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11.2 ECG

Patient input	Fully floating and isolated, defibrillation-protected (only with original SCHILLER patient cable)
Leads	• 12 simultaneous leads • Standard • Cabrera
Monitor display	
Leads	• 3 - 12 channel display of the selected leads – selectable speed of 5, 10, 20 mm/s – selectable amplitude 10 or 20 mm/mV
Status	• Filter status (on/off) • Power source • Lead selection • Electrode contact status • Heart Frequency, HF • Date and Time
Filters	
Myogram filter (muscle tremor)	• Adjustable at 25 or 35 Hz
Line frequency filter	• Distortion-free suppression of superimposed 50 or 60 Hz sinusoidal interferences by means of adaptive digital filtering
SSF SCHILLER Smoothing filter	
SBS SCHILLER Baseline Stabilizer	

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Patient input	Fully floating and isolated, defibrillation-protected (only with original SCHILLER patient cable)
Leads	• 12 simultaneous leads • Standard • Cabrera
Automatic lead programs	3/12-channel presentations of 12 simultaneously recorded leads
Long-term rhythm recordings	1 lead, 10min, 5min or 90sec/page
Exercise ECG with final report	• Automatic control of bicycle ergometer and treadmill (user programmable) • Final report showing trend plots of heart rate, load and blood pressure, physical working capacity (PWC 150, PWC 170, PWC max.) • Options C: QRS and ST measurements
Data record	• Patient data (name, age, height, weight, BP), user ID • Listing of all ECG recording conditions (date, time, filter)
With optional interpretation (C) program	• ECG measurements results (intervals, amplitudes, electrical axes) • Average complexes with optional measurement reference markings • Guidance on interpreting adult and paediatric ECGs
ECG amplifier	Simultaneous recording of all 9 active electrode signals (= 12 leads)
Sampling frequency	• 1000 Hz
Resolution	• 5 µV / 12 bit
Pacemaker detection	• ≥ ±2 mV /pulse widths ≥ 0.1 ms
Frequency range	• 0.05 ... 150 Hz (IEC/AHA)
Measurement range	• dynamic ±10 mV, DC ±300 mV
CMRR	• > 100 dB
Input Impedance	• 100 MΩ
Defibrillation protection	• 5000 VDC
Patient leakage current	• < 5µA

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11.3 Safety Standards

Safety standard	IEC/EN 60601-1 IEC/EN 60601-2-25
EMC	IEC/EN 60601-1-2
Protection class	I according to IEC/EN 60601-1 (with internal power supply)
Conformity/Classification	CE/IIa according Directive 93/42/EEC
Protection	This device is not designed for outdoor use (IP 20)

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