MAC 1100 / MAC 1200
Operator's Manual

Version 1.1
227 492 02 GA (e) Revision C

marquette

A GE Medical Systems Company

Revision History

This manual is subject to the Marquette Hellige change order service. The revision code, a letter that follows the document part number, changes with every update of the manual.

P/N / Index	Date	Comment
227 492 02-A	01 Feb. 1999	Initial Release
227 492 02-B	15 May 1999	ECO 062 136
227 492 02-C	11 Oct. 1999	ECO 062 920

General Information

- The product **MAC 1100 / MAC 1200** bears the CE marking

  CE-0366

  indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive. It is class IIa (MDD) equipment.

- The product complies with the electromagnetic immunity requirements of standard IEC 60601-1-2/EN 60601-1-2 "Electromagnetic Compatibility - Medical Electrical Equipment".

- The radio-interference emitted by this device is within the limits specified in CISPR11/EN 55011, class B.

- The device is designed to comply with IEC 60601 requirements. It is a protection class I device.

- The CE mark covers only the accessories listed in the chapter "Order Information".

- The information contained in this manual describes version 1.1 and reflects software version 5.1.

- This manual is an integral part of the device. It should always be kept near the device. Close observance of the information given in the manual is a prerequisite for proper device performance and correct operation and ensures patient and operator safety. **Please note that information pertinent to several chapters is given only once. Therefore, carefully read the manual once in its entirety.**

- The symbol ⚠ means: **Consult accompanying documents.** It indicates points which are of particular importance in the operation of the device.

- This manual is in conformity with the device specifications and standards on safety of electromedical equipment valid at the time of printing. All rights are reserved for devices, circuits, techniques, software programs, and names appearing in this manual.

- On request Marquette Hellige will provide a service manual.

- The Marquette Hellige quality management system complies with the standards DIN EN ISO 9001 and EN 46001.

- The safety information given in this manual is classified as follows:

Danger
indicates an imminent hazard. If not avoided, the hazard will result in death or serious injury.

Warning
indicates a hazard. If not avoided, the hazard can result in death or serious injury.

Caution
indicates a potential hazard. If not avoided, this hazard may result in minor personal injury and/or product/property damage.

- To ensure patient safety, the specified measuring accuracy, and interference-free operation, we recommend to use only original Marquette Hellige components. The user is responsible for application of accessories from other manufacturers.

- The warranty does not cover damage resulting from the use of unsuitable accessories and consumables from other manufacturers.

- Marquette Hellige is responsible for the effects on safety, reliability, and performance of the device, only if

  – assembly operations, extensions, readjustments, modifications, or repairs are carried out by Marquette Hellige or by persons authorized by Marquette Hellige,

  – the device is used in accordance with the instructions given in this operator's manual.

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1 Intended Use and Functional Description

The **MAC 1100** and **MAC 1200** units are electrocardiographs with the following performance features:

MAC 1100

Electrocardiograph equipped with standard software for the following modes of operation:
- automatic (acquisition of 12 leads of ECG for a period of 10 seconds), and
- manual (real-time recording of 6 ECG leads).

The graphics display shows 3 leads at a time.

Resting ECGs acquired in the automatic operating mode can be transferred to a PC via the RS232 interface.

Two versions of the electrocardiograph are available:
- unit for mains power only
- unit for mains and battery power.

The mains and battery power version can be ordered with an optional integrated suction pump for the electrode application system KISS.

MAC 1200

Electrocardiograph equipped with standard software for the following modes of operation:
- automatic (acquisition of 12 leads of ECG for a period of 10 seconds),
- manual (real-time recording of 6 ECG leads), and
- arrhythmia (recording of 6 ECG leads with continuous arrhythmia analysis).

The graphics display shows 3 leads at a time.

Resting ECGs acquired in the automatic operating mode can be transferred **between** the MAC 1200 and a PC and **from** the MAC 1200 to a MUSE CV system via the RS232 interface.

The unit operates on AC line power and can also be powered from a rechargeable battery. The unit can be ordered with an optional integrated suction pump for the electrode application system KISS.

The performance features of the MAC 1200 can be upgraded with the following optional programs:
- MEAS - measurement of the 10-second resting ECG
- DIAG - interpretation of the 10-second resting ECG
- MEMO - storage of a maximum of 40 10-second resting ECGs

Both versions of the electrocardiograph have a configuration menu to customize the system setup.

Patient and user data can be entered for reliable and safe archiving of patient records. The patient name is annotated on each printed sheet. All other data are printed on request.

The **MAC 1100 / MAC 1200** units are designed to comply with IEC 60601 / EN 60601 requirements. They are protection class I devices/devices with an internal power source. They are classified as MDD class IIa devices. They are designed for continuous operation. The units are not suitable for intracardiac application. The units are not intended for use as vital signs physiological monitors.

Caution

Patient Hazard — Medical technical equipment such as the MAC 1100 / 1200 must only be used by qualified and trained personnel.

2 Controls and Indicators

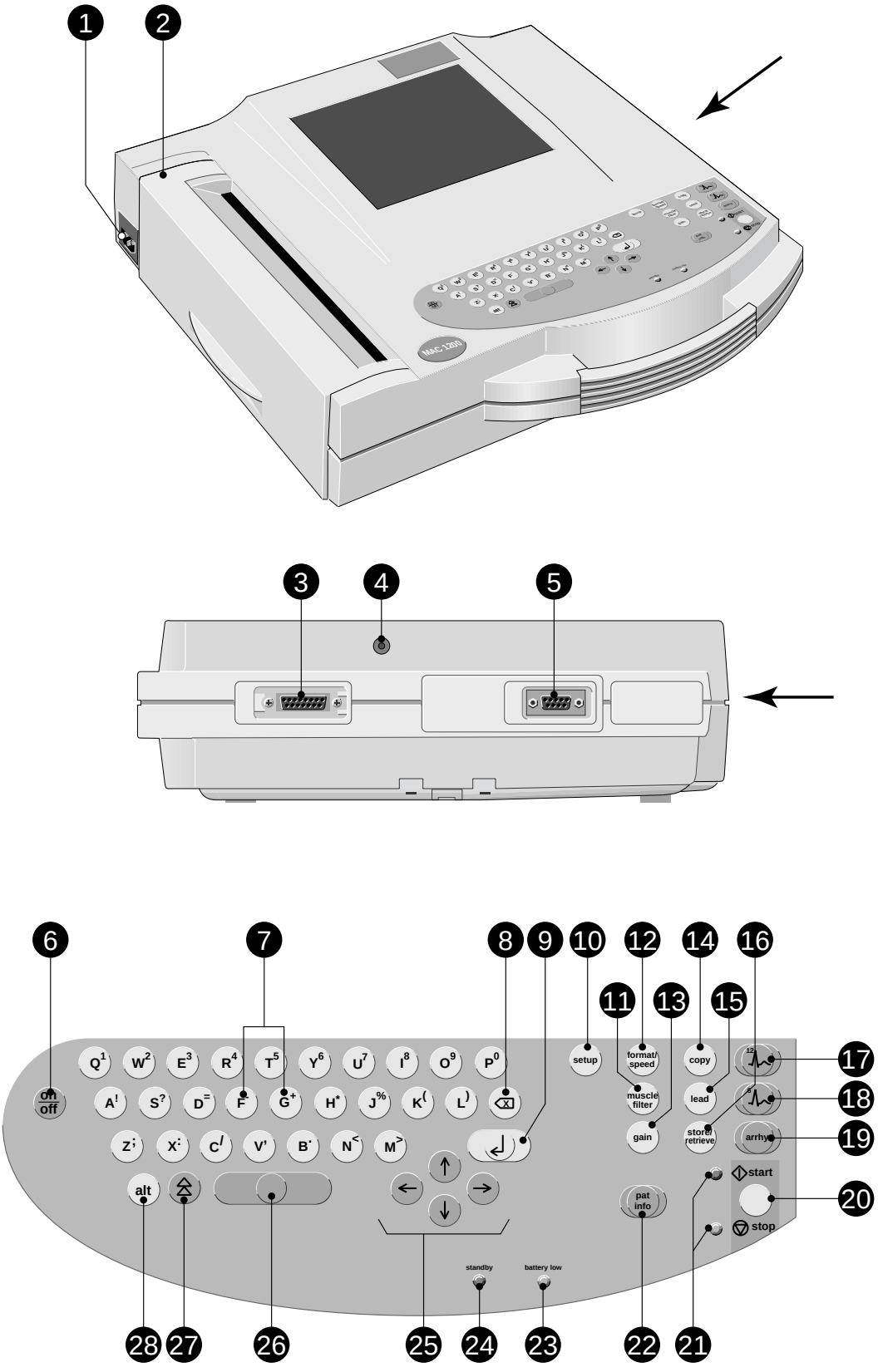


*Figure 2-1. Controls and indicators of the **MAC 1100 / MAC 1200** electrocardiographs*

1 *Power input*

2 *Paper door, windows allows you to check the paper supply*

3 *Patient cable connector*

4 *Connection for electrode application system KISS (option)*

5 *Serial interface (see chapter 13 "Technical Specifications")*

6 *Power switch (ON/OFF)*

7 *Keys to select a higher or lower HR alarm limit*

8 *Correction key (entry of data)*

9 *Confirms entered data*

10 *Displays the configuration menu*

11 *Enables/disables the muscle filter (elimination of muscle artifact)*

12 *Selects the writer speed 25, 50 or 5 mm/s in Manual Mode and the report formats in Automatic Mode*

13 *Selects the gain (5, 10, 20, 40 mm/mV)*

14 *Press to print the report or additional copies of the ECG, or to send/receive ECGs*

15 *Selects the ECG leads displayed and recorded in Manual Mode and displayed Automatic Mode*

16 *Sends ECG to memory/retrieves ECG from memory*

17 *Selects the Automatic Mode*

18 *Selects the Manual Mode*

19 *Selects the Arrhythmia Mode*

20 *Starts and stops the recorder, clears the setup menu and terminates patient data entry*

21 *Indicators*
- *green: recording in selected mode started;*
- *yellow: recording in selected mode stopped*

22 *Enables entry of patient data*

23 *Indicator lights up when battery needs to be recharged*

24 *Indicator is illuminated when unit is connected to the power line*

25 *Cursor control keys*

26 *Space bar*

27 *Shift key*

28 *Press to access special characters*

Explanation of symbols used on the device


Consult accompanying documents


Signal input


Type CF signal input, highly insulated, defibrillation-proof


Start


Stop


Battery


Saving/retrieving ECGs


Correction key


Direction indicator


Device ON/OFF


ECG lead selector


Printout of reports and ECG copies


Standby

3 Putting the Device into Operation and Performance Test

3.1 Safety Information

Danger

Explosion Hazard – The device is not designed for use in areas of medically used rooms where an explosion hazard may occur. An explosion hazard may result from the use of flammable anesthetics, skin cleansing agents and disinfectants.

Warning

Shock Hazard — Strictly observe the following warnings. Failure to do so may endanger the lives of the patient, the user and bystanders.

- ***Before using the device, the operator must ascertain that it is in correct working order and operating condition. In particular, all connectors, electrodes as well as sensors and probes must be checked for signs of damage. Damaged parts must be replaced immediately, before use.***
- ***When disconnecting the device from the power line, remove the plug from the wall outlet first,, before disconnecting the cable from the device. Otherwise there is a risk of coming in contact with line voltage by inadvertently introducing metal parts in the sockets of the power cord.***
- ***The mains plug must be connected to an appropriate power supply with a non-fused earthed wire. If these requirements cannot be met, operate the device on battery power.***
- ***Do not use multiple portable socket outlets (MPSO) to connect the device to the power line.***
- ***Devices may be connected to other devices or to parts of systems only when it has been made certain that there is no danger to the patient, the operators, or the environment as a result. In those instances where there is any element of doubt concerning the safety of connected devices, the user must contact the manufacturers concerned or other informed experts as to whether there is any possible danger to the patient, the operator, or the environment as a result of the proposed combination of devices. Standards IEC 60601-1-1/EN60601-1-1 must be complied with in all cases.***
- ***All devices of a system must be connected to the same electric circuit. Devices which are not connected to the same circuit must be electrically isolated (isolated RS232 interface!).***

Warning

- ***Equipment Failure — Magnetic and electrical fields are capable of interfering with the proper performance of the device. For this reason make sure that all external devices operated in the vicinity of the defibrillator comply with the relevant EMC requirements. X-ray equipment, MRI devices, radio systems (cellular telephones) etc. are possible sources of interference as they may emit higher levels of electromagnetic radiation.***
  Keep the recorder away from these devices and verify the recorder performance before use.
- ***Suffocation Hazard — Dispose of the packaging material, observing the applicable waste-control regulations. Keep the packaging material out of children's reach.***

Caution

- ***Equipment Damage — Devices intended for emergency application must not be exposed to low temperatures during storage and transport to avoid moisture condensation at the application site. Wait until all moisture has vaporized before using the device.***
- ***Equipment Damage — Before connecting the device to the power line, verify that the ratings of your local power line are those indicated on the device nameplate.***

Biocompatibility

The parts of the product described in this operator manual, including all accessories, that come in contact with the patient during the intended use, fulfill the biocompatibility requirements of the applicable standards. If you have questions in this matter, please contact Marquette Hellige GmbH or its representatives.

Literature

Medical Device Directive of August 2, 1994

EN 60601-1: 1990 + A 1: 1993 + A 2: 1995
Medical electrical equipment. General requirements for safety.

EN 60601-1-1: 9/1994 + A1: 12/1995
General requirements for safety. Requirements for the safety of medical electrical systems.

IEC-Publication 513/1994: Fundamental aspects of safety standards for medical equipment.

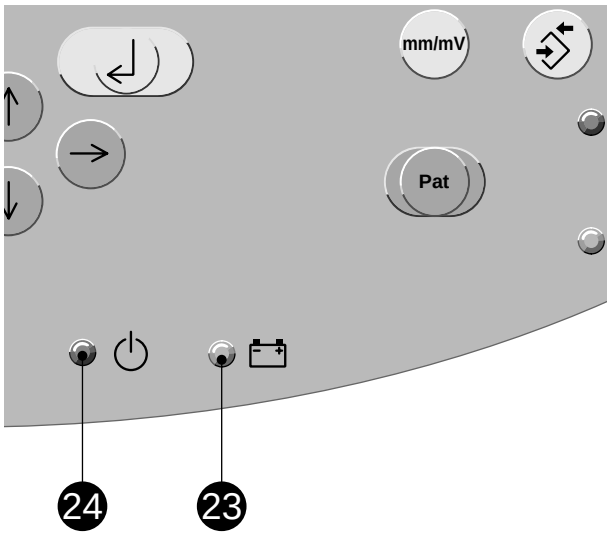


Figure 3-1. Indicators

3.2 Power Supply

The units are powered from the power line or from the rechargeable battery.

The battery charges automatically when the unit is connected to the power line and indicator **24** is illuminated (Figure 3-1). It is not necessary to switch on the device for charging. To ensure that the battery is always fully charged, leave the electrocardiograph connected to the power line whenever possible. After 4 hours the battery has regained its full capacity.

Indicator **23** is illuminated when the battery needs to be charged.

With a full battery, about 50 ECGs (1 page) can be recorded in the Automatic Mode. When its capacity drops to about 25 recordings, the battery is used up and must be replaced by a service specialist.

Note

To prolong the battery life, fully discharge the battery at least once per month (by operating the electrocardiograph on battery power).

Note

In standby mode, a fully charged battery is drained within approx. 4 hours. Therefore, when operating the device on battery power, be sure to turn it off when it is not in use.

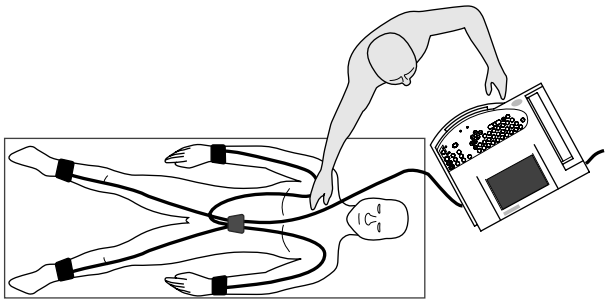


Figure 3-2. Arranging the electrocardiograph and the examination couch

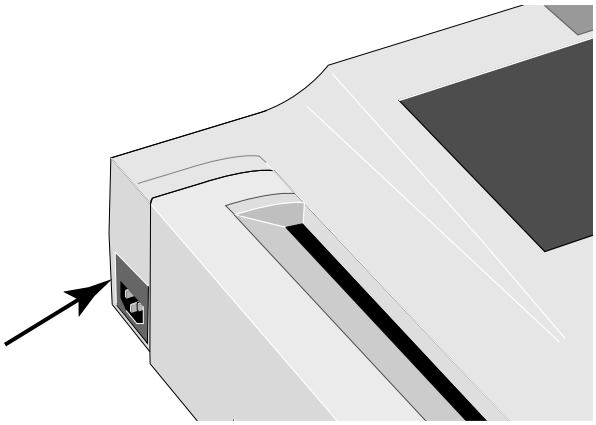


Figure 3-3. AC power input

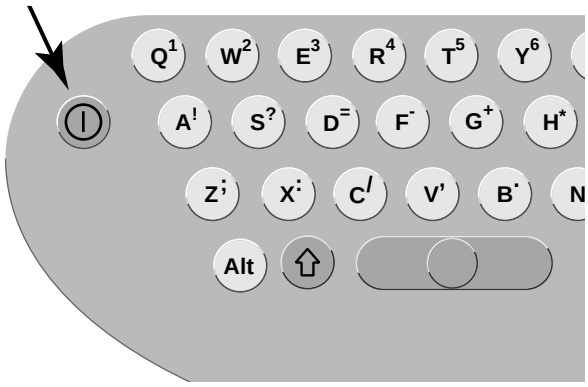


Figure 3-4. Power button

Note

- ***The backlighting of the display switches off automatically when no key is activated for 20 minutes (adjustable). The illumination is turned on again by activation of any key.***
- ***Run the full self-test at least once a day to ensure that the device is functioning properly.***
- ***Hold the power button depressed for some seconds to turn the device off.***

3.3 Installation and Mains Connection

Figure 3-2 shows a practical arrangement of patient and recorder. For interference-free operation, it is important that the patient cable and the power cord do not run parallel.

- Using the power cord, connect the device to the power line (Figure -3-3). Use only the original power cord or an equivalent cable.

Indicator ⏻ **24** will illuminate.

- Check the paper supply (the window in the paper door allows you to look inside the compartment). If it is necessary to insert a new paper pad, refer to chapter 10 for instructions.

3.4 Performance Check

- Press the power button to switch the device on (Figure 3-4).

The amber indicator **21** will illuminate.

After power-up, the electrocardiograph runs an automatic self-test. The display indicates the memories currently being tested. The self-test takes about 15 to 20 seconds. When no problem is detected, the device defaults to the Automatic Mode. If a malfunction is identified, the display will show an error message "Error...". In this situation, notify service to check and repair the device.

The self-test can be aborted with the R4 $ button. In this case, the device immediately activates the Automatic Mode.

Adjusting Contrast

Simultaneously press Alt and the appropriate cursor key: more contrast ↑, less contrast ↓.

3.5 General Device Settings

The table at left shows the general device settings that can be modified and the factory defaults. Refer to section 9.5 for details on changing the general device settings.

Parameter	**Factory Default**	**Options**
Ordering physician	empty text box	selection from a list of 10 names
Referring physician	empty text box	selection from a list of 10 names
Technician ID	empty text box	selection from a list of 10 names
Hospital/Practice	empty text box	text box for 40 characters
Cart Number	1	1 ... 9999
Site Number	1	1 ... 255
Location Number	1	1 ... 600
Date (dd.mm.yyyy)	current date	
Time (hh:mm)	current time	
Lead Fail Beep	No	Yes
High HR Beep	No	Yes
Lead Labels	IEC	AAMI
Date	dd.mm.yyyy	mm/dd/yyyy
Time	24	12
Units	cm, kg	in, lb
Mains	50 Hz	60 Hz
LCD light off after	20 min	1 ... 99 min
Default mode	Automatic	Manual, Arrhythmia (MAC 1200 only)
Language	German	all available languages
Enable password	No	Yes
Test DATA	No	Yes
Factory Default	No	Yes
Print config. lists	No	Yes

Table 3-1. Setup menu for the General Device Settings

3.6 Connecting Peripheral Equipment

Warning

Shock Hazard — Strictly observe the following warnings. Failure to do so may endanger the lives of the patient, the user and bystanders.

- ***Connecting peripheral devices to the RS232 interface of the electrocardiograph creates a medical system. This system must meet the requirements of IEC 60601-1-1.***
- ***Use only the original Marquette Hellige connection cables.***
- ***All non-medical devices of a system must be connected to the same electric circuit. Devices which are not connected to the same circuit must be electrically isolated (use isolated RS232 interface as per IEC 60601-1).***
- ***A PC connected to the electrocardiograph should meet the requirements of EN 60601. If it doesn't, it must be set up outside the patient environment. If the PC fulfills the requirements of EN 60950, it must be set up within the medically used area, but outside the patient environment.***
- ***Do <u>not</u> connect PCs to the electrocardiograph that fulfill neither EN 60601 nor EN 60950.***
- ***Modems connected to the electrocardiograph must meet the requirements of EN 60950 or UL1950 (all modems recommended by Marquette Hellige meet these requirements). The specific regulations valid in your country must also be observed.***
  The modem must be set up within the medically used area, but outside the patient environment.

Via the serial interface, the electrocardiograph can be directly connected to a PC (**CardioSoft**), to the **CardioSys** system or to a **MUSE** CV system. Resting ECGs acquired in the Automatic Mode as well as the corresponding data can then be transmitted to these external devices (see section 5.5 "ECG Transmission").
The table below shows the factory defaults and all possible adjustments.
For instructions on changing the default setup, refer to section 9.6 "Communication".

Parameter	**Factory Default**	**Options**
Choices for "Modem → Other"		
		none user-defined MultiTech 19.32 MultiTech 56.6 Elsa 28.8 Elsa 33.6 Elsa 56.6
Choices for "Modem → user-defined"		
telephone init string dial string hangup	 AT&FM0&D0 &Q1V0 ATDT +++ATH	
Choices for "Modem → MultiTech, Elsa 28.8, Elsa 33.6, Elsa 56.6"		
dial mode telephone outside line	tone	pulse 0 to 9 (28 digits) 0 to 9 (20 digits)

Table 3-2. Modem configuration menu

The remote start pulse from a connected ergometer (interface **5**, Figure 2-1) initiates the following functions:

Automatic Mode	Start/Stop
Manual Mode	Start/Stop
Arrhythmia Mode	printout of event report

4 Preparations for ECG Recording

4.1 Connecting the patient cable

If your electrocardiograph is equipped with an integrated suction pump (connector **4**), you can connect the electrode application system KISS instead of the standard patient cable.

Use the 10-lead patient cable for acquisition of the standard ECG leads (Einthoven, Goldberger, Wilson). The 12-lead patient cable is required when you intend to record the Nehb leads also.

- Connect the patient cable to connector **3** (Figure 4-1).
- When using the electrode application system, connect it to the suction pump (connector **4**).

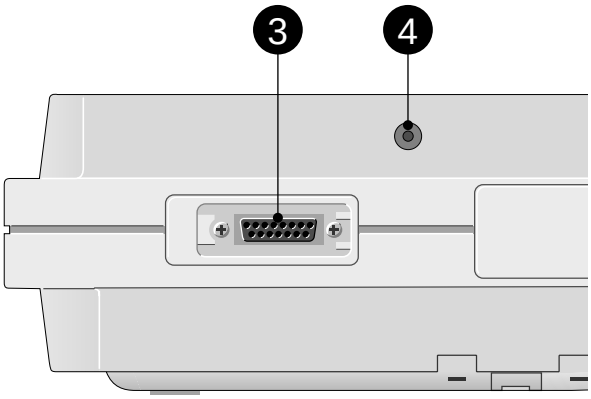


Figure 4-1. ***3*** *ECG signal input*
4 *connection for suction pump*

Warning

Shock Hazard — Strictly observe the following warnings. Failure to do so may endanger the lives of the patient, the user and bystanders.

- ***For reasons of patient safety, use only the original Marquette Hellige patient cable. Before connecting the cable to the device, check it for signs of mechanical damage. Do not use a damaged cable.***
- ***Ensure that conductive parts (such as the patient, connectors, electrodes, transducers) that are connected to the isolated patient signal input do not come into contact with other grounded, conductive parts. This would bridge the patient's isolation and cancel the protection provided by the isolated input. The neutral electrode, in particular, must not come into contact with ground.***

4.2 Electrode Application

Caution

Patient Hazard, Delayed ECG Display — Use only silver-silver chloride electrodes when recording the ECG of a patient who may have to be defibrillated. (Refer to section 8.2 "ECG Recording During Defibrillation".)

Careful application of the electrodes is the key to an interference-free ECG.
For quick, reliable and trouble-free application of electrodes, we recommend using our electrode application system KISS.
Otherwise, use the **plate electrodes** on the limbs and the **suction electrodes** on the thorax.

Applying Plate Electrodes (Limbs)

Plate electrodes are applied by means of a rubber strap, and electrode paper is the recommended contact medium.

- Moisten the electrode paper with tap water and place it between skin and electrode.
- Secure the electrode with the rubber strap (Figure 4-2), but do not hinder blood circulation.

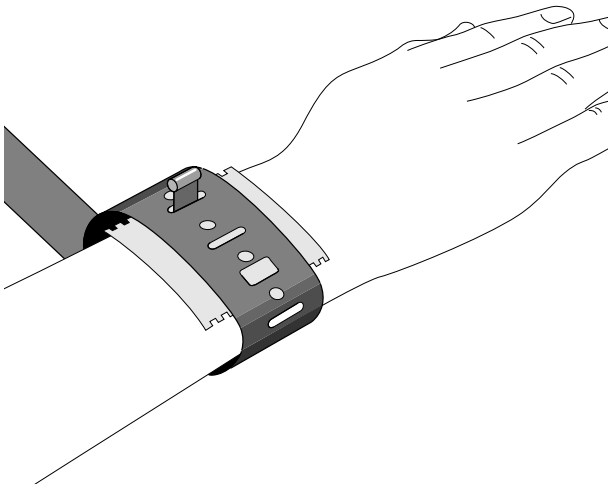


Figure 4-2. Applying the plate electrodes

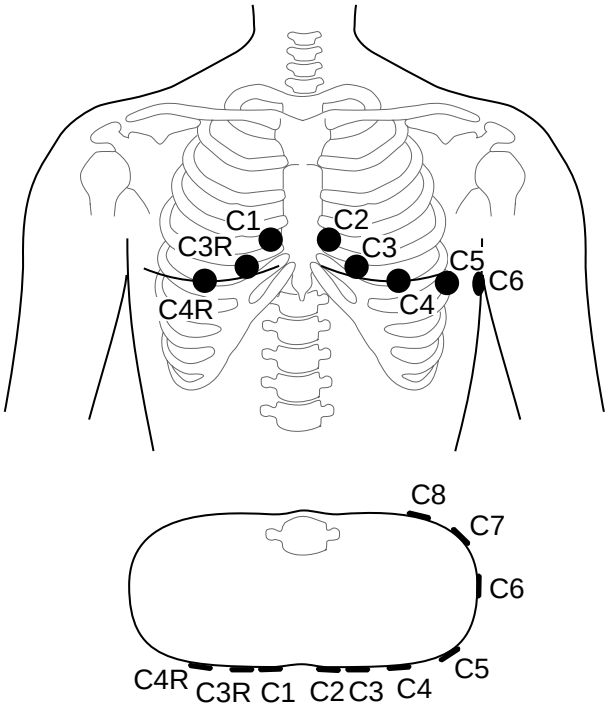


Figure 4-3. Chest electrode placement

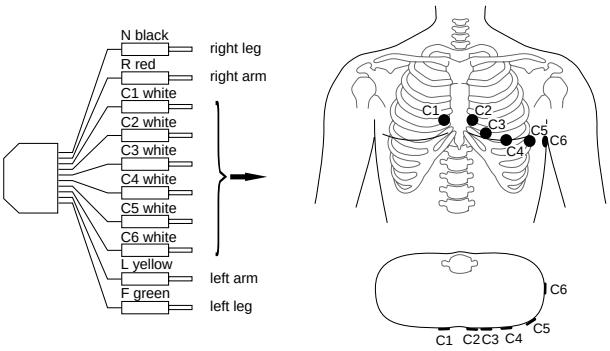


Figure 4-4. Connecting the patient cable (10-lead cable, standard ECG leads)

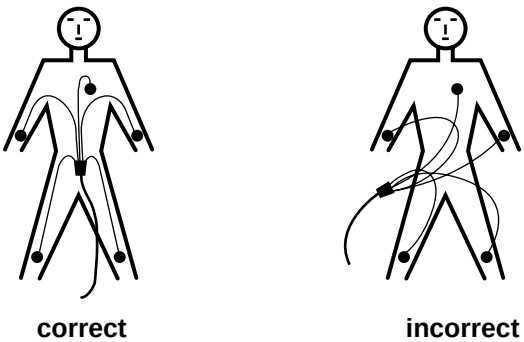


Figure 4-5. Arranging the patient cable

Applying Suction Electrodes (Thorax)

- Shave application points, if necessary.
- Moisten the electrode paper with tap water and place it between skin and electrode.
  Electrode cream or gel can be used instead of paper. On hairy chests, the cream or gel improves adhesion of the electrodes.

Electrode Placement for Standard Leads (l, II, III, aVR, aVL, aVF, V1...V6)

For acquisition of the standard ECG leads 4 electrodes must be applied on the limbs and 6 on the chest. The limb electrodes should be placed above the wrists and ankles. Figure 4-3 shows the chest electrode application points.

C1 4th intercostal space at the right border of the sternum
C2 4th intercostal space at the left border of the sternum
C3 on the 5th rib, midway between locations C2 and C4
C4 at the mid-clavicular line in the 5th intercostal space
C5 at the anterior axillary line on the same horizontal level as C4 and C6
C6 at the mid-axillary line on the same horizontal level as C4
C7* at the left posterior axillary line in the 5th intercostal space
C8* at the left scapulary line in the 5th intercostal space
C3R* opposite C3, on the right side of the thorax
C4R* opposite C4, on the right side of the thorax

* additional standard leads

- Connect the 10-lead patient cable as shown in Figure 4-4.
- Arrange the leadwires and patient cable as shown in Figure 4-5.

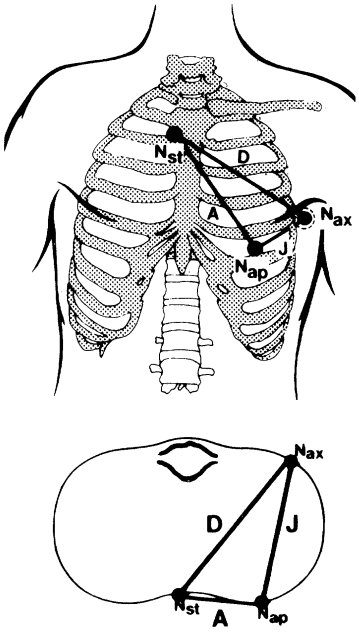


Figure 4-6. Electrode placement for Nebh leads

Nst 4th intercostal space at the right border of the sternum

Nax at the posterior axillary line in the 5th intercostal space (identical with C7)

Nap at the mid-clavicular line (identical with C4) in the 5th intercostal space

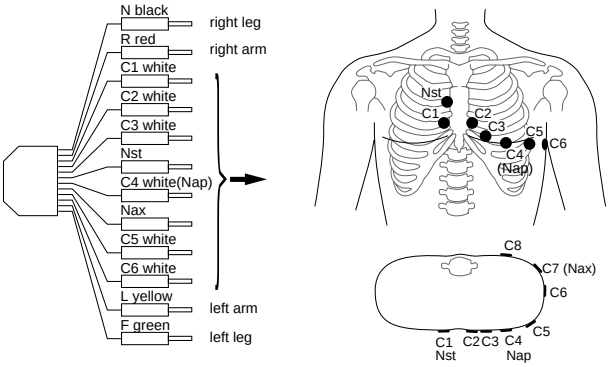


Figure 4-7. Connecting the patient cable (12-lead cable, NEHB leads)

Electrode Placement for Nebh Leads

Figure 4-6 shows the electrode sites for acquisition of the Nehb leads. Connect the 12-lead patient cable as shown in Figure 4-7 (Nap is the same as C4).

As an alternative it is also possible to record the Nehb leads with the 10-lead patient cable (only in Manual Mode).

- To do so, connect
  R to Nst
  L to Nax (C7)
  F to Nap (C4)
- Select "SEQ. No. 4" (section 9.3 "Manual Mode") and change the lead labels as follows:
  I to D
  II to A
  III to J

Artifact Due to Poor Electrode Application

The electrocardiograph is equipped with state-of-the-art electronic utilities that ensure artifact-free recordings. Among these are the automatic baseline adjustment and the anti-drift system (cubic spline) (ADS).
At the beginning of the recording the automatic baseline adjustment algorithm verifies the incoming signal and adjusts the baseline position accordingly.

During the recording, the anti-drift system (cubic spline) continuously checks the baseline position and returns it to the normal level, if required (Figure 4-8).
For the Manual Mode, the anti-drift system (cubic spline) can be enabled and disabled from the setup menu, in the Automatic and Arrhythmia Modes, it is always enabled.

When electrodes are not properly applied, these measures may not fully compensate for artifact. High polarization voltages induced by electrodes applied without conductive gel may cause the amplifier to overrange, so that a straight line will be recorded instead of the ECG (see Figure 4-8). In this situation the device will automatically block and return the baseline to its normal position. A baseline is then recorded for approx. 1 second. It is possible to block the amplifiers manually by disconnecting the R electrode.

On the display this condition is indicated by **** instead of the electrode label (e.g. at **i**, Figure 5-1).

Remedy:

- Apply the electrodes according to instructions.
- Do not apply the electrodes on top of clothing.
- Use a contact agent (e.g. moistened electrode paper, electrode cream, spray, etc.).
- Wait approx. 10 seconds before initiating a recording. After the 10-second period, the automatic functions are enabled and the polarization voltages have stabilized, provided the electrodes are properly applied. In case of improper electrode application, an error message will appear on the display (R, L, F, N, C1 to C6, NA, NT, NX).
- If required, the ADS (cubic spline) and the filters (20/40 Hz, 50 Hz) can be disabled to verify the "raw" ECG signal.

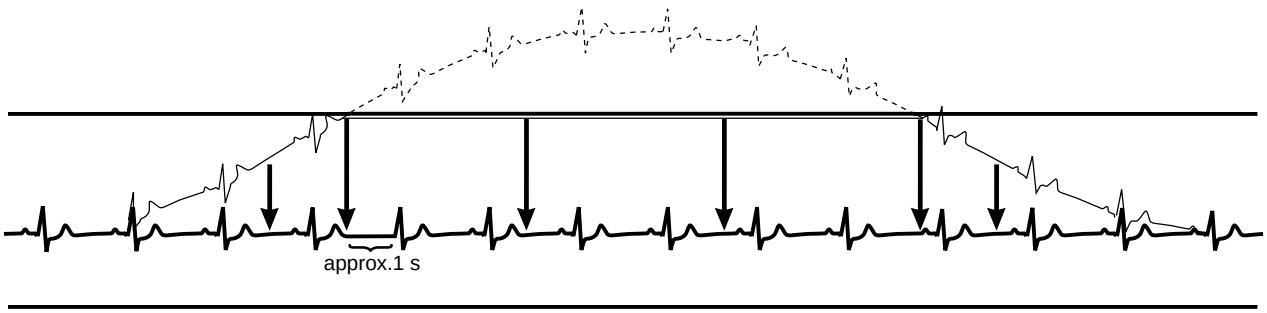


Figure 4-8. Sample recording

Parameter	Factory Default		Options
	adjusted	Menu item displayed	
New patient	No	Yes	Yes
Name		Yes	
First name		Yes	
Date of birth	00.00.0000 (dd.mm.yyyy)	Yes	
Patient ID		Yes	
2nd Patient ID		No	
Pacemaker	No	Yes	Yes
Gender	-	Yes	female, male
Height		Yes	
Weight		Yes	
Race	unknown	Yes	other
Systole	0 mmHg	Yes	
Diastole	0 mmHg	Yes	
Ordering physician		Yes	selection from a list of 10 names
Referring physician		Yes	selection from a list of 10 names
Technician ID		Yes	selection from a list of 10 names
Phone No.	–	Yes	
Medication		Yes	
1.	unknown	Yes	other
2.	unknown	Yes	other
Comments		Yes	
Location Number		No	1 ... 600
Room		No	
Order Number		No	
Prompt 1		No	
Prompt 2		No	
Prompt 3		No	
Prompt 4		No	

Table 4-1. Patient data entry menu

4.3 Entering Patient Data

It is possible to enter patient data and have them annotated on the recording for easy archiving of patient records.

- Press Pat to enter the patient data mode.

– The recorder displays the menu items in a defined order.
In the configuration menu (section 9.7 "Patient Data") you determine the items to be included in the menu (In the table at left, the items that appear in the patient data menu in the default configuration are marked as "Yes" in the "Menu item displayed" column, the other menu items are marked as "No".

– To skip a menu item, press ↵ or the cursor key ↓ or ↑.

– It is not possible to write capital and small letters (do not press the Shift key); for entry of numbers (e.g. date of birth), it is not necessary to press the Shift key.

– All entries must be confirmed with ↵.

– Press Pat or ◇▽ to exit the patient data mode.

The table at left shows the menu items in the correct order. On the display, selected options are shown in brackets.

Note

Please refer to the Appendix for instructions on entering special characters.

New patient
yes: existing patient data are deleted
no: entered data can be edited.

Name, First Name
18 characters each

Date of birth
The dot between day.month.year must also be entered (key "B").

Patient ID
16 characters max.

Pacemaker
Influences the identification of pacer pulses in Arrhythmia Mode. Enable the function ("Yes") when recording the ECG of a pacemaker patient. The recording will then be annotated with the message "Pacemaker Patient".

Gender/Race
These parameters influence the ECG. If you do not intend to enter all patient data, select the neutral entries "-" and "unknown".

Height/Weight
Enter the patient's height (cm) and weight (kg). The weight can be entered with one decimal place.

Systole/Diastole
Enter the blood pressure readings in mmHg.

Ordering Physician / Referring Physician / Technician
When you choose "yes" for "New patient", the default names entered in the General Settings will appear here. When you choose "other", you can pick a name from the list. It is also possible to choose "no". You can press  to quit the list. The "Referring Physician" is only relevant if you send ECGs to the MUSE CV system. This name will not be annotated on the ECG recording.

Telephone
Enter the patient's telephone number.

Medication
When you choose "other", you will see the following list (scroll through the list with  and confirm with ):

no
unknown
Digitalis
Diuretics
Antidepress.
Steroids
Beta-blockers II
Beta-blockers III
Antiarrhythmics la
Antiarrhythmics lb
Antiarrhythmics lc
Antiarrhythmics III
Ca antagonist Verapamil type
Ca antagonist Nifedipin type
Nitrates
ACE
Alpha-blockers
Cytostatics

Comments
4 lines of 30 characters each

Location Number
3-place ID number for the location. When you select "yes" for "New patient", the default value from the "General Settings" will automatically be adopted, but you can overwrite this number.

Room
5 digits

Order number
5 digits for entry of the ECG order number.

Extra questions
Answer the prompts entered in the patient data setup menu (section 9.7).

5 Automatic Mode Recording

5.1 Some Basic Facts

In Automatic Mode, 12 leads of ECG are acquired simultaneously for a period of 10 seconds. When initiated with  , the recording proceeds automatically.

Depending on the implemented software options, the ECG

- is only printed out (MAC 1100, MAC 1200 without options MEAS, DIAG)
- is measured and printed out with the measurement results (MAC 1200 with option MEAS)
- is measured, interpreted (analyzed) and printed out with the interpretative statements (MAC 1200 with option DIAG).

Note

The program will only interpret the standard and Cabrera lead sequences. The Nehb leads will only be measured.

Units equipped with the optional "Memory" function MEMO (MAC 1200 only) can save up to 40 resting ECG.

These ECGs can be

- printed or
- sent to CardioSys / CardioSoft (A5 protocol) or to the MUSE CV system (CSI protocol) (see section 5.3 "The Memory Function).

The unit offers different report formats for printout of the ECG. With the system defaults, all 12 leads including the measurement and analysis results will be documented on a single sheet (see section 5.4 "The Report Formats").

Some of the system settings can be customized. They are identified with the letter (**c**).

The following information refers to a unit with the system defaults (see table below). For instructions on changing the default setup, refer to section 9.2 "Automatic Mode".

Parameter	**Factory Default**	**Options**
Report sequence	STANDARD	CABRERA, NEHB
Rhythm leads	II, V1, V5, V2, V3, V4	all leads
Gain	10 mm/mV	"*auto", 5, 20, 40 mm/mV
Report format	12_FS	12_F1, 12_F2, 6_F1, 6_F2_25, 3_F1, H1, H2, A1, 1x10R3, 4x2.5R3
Detailed results	No	Yes
Contin. rhythm	Yes	No
Muscle filter	No	Yes
Filter frequency	40 Hz	20 Hz
AC line filter	Yes	No
Manual copy to	ECG	HOST
No. of copies	1	0...9
Delete ECG after trans.	No	Yes
Auto save ECG	No	Yes
Interpretation	Yes	No
Print interpretation	Yes	No
Override function	No	Yes

Table 5-1. Setup menu for the Automatic Mode

5.2 Recording

Note

When an electrode is off the patient the unit will not start in Automatic Mode (if the "Override function" is disabled, see chapter 9.2 "Automatic Mode").

On power up, the unit defaults to the Automatic Mode (this default setting can be modified; in the following text the letter "**c**" identifies system defaults which can be changed).

– Before recording the ECG, patient data can be entered (Pat). We recommend to enter the patient's name to annotate it on every report.

– After applying the electrodes, please wait about 10 seconds for the signal to stabilize (stabilization of polarization voltages, see section "Artifact Due to Poor Electrode Application" in chapter 4). If you initiate a recording with ◇▽ immediately after selection of the Automatic Mode, a waiting period of 10 to 12 seconds ensues (message "Collecting data" on display).

– Before initiating a recording, check the display for error messages (see table at left). Check all electrodes; if the message persists, there must be a break in the patient cable. Replace the cable with a new one.

– The MAC 1100 / MAC 1200 continuously saves 10 seconds of the incoming ECG signal.

– The device can be set up to allow a recording only when specific patient data have been entered (last name, first name, ID, 2nd ID, section 9.7 "Patient Data").

When you initiate a recording with ◇▽, the unit prints the most recent 10 seconds of ECG data and analyzes it.

Therefore, wait until the patient has been lying relaxed and motionless for about 10 seconds before starting the recording.

***R*:**	***right arm electrode disconnected***
***L*:**	***left arm electrode disconnected***
***F*:**	***left leg electrode disconnected***
***C1*:**	***chest electrode C1 disconnected***
***C2*:**	***chest electrode C2 disconnected***
***C3*:**	***chest electrode C3 disconnected***
***C4*:**	***chest electrode C4 disconnected***
***C5*:**	***chest electrode C5 disconnected***
***C6*:**	***chest electrode C6 disconnected***
***NA*:**	***Nehb electrode Nap disconnected***
***NT*:**	***Nehb electrode Nst disconnected***
***NX*:**	***Nehb electrode Nax disconnected***

Messages indicating disconnected electrodes

Note

Please note that filters may suppress diagnostically relevant portions of the signal, because they limit the transmission range. Filters should therefore only be enabled if necessary.

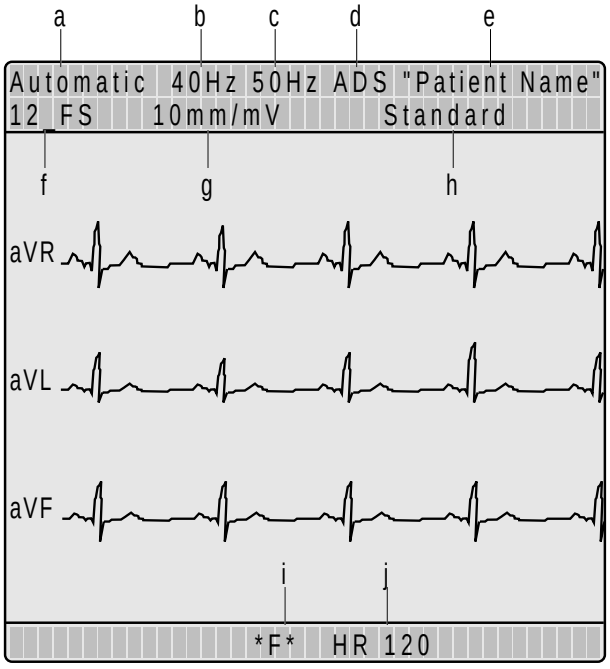


Figure 5-1. Automatic mode display

- ***a*** *Operating mode*
- ***b*** *Muscle filter enabled*
- ***c*** *AC line filter enabled*
- ***d*** *Anti-drift system enabled*
- ***e*** *Patient name*
- ***f*** *Report format or "REC OFF" when the recording function is disabled*
- ***g*** *Gain 10 mm/mV (automatic gain adjustment off)*
- ***h*** *Report sequence*
- ***i*** *Left-leg electrode failure*
- ***j*** *Heart rate*

With the system defaults unchanged, the unit will activate the following functions and settings after power-up:

- the Automatic Mode (**c**)
- the Standard report sequence (lead to channel correspondence): I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6,
  also available: CABRERA, NEHB
- rhythm lead [1)]
- a gain of 10 mm/mV (**c**) (calibration pulse at the beginning of the recording)
- the muscle filter is disabled (Filter) (**c**)
- the AC line filter is enabled (**c**)
- the report format is "12_FS", i.e. 12 leads and all data are printed on one page (**c**)
- the interpretation is printed (**c**)
- the "Detailed results" page (including the median complexes and the ST measurement results) is not printed (**c**) (MAC 1200 only)
- pressing will produce one copy of the printed ECG (**c**)

[1)] The selected report format determines the number of displayed rhythm leads (see section 5.4 "The Report Formats"). The default report format is the 12_FS format (without rhythm lead).

With the factory default settings, the following rhythm leads are recorded in the different report formats:
report formats with 1 rhythm lead: II
report formats with 3 rhythm leads: II, V1, V5
report formats with 6 rhythm leads: II, V1, V5, V2, V3, V4 (see Table 5-1)

– the "Override" function is disabled (**c**)

– MAC 1200 with the MEMO (memory) option:
  ECGs are not automatically stored (**c**),
  ECGs that were successfully transmitted to a host system are not automatically removed from memory (**c**)

– QTC is calculated with the Bazett formula (only MAC 1200 with option MEAS (measurement) or DIAG (interpretation))

All relevant device settings are shown on the display (Figure 5-1).
The display shows 3 leads at a time. With  you can display all leads of the report sequence in groups of 3.

– The recording can be stopped with 

– For a description of the different reports, refer to section 5.4 "The Report Formats".

Note

When the unit runs out of paper while printing all stored ECGs (menu item "All stored ECGs - Print"), press after inserting a new paper pad. Then print the remaining ECGs one after the other, or restart a printout of all recordings ("All stored ECGs - Print").

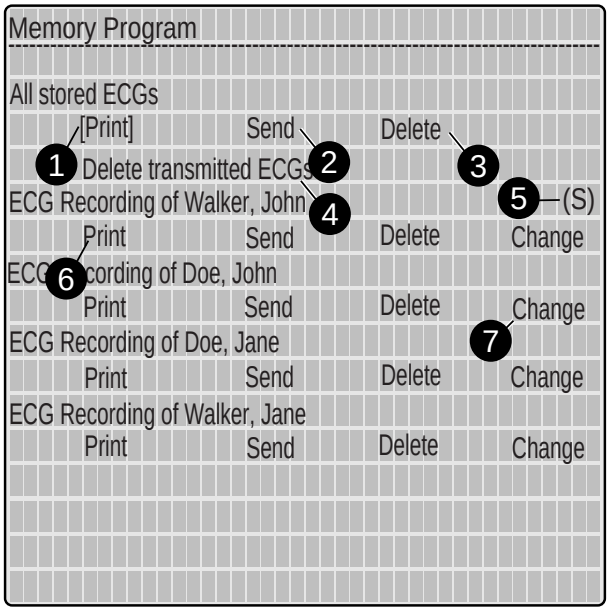


Figure 5-2. ECG identified by patient name

- ***1*** *All stored ECGs will be printed*
- ***2*** *All stored ECGs will be transmitted*
- ***3*** *All stored ECG will be deleted*
- ***4*** *All transmitted ECGs will be deleted*
- ***5*** *ECG has been sent (S)*
- ***6*** *John Walker's ECG will be printed*
- ***7*** *Select to edit the patient data*

Note

With a fully charged battery and the unit turned off, ECGs will remain stored for approx. 4 weeks.

5.3 The Memory Function

With MAC 1200 units equipped with the optional Memory function MEMO the ECG including patient, measurement and analysis data can be saved with the button after ECG acquisition. A message informs the user that ECGs are being saved and indicates the number of stored ECGs.

To retrieve an ECG from memory, simultaneously press and .

You will see the memory program as shown in Figure 5-2.
The first line refers to all stored ECGs.
With the command in the line below all transmitted ECGs can be deleted.
The individual ECGs (either identified by name or, if the patient name was not entered, by date and time) follow.

The cursor is positioned at "All stored ECGs [Print]" **1**, which means that all stored ECGs will be printed when you press the button.

To transmit or delete **all stored** ECGs, position the cursor on "Send" **2** or "Delete" **3** and confirm the command with .

To delete **all sent** ECGs (identified with the letter "S" **5**), position the cursor on field **4** and confirm the command with .

To print, transmit or delete an individual ECG or change the corresponding patient data, position the cursor in the appropriate field (e.g. **6** [Print] or **7** [Change]).

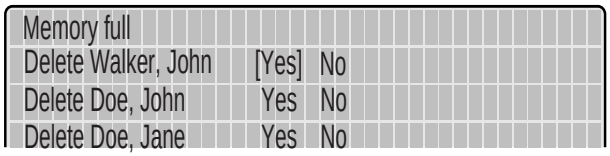


Figure 5-3. "Memory full" message

If you try to save an ECG when the memory is full, a message informs you of the memory status. When you delete an ECG from memory (the cursor highlights the last acquired ECG), the new ECG will automatically be saved (Figure 5-3).

The unit may be set up to automatically save ECGs (without pressing) and automatically remove ECGs from memory that were successfully transmitted to CardioSys, CardioSoft or MUSE.

The memory program can be terminated at any time with .

Note

- ***If you intend to print a large number of stored ECGs, we recommend to connect the unit to the power line or to check that the battery is fully charged.***
- ***When you terminate the memory function with , it is not possible to save the current ECG again.***

5.4 The Report Formats

The length and scope of the reports depends on the implemented software (standard, MEAS (measurement), DIAG (interpretation)).

The table below shows all of the 12 different report formats available with MAC 1100 / MAC 1200 units.

Format	ECG traces	Rhythm lead	Speed	Measurement*	Interpretation*	Pages	Medians
	length/leads	length/leads					
12_FS	10 s / 1x12	no	25 mm/s	no	no	1	no
12_F1	5 s / 1x12	10 s / 1 (V6)	25 mm/s	yes	yes	1	no
12_F2	8 s / 1x12	10 s / 1 (V6)	50 mm/s	yes	yes	2	no
6_F1	2x5 s / 2x6	10 s / 1	25 mm/s	yes	yes	1	no
6_F2	2x5 s / 2x6	no	50 mm/s	yes	yes	2	no
6_F2_25	2x10 s / 2x6	no	25 mm/s	yes	yes	2	no
3_F1	4x2.5 s / 4x3	10 s / 1	25 mm/s	yes	yes	1	no
H1**	10 s / 1x6	10 s / 6	12.5 mm/s	yes	yes	1	12
H2	2x5 s / 2x6	no	50 mm/s	yes	yes	2	no
A1**	10 s / 1x6	10 s / 6	12.5 mm/s	yes + matrix	yes	1	12
1x10R3	10 s / 1x3	10 s / 3	25 mm/s	yes	yes	1	no
4x2.5R3	4x2.5 s / 4x3	3x10 s / 3	25 mm/s	yes	yes	1	no

* Measurements and interpretative statements are only available from MAC 1200 with the required software options.

** Only possible with option MEAS or DIAG.

Note

- ***The heart rate is calculated from all beats of the 10-second ECG.***
- ***The printed reports are unconfirmed documents. They must be overread, verified, and signed by a physician for confirmation.***

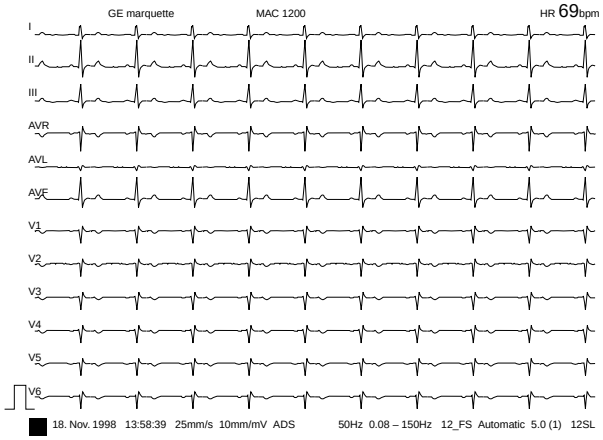


Figure 5-4. 12_FS report format

Report formats H1 and A1 are only available with MAC 1200 units (option MEAS or DIAG required). In these reports, the rhythm leads are printed with a speed of 12.5 mm/s and the medians with 50 mm/s.

Detailed results

The MAC 1200 (with option MEAS or DIAG) setup menu allows you to choose the "Detailed results" page. When selected, this page will be appended to the report. It contains patient data, measurement results, interpretative statements (reasons are only annotated if the unit is equipped with the HEART interpretation program), medians and the tabular measurement values.

Note

To obtain a printout of the full patient data, select the Manual Mode and press .

5.5 ECG Transmission

Note

Observe the safety information given in section 3.6 "Connecting Peripheral Equipment".

Resting ECGs acquired in Automatic Mode can be transmitted to CardioSys / CardioSoft or to a MUSE CV system. The units can either communicate via modem or directly via a connection cable (see section "Direct Transmission" below).

Transmission via Modem

Depending on the modem model used, the modem **must** be connected either with the 9-pole cable 223 378 01 or with the 25-pole cable 223 378 02.

For transmission of the ECG, the unit must be set up as described in section 9.9 "ECG Transmission via Modem".

After acquisition of the ECG, the transmission is started with .

The MAC 1200 is also capable of transmitting stored ECGs (if Memory option MEMO is installed).

Activate the memory program by simultaneously pressing and (press the button first and hold it depressed) (Figure 5-5).

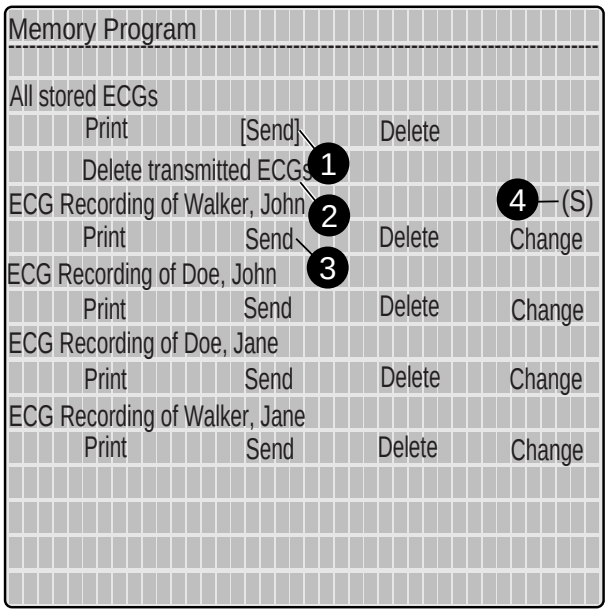


Figure 5-5. Memory program

- ***1*** *All stored ECGs will be transmitted*
- ***2*** *All transmitted ECGs will be deleted*
- ***3*** *John Walker's ECG will be transmitted*
- ***4*** *ECG has been sent (S)*

- To transmit all stored ECGs in one pass, position the cursor on "All stored ECGs - Send" (**l**, Figure 5-5), to transmit only one ECG, position the cursor on the "Send" command of that ECG (e.g. **3**, Figure 5-5).
- Confirm the command with .

You will see the transmission menu as shown in Figure 5-6.

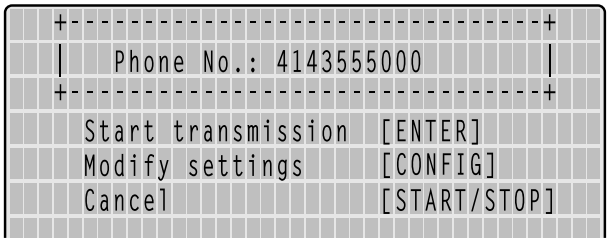


Figure 5-6. Menu for modem transmission

- Check the displayed telephone number and press to initiate the transfer.
- If it is necessary to change the number, press Config to display the configuration menu.
- With the transmission can be stopped.
- ECGs that were successfully transmitted are identified with the letter "S" (for "Sent", **4**, Figure 5-5).

Figure 5-7. Initializing the transmission

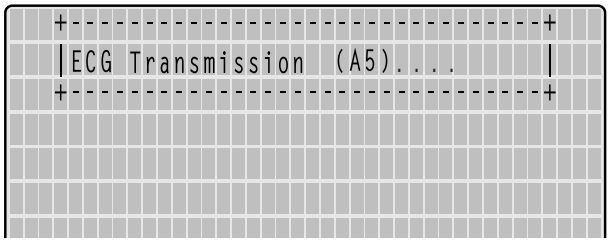


Figure 5-8. Display during ECG transfer

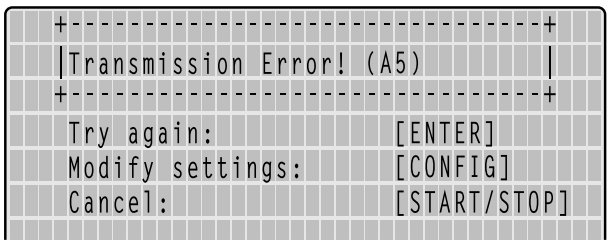


Figure 5-9. Error message

Note

Pacemaker information, telephone number and comments entered in the patient data are not transmitted to MUSE.

As soon as you initiate the transmission with ↵, the unit will automatically dial the number of the modem at the receiving end and establish a connection (Figure 5-7). Then it will send the ECG (Figure 5-8).

After the transmission, a message on the display indicates the number of successfully transmitted ECGs. As soon as you acknowledge the message with ↵, the Automatic Mode acquisition screen appears.

If the ECG could not be transmitted (wrong modem setup, modem off), the unit will display an error message, such as

Transmission Error! (A5)

(Figure 5-9).

In this situation you have the following choices:

- you can repeat the transmission with ↵
- you can change the settings with Config
- you can stop the transmission with ◇ ▽

List of error messages:

- ECG transmission error! (A5) / (CSI) (depending on selected protocol)
- Check interface!
- Dial locked! (temporarily)
- No dial tone!
- Busy!
- No answer!
- No carrier!
- Check modem configuration!

Transmitting Data to a MUSE CV System

Before sending data to the MUSE CV system, the MAC 1200 automatically logs on to the database. The data will be transferred. If the transfer is stopped, the MAC 1200 may take a few seconds before cancelling the connection because it has to log off the database first. Then the communication link with the receiving modem is interrupted and the standard display reappears.

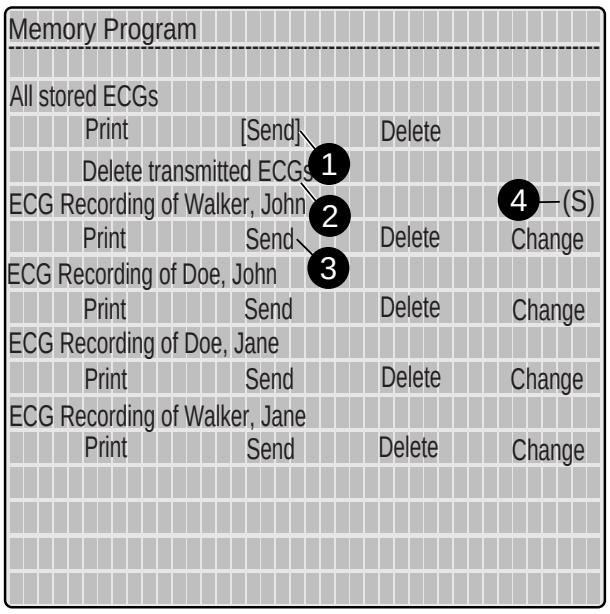


Figure 5-10. Memory program

- ***1*** *All stored ECGs will be transmitted*
- ***2*** *All stored ECGs will be deleted*
- ***3*** *John Walker's ECG will be transmitted*
- ***4*** *ECG has been sent (S)*

Figure 5-11. Initializing the transmission

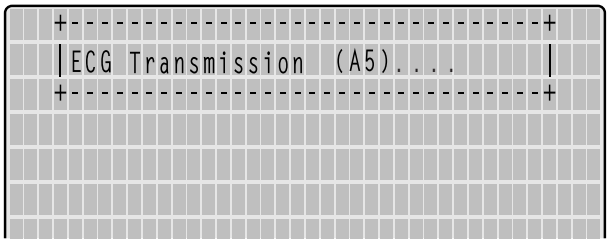


Figure 5-12. Display during ECG transmission

Direct Transmission

The unit must be connected to the PC or to the MUSE CV system by means of the connection cable 223 362 03.

For transmission of the ECG, the unit must be set up as described in section 9.10 "Direct ECG Transmission".

After acquisition of the ECG, the transmission is started with .

The MAC 1200 is also capable of transmitting stored ECGs (if Memory option MEMO is installed).

Activate the memory program by simultaneously pressing and (press the button first and hold it depressed) (Figure 5-10).

- To transmit all stored ECGs in one pass, position the cursor on "All stored ECGs - Send" (**l**, Figure 5-10), to transmit only one ECG, position the cursor on the "Send" command of that ECG (e.g. **3**, Figure 5-10).
- Confirm the command with .

The transmission is first initialized (Figure 5-11), then it starts (Figure 5-12).

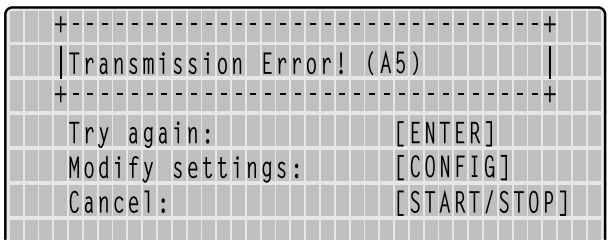


Figure 5-13. Error message

After the transmission, a message on the display indicates the number of successfully transmitted ECGs. As soon as you acknowledge the message with ↵, the Automatic Mode acquisition screen appears.

If the ECG could not be transmitted (e.g. wrong baud rate, connection error), the unit will display the error message

Transmission Error! (A5) / (CSI)

(the message depends on the selected protocol, Figure 5-13).

In this situation you have the following choices:

- you can repeat the transmission with ↵
- you can change the settings with Config
- you can stop the transmission with ◇▽

Direct Transmission to MUSE CV System

Note

Pacemaker information, telephone number and comments entered in the patient data are not transmitted to MUSE.

Before sending data to the MUSE CV system, the MAC 1200 automatically logs on to the database. The data will be transferred. If the transfer is stopped, the MAC 1200 may take a few seconds before cancelling the connection because it has to log off the database first. Then the standard screen reappears.

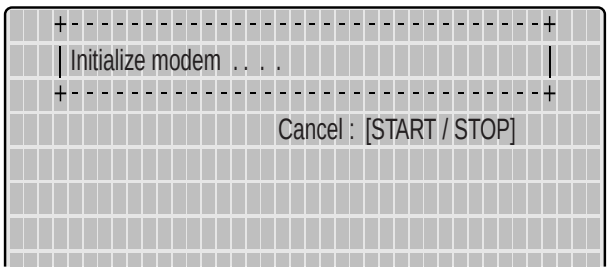


Figure 5-14. Screen display after activation of and

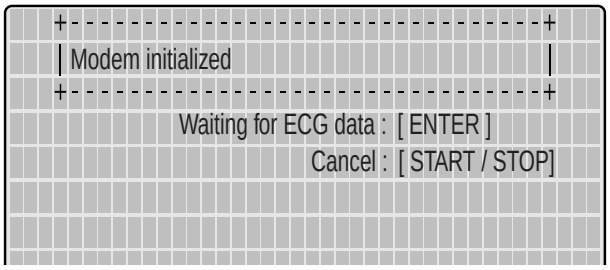


Figure 5-15. Screen display after modem initialization

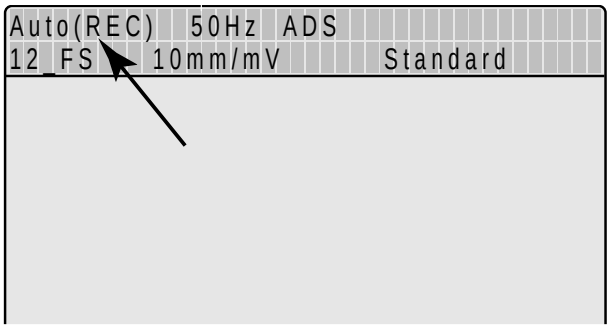


Figure 5-16. Unit is ready to receive data

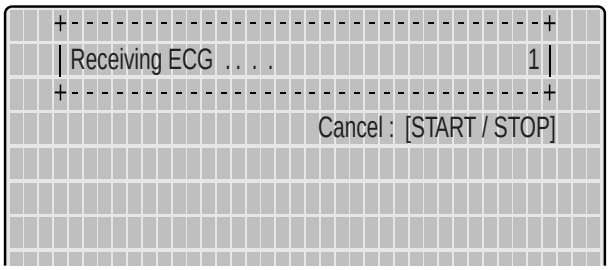


Figure 5-17. Unit is receiving ECG 1

Receiving Data with the CSI Communication Protocol
(see also chapter 13 "Technical Specifications")

Receiving ECGs is only possible with MAC 1200 units and in the Automatic Mode.

- Use the key combination and to display the screen for receiving ECGs (Figure 5-14). The connected modem is automatically initialized. The procedure can be aborted with .
- Press to enable the "receive data" mode. The procedure can be aborted with .

When you have enabled the "receive data" mode, the standard screen display of the Automatic Mode displays. The message "Auto (REC)" indicates that the unit is ready to receive data (Figure 5-16).

ECGs can be recorded in the Automatic Mode even while the unit is in the "receive data" mode.

A message displays on the screen when the unit is receiving data (Figure 5-17). The reception can be aborted with .

The ECG which has just been received is processed for the printout. The report is printed in the selected format. Multiple ECGs are received and printed one after the other.

After printout of the last ECG, the "receive data" mode is automatically disabled. The mode is also disabled when you select another operating mode.

The following information is annotated in the bottom line of each report:

– the sender
– the software version and analysis program version used at the sending unit (e.g. "ACQ-DEV: V5.1M12i HEART V5.1").

Modem Setup (for Modem --> other)

If you prefer to use another modem than the standard models listed in the setup menu (MultiTech, Elsa), you will have to enter a few parameters required for communication between the MAC 1100 / MAC 1200 and the modem.

For the AT commands which your modem understands, please refer to the modem user instructions. Three command sequences have to be entered in all, each of which defines a specific modem operating state:

1. the modem is initialized (init string)
2. a communication link is established (dial string)
3. the communication is terminated (hangup string)

These three strings are entered in the modem setup menu (section 3.6 "Connecting Peripheral Equipment").

The example below shows the command strings for the MultiTech ZDX modem.

1. AT Command for Modem Initialization

AT	prefix that precedes every command line
&F	fetch factory configuration (loads the factory configuration from ROM into the active configuration memory (RAM))
MO	speaker is always off
&DO	ignore DTR status transition
&QI	standard AT result code
VO	digit result codes selected (0 to 999)
-	init string: AT&FMO&DO&:QIVO

2. AT Command for Establishing a Communication Link

Example of a dial string for a modem connected to a branch (PBX system) and dialling a modem via the public telephone network, using the touch tone mode.

AT	prefix that precedes every command line
DT	touch tone dial mode
xxx	after DT, enter the characters for access to the public telephone network (e.g. 0)
W	W, placed after a number, tells the modem in a PBX system to wait for the dial tone of an outside telephone line
-	dial string: ATDTOW

3. AT Command for Termination of the Communication

The communication is terminated in two steps.

First of all, the MAC 1100 / MAC 1200 sends an escape command to return from the on-line state to the command state. Then the hangup command follows:

+++	escape command
AT	prefix that precedes every command line
H	hangup command
-	hangup string: +++ATH

5.6 Adjusting Measurement Points / QT Dispersion

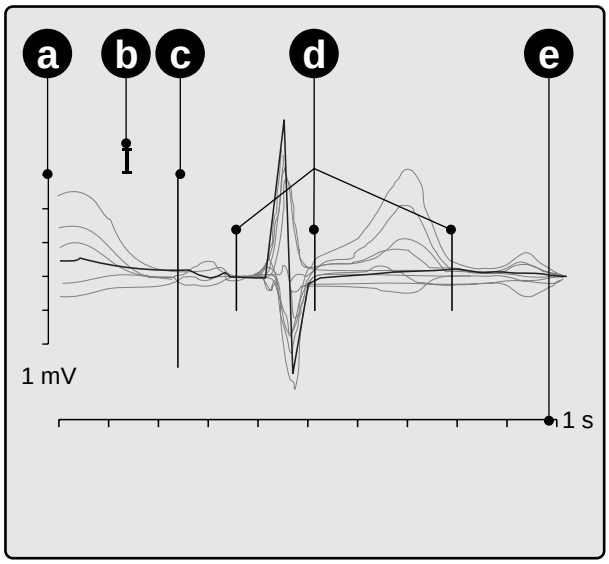


Figure 5-18. Verification of the global measurement points
a *Amplitude in [mV]*
b *Selected lead*
c *Active marker (large)*
d *Inactive marker (small)*
e *Time in [s]*

This feature is only available with MAC 1200 units equipped with the MEAS or DIAG option. The HEART interpretation program is also required.

Global Measurement Points

After acquisition of an ECG in the Automatic Mode, the global measurement points for

– P onset
– P offset
– QRS onset
– QRS offset, and
– T offset

can be adjusted manually.

- After acquisition of the ECG, press R to display the screen for verification of the global measurement point markers (Figure 5-18).

On this display you will see all 12 ECG leads: the active lead is black and displayed in the foreground, the inactive leads appear dimmed in the background.
The active measurement point marker is large, the 4 inactive markers are small.
The following keys can be used to adjust the markers:

← →	moves the active marker right or left
↑ ↓	selects the next or previous marker
	activates the next lead
mm/mV	changes the gain
	terminates the adjustment, saving the changes
	terminates the adjustment without saving the changes
space bar	for the P onset and P offset values, this key toggles between "definite value" and "approximate value"

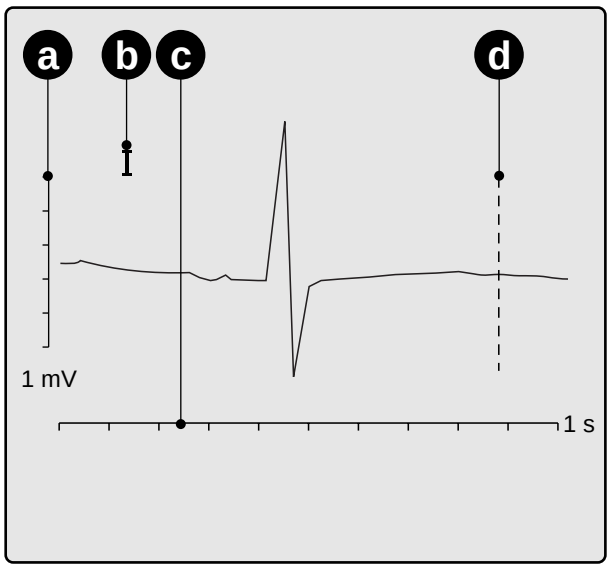


Figure 5-19. Verification of the T offset measurement point

a *Amplitude in [mV]*

b *Selected lead*

c *Time in [s]*

d *Active marker*

Local T Offset Measurement Point / QT Dispersion

When you exit the screen for verification of the global measurement points, the screen for verification of the T offset measurement point will appear automatically (Figure 5-19).
Therefore, this screen always shows only one lead at a time and the T offset point.
Changing the local T offset point also affects the QT dispersion value.
The following keys can be used to adjust the marker:

← →	moves the marker right or left
	displays the next lead
mm/mV	changes the gain
	terminates the adjustment, saving the changes
	terminates the adjustment without saving the changes

When you exit the screen, the acquisition screen for the Automatic Mode reappears.
The corrected ECG can be printed with the button.
If the unit is equipped with the MEMO memory option, the corrected data can be saved (or it will be saved automatically when the corresponding function is enabled). If the original ECG had already been saved, the corrected data will overwrite this ECG.

Note

Changing the local T offset measurement point does not affect the global T offset point.

6 Manual Mode Recording

6.1 Some Basic Facts

In Manual Mode, the system acquires 6 leads of ECG in realtime. Recordings are started and stopped with  . Some of the system settings can be customized. They are identified with the letter (**c**).

The following information refers to a unit with the system defaults (see table at left). For instructions on changing the default setup, refer to section 9.3 "Manual Mode".

Parameter	**Factory Default**	**Options**
Report sequence	STANDARD	CABRERA, NEHB, SEQ.NO.4
Gain	10 mm/mV	"*auto", 5, 20, 40 mm/mV
Speed	25 mm/s	5, 50 mm/s
Muscle filter	No	Yes
Filter frequency	40 Hz	20 Hz
AC line filter	Yes	No
Anti-drift system	No	Yes
Auto. paper feed	No	Yes

Table 6-1. Setup menu for the Manual Mode

6.2 Recording

After switching on the unit, press Man to select the Manual Mode.

– Before recording the ECG, patient data can be entered (Pat). We recommend to enter the patient's name to annotate it on every report.

– Before initiating a recording, check the display for error messages (see table at left). Check all electrodes; if the message persists, there must be a break in the patient cable. Replace the cable with a new one.

– The recording is started and stopped with ◇|▷ ▽.

With the system defaults, the MAC 1100 / MAC 1200 will activate the following functions and settings:

– the Standard report sequence (lead to channel correspondence): I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6 (**c**);
also available: CABRERA, NEHB, SEQ. NR. 4 (custom report sequence)

– a gain of 10 mm/mV (**c**) (calibration pulse at the beginning of the recording The unit can be set up to automatically adapt the gain to the ECG signal (see section 9.3 "Manual Mode"). Also, the gain setting can be changed with mm/mV (5, 10, 20 and 40 mm/mV).

Note

In Manual Mode, messages indicating disconnected electrodes are also annotated on the recording, e.g. Lead fail C1.

***R*:**	***right arm electrode disconnected***
***L*:**	***left arm electrode disconnected***
***F*:**	***left leg electrode disconnected***
***C1*:**	***chest electrode C1 disconnected***
***C2*:**	***chest electrode C2 disconnected***
***C3*:**	***chest electrode C3 disconnected***
***C4*:**	***chest electrode C4 disconnected***
***C5*:**	***chest electrode C5 disconnected***
***C6*:**	***chest electrode C6 disconnected***
***NA*:**	***Nehb electrode Nap disconnected***
***NT*:**	***Nehb electrode Nst disconnected***
***NX*:**	***Nehb electrode Nax disconnected***

Messages indicating disconnected electrodes

Note

In Manual Mode, report sequences can also be selected with these shortcuts:

Q1 = ***Standard***
W2 = ***CABRERA***
E3 = ***NEHB***
R4 = ***Seq. 4***

Note

– ***Please note that filters may suppress diagnostically relevant portions of the signal, because they limit the transmission range. Filters should therefore only be enabled if necessary.***

– ***selects the other 6 leads of the selected report sequence.***

– ***, display the other 3 leads of the selected group of 6.***

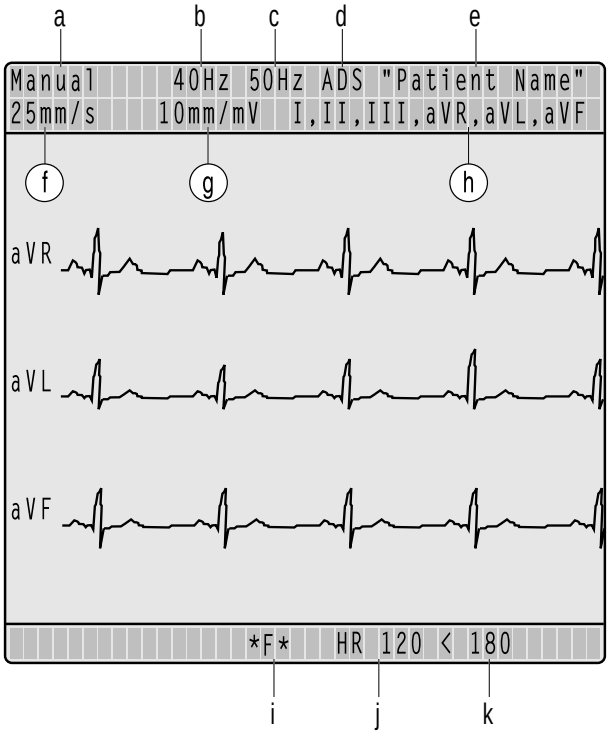


Figure 6-1. Manual mode display

a	*Operating mode*
b	*Muscle filter enabled*
c	*AC line filter enabled*
d	*Anti-drift system enabled*
e	*Patient name*
f	*Writer speed*
g	*Gain 10 mm/mV (automatic gain adjustment off)*
h	*Report sequence*
i	*Left leg electrode failure*
j	*Heart rate*
k	*Heart rate limit (adjustable)*

– the writer prints at a speed of 25 mm/s, the speed can be changed with mm/s

– the muscle filter is disabled (**c**)

– the AC line filter is enabled (**c**)

– the anti-drift system (cubic spline) is disabled (**c**)

– pressing will not advance the paper to the next fold (Auto Paper Feed (**c**))

– pressing after the ECG recording will print the patient data

All relevant device settings are shown on the display (Figure 6-1).

– If you change the writer speed, lead group or any filter settings during a recording, the unit will briefly stop.

– With you advance to the next group of 6 leads of the selected report sequence.

– When the anti-drift system is enabled, there will be a short delay of 2.2 s before the recording starts.

The heart rate limit is automatically calculated from the date of birth (WHO 100% = 220 - age). When the date of birth is not entered, the unit will set the limit at 180 bpm. This value can be changed with F- and G+ (in steps of 5 bpm).

7 Arrhythmia Mode Recording

7.1 Some Basic Facts

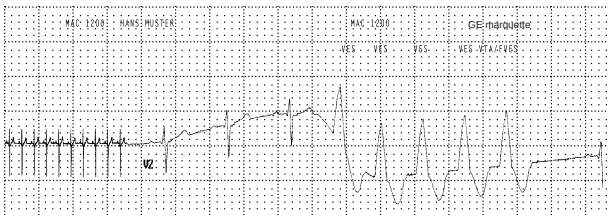


Figure 7-1. Event recording

Note

After starting the program, press mm/s to select a continuous recording at 5 mm/s (c). If the unit identifies an arrhythmic event, it will automatically switch to the faster paper speed. With the same key mm/s, the trend recording can be stopped. The unit can be set up to automatically start a trend recording when the Arrhythmia Mode is initiated.

Parameter	Factory Default	Options
Report sequence	STD-CH	STD_RED STD_LI CABR_EX NEHB CH_HIGH
Gain	10 mm/mV	"*auto", 5, 20, 40 mm/mV
Muscle filter	No	Yes
Filter frequency	40 Hz	20 Hz
AC line filter	Yes	No
Trend recording	No	Yes
Arrhythmia report	unequal	all, no
Episode report	chron.	prio., ventr., no

Table 7-1. Setup menu for the Arrhythmia Mode

In Arrhythmia Mode, the MAC 1200 continuously scans the ECG for arrhythmias.

From six simultaneously acquired leads, the MAC 1200 automatically selects the two that provide the best signal for analysis.

When the analysis algorithm detects an arrhythmia, the event is recorded with "context" (Figure 7-1). The length of the recording varies with the duration of the event episode. In the setup menu (section 9.4 "Arrhythmia Mode") you determine the conditions for a recording:

- the recorder starts each time it detects a single-beat event
- the recorder starts each time it detects an event different from the previous event
- the recorder does not start at all.

Some of the system settings can be customized. They are identified with the letter (**c**). The following information refers to a unit with the system defaults (see table at left). For instructions on changing the default setup, refer to section 9.4 "Arrhythmia Mode".

Note

For proper functioning of the ECG analysis algorithm, pacemaker patients must be identified in the patient data: Pacemaker – yes (section 4.3 "Entering Patient Data").

***R*:**	***right arm electrode disconnected***
***L*:**	***left arm electrode disconnected***
***F*:**	***left leg electrode disconnected***
***C1*:**	***chest electrode C1 disconnected***
***C2*:**	***chest electrode C2 disconnected***
***C3*:**	***chest electrode C3 disconnected***
***C4*:**	***chest electrode C4 disconnected***
***C5*:**	***chest electrode C5 disconnected***
***C6*:**	***chest electrode C6 disconnected***
***NA*:**	***Nehb electrode Nap disconnected***
***NT*:**	***Nehb electrode Nst disconnected***
***NX*:**	***Nehb electrode Nax disconnected***

Messages indicating disconnected electrodes

Note

With a single-page recording can be initiated after program start.

Note

Please note that filters may suppress diagnostically relevant portions of the signal, because they limit the transmission range.
Filters should therefore only be enabled if necessary.

7.2 Recording

– After switching on the unit, press Arrhy to select the Arrhythmia Mode.

– Before recording the ECG, patient data can be entered (Pat). We recommend to enter the patient's name to annotate it on every report.

– Before initiating a recording, check the display for error messages (see table at left). Check all electrodes; if the message persists, there must be a break in the patient cable. Replace the cable with a new one.

– The recording is started and stopped with .

Upon program start, the unit records 6 leads of ECG (1 page). During the following learn phase, the analysis algorithm learns the patient's typical QRS complex. After the learn phase, the recorder prints a report where the QRS complexes acquired in the learn phase are labeled "L" and the complex found to be the patient's typical complex is labeled "QRSL". Having completed the learn phase, the MAC 1200 is ready to identify arrhythmias.

With the system defaults, the MAC 1200 will activate the following functions and settings:

– the STD_CH report sequence (lead to channel correspondence) (V1 to V6) (**c**)

– a gain of 10 mm/mV (**c**) (calibration pulse at the beginning of the recording). The unit can be set up to automatically adapt the gain to the ECG signal (*auto)

– the muscle filter is disabled (**c**)

– the AC line filter is enabled (**c**)

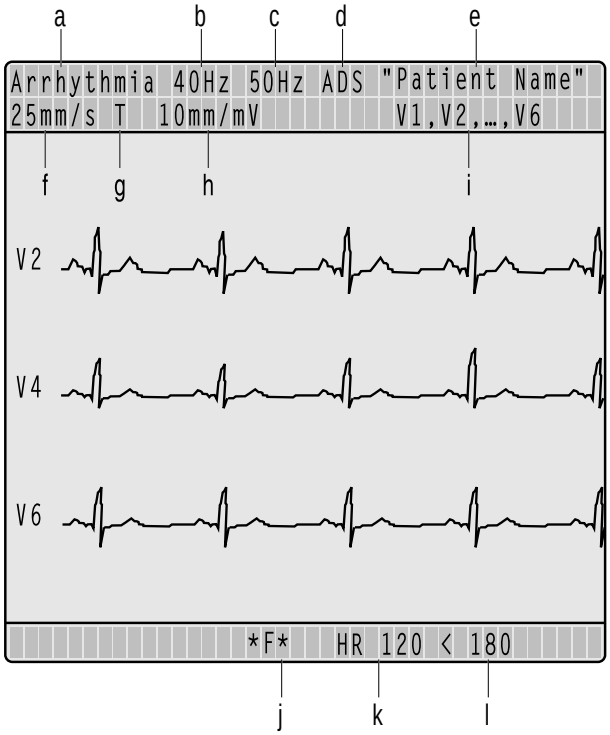


Figure 7-2. Arrhythmia mode display

a *Operating mode*
b *Muscle filter enabled*
c *AC line filter enabled*
d *Anti-drift system enabled*
e *Patient name*
f *Writer speed (event episodes)*
g *Trending enabled*
h *Gain*
i *Report sequence*
j *Left leg electrode failure*
k *Heart rate*
l *Heart rate limit (adjustable)*

Note

The letter A on a recording indicates the presence of artifact which does not allow the algorithm to identify arrhythmias. Causes include wandering baselines. The anti-drift system largely prevents these disturbances. Still you should check the electrodes and leadwires.

– the slow trend recording is disabled (**c**)
– event episodes are recorded at a speed of 25 mm/s
– the unit documents all events that are different from the previous event (**c**). You can set up the unit to document all events or no event at all.
– in the final report the event episodes are printed in chronological order

All relevant device settings are shown on the display (Figure 7-2).

Refer to table 7-2 for an explanation of the arrhythmia codes annotated on the recording.

The heart rate limit is automatically calculated from the date of birth (WHO 100% = 220 - age). When the date of birth is not entered, the unit will set the limit at 180 bpm. This value can be changed with F⁻ and G⁺ (in steps of 5 bpm).

Final Report

The arrhythmia recording can be stopped with ◇▽.

Then the final report can be printed with 📄. The final report consists of

– the patient ID sheet (with all patient data as well as with all analyzed QRS complexes, type and number of detected events and the analysis duration in tabular form) and
– the episode report (3 sheets max. with 2 episodes each).

Arrhythmic Events	
– asystole, limit value	ASYSTO
– ventricular fibrillation/flutter	VFIB
– ventricular tachycardia (>3 PVCs)	VTAC
– ventricular run (3 VPBs)	RUN
– ventricular couplet (2 VPBs)	CPLT
– pause of 2 missed beats	PAU2
– pause of 1 missed beat	PAU1
– early VPB	EVPB
– ventricular bigeminy	VBIG
– new form (e.g. intermittent bundle branch block)	NF
– multiform VPBs	MULT
– supraventricular arrhythmia	SVAR
– paroxysmal supraventricular tachycardia	PSVT
– tachycardia	TACH
– bradycardia	BRAD
– pacemaker malfunction	PERR
– ventricular escape beat	ESC
– ventricular premature beat	VPB
– supraventricular premature beat	SVPB
– aberrant beat	ABR
– pacemaker capture	PCAP
– pause (>l.5 times the normal RR interval)	TL
– absolute pause, limit value	PAUA
– artifact	A
– learn phase	L
– learned QRS complex	QRSL

Table 7-2. Arrhythmia codes

8 ECGs of Pacemaker Patients / ECG Recording during Defibrillation

8.1 Recording ECGs of Pacemaker Patients

Due to the slow paper speed it is not possible to display pacer pulses directly on the ECG recording. At a paper speed of 50 mm/s and a pulse duration of only 0.5 ms, the width of the recorded pacer pulse would be only 0.025 mm.

For this reason the recorder reduces the pulse amplitude and expands the pulse width, so that the pacer pulse is easier to identify. The MAC 1100 / MAC 1200 records the pulse with the correct polarity, with a width of 5 ms and with the same amplitude in all leads (depending on the polarity of the pacer pulse in leads I and II, the pacer pulse in lead III may be suppressed) The amplitude of the reverse current Figure 8-1 shows an ECG recording with pacer pulses.

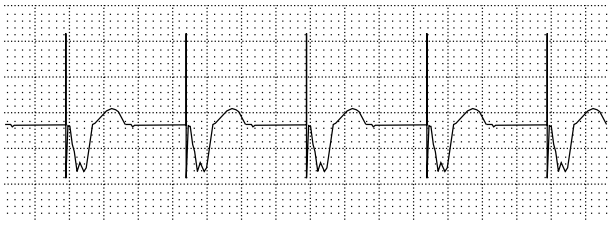


Figure 8-1. ECG recording with pacer pulses

Warning

Incorrect HR, No HR Alarm — If several adverse conditions exist at once, the possibility that the pacer pulses are interpreted (and counted) as QRS complexes should be considered. At the same time, however, QRS complexes might be suppressed in certain situations. Therefore, pacemaker patients should always be watched closely.

8.2 ECG Recording During Defibrillation

The patient signal input is defibrillation-proof so it is not necessary to remove the ECG electrodes before defibrillating the patient.
However, when using stainless steel or silver electrodes, the defibrillator discharge current may cause complete polarization at the electrode/skin interface. This condition may prevent ECG signal acquisition for several minutes. With silver/silver chloride electrodes, this will not happen.

Set the MAC 1100 / MAC 1200 to Manual Mode when you may have to defibrillate the patient while recording the ECG, and disable the anti-drift system which would cause a 2 second signal delay (section 9.3 "Manual Mode").

When using other electrodes, disconnect the patient cable from the recorder while defibrillating the patient.

Warning

- ***Equipment Damage — For reasons of patient safety, use only the original Marquette Hellige patient cable. Before connecting the cable to the device, check it for signs of mechanical damage. Do not use a damaged cable.***
- ***Patient Hazard, Delayed ECG Display — Use silver/silver chloride electrodes for ECG signal acquisition, if the patient may have to be defibrillated.***
- ***Shock Hazard — During defibrillation, do not touch the patient, the electrodes or the leadwires.***

Note

Observe the safety information of the defibrillator.

9 System Setup

9.1 Some Basic Facts

- Press Config to display the configuration menu.

The main menu with the following options will appear:
- Operating mode: Automatic (Manual, Arrhythmia)
- General Settings
- Communication
- Setup Patient Data
- Option Code

At "Operating mode", you will always see the currently selected mode. So be sure to select the appropriate mode before entering the configuration menu.

- To access the menu options, position the bar cursor on the option with the cursor keys and confirm the selection with ↵.

The operating steps to select a setting are always the same:

- Using the cursor keys ← and →, you select the setting and confirm the selection with ↵.

The cursor will move to the next menu item.

- Individual items can be skipped with ↓ or ↑.
- To exit the menu, press ◇ ▽.

The factory default setting is shown in angular brackets [...].

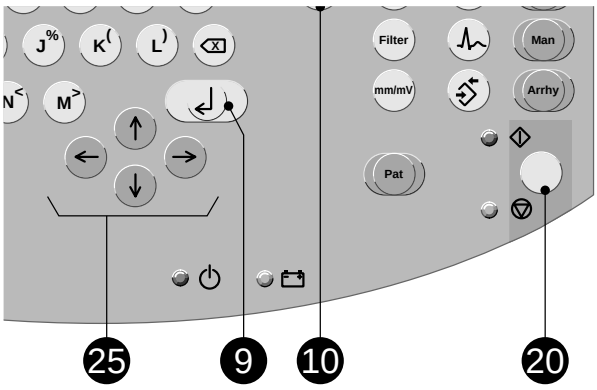


Figure 9-1. System setup keys

9.2 Automatic Mode

- Use the cursor keys to position the bar cursor on "Automatic" and confirm the selection with ↵.

The configuration menu for the Automatic Mode will appear.

Report sequence

[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)
NEHB (I, II, III, aVR, aVL, aVF, D, A, J, D, A, J) (only with the HEART interpretation program)

Rhythm leads

Depending on the selected report format, the recorder will print no, 1, 3 or 6 selectable rhythm leads.
With the 12_F1 report format, the printed rhythm lead is V6 (for NEHB leads: lead J), with formats 3_F1 and 6_F1, the first (selected) rhythm lead, with formats 1x10R3 and 4x2.5R3 the first 3, and with formats H1 and A1 all 6 rhythm leads.

Gain

5, [10], 20, 40 mm/mV, *auto

Report format

Refer to section 5.4 "The Report Formats".

Detailed results (MAC 1200 only)

The "Detailed results" page will be printed, yes/[no] (section 5.4 "The Report Formats").

Contin. rhythm

[yes]: In 6_F1 reports, the first 6 leads represent the first half of the 10-second signal acquisition period, while the second set of 6 leads represent the 2nd half of the acquisition period.

no: The second set of 6 leads also represents the first half of the acquisition period.

The same is true for the report format 3_F1.

Muscle filter/AC line filter

Elimination of muscle artifact and AC line interference. Muscle filter: [no], AC line filter: [yes]

> **Note**
>
> ***Please note that filters may suppress diagnostically relevant portions of the signal, because they limit the transmission range. Filters should therefore only be enabled if necessary.***

Filter frequency

Cut-off frequency of the muscle filter: [40 Hz], 20 Hz.
The frequency range is indicated in the lower margin of the recording strip.
"0.08 - 40 Hz" (40-Hz muscle filter enabled)
"0.08 - 20 Hz" (20-Hz muscle filter enabled)
"0.08 - 150 Hz" (muscle filter off).

Manual copy to

When the key is pressed, the unit will print a copy of the ECG [ECG], or the ECG is sent to a host system (CardioSys, CardioSoft, MUSE CV).

No. of copies

If you do not want to print the ECG, but only collect data or send the ECG to a PC, select "0" (message on display "REC OFF"). When a number greater than 1 is selected, multiple copies of the reports will be printed. Default: [1]

Autosave ECG (MAC 1200 with "Memory" option MEMO only)

After report generation, the ECG will or will not be automatically saved to the internal memory: [no], yes.

Delete ECG after transmission (MAC 1200 with "Memory" option MEMO only)

Stored ECGs that were successfully sent to a host system via the RS232 interface will be cleared from the recorder memory. Default: [no]

If this menu item is set to "yes" and ECGs have already been sent from the recorder memory, these ECGs will be deleted after the next transmission of a stored ECG.

Interpretation

When you select "yes" the unit will generate an interpretation of the ECG data.

Print interpretation

When you select "yes", the interpretation will be printed with the report.
Interpretations will always be sent to CardioSys, CardioSoft or MUSE, irrespective of your selection here.

Override function)[no]

When this function is enabled (yes), the recorder will print in the Automatic Mode, even when not all electrodes are applied or do not supply a good signal.
When electrodes are disconnected, a message informing the user of poor signal quality will be printed on the recording strip.

Measurement and interpretation results may be adversely affected by disconnected electrodes.

9.3 Manual Mode

- Use the cursor keys to position the bar cursor on "Manual" and confirm the selection with ↵.

The configuration menu for the Manual Mode will appear.

Report sequence

[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)
NEHB (D, A, J, I, II, III, aVR, aVL, aVF, D, A, J)
SEQ. NO. 4 (here, users can define a custom report sequence):

- Position the cursor on "SEQ. NO. 4".
- Press Config.

The display shown in Figure 9-2 will appear.

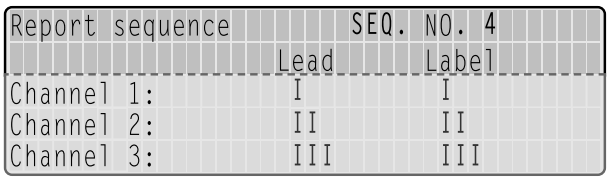


Figure 9-2. Creating a custom report sequence

- Press ↓.

The cursor will move to the position for entry of the lead in channel 1. Follow these steps, if you wish to record aVR in channel 1, for instance:

- Enter AVR and confirm the entry with ↵.

The cursor moves to the position for entry of the lead designation. AVR appears there as well.

- If you wish to enter another designation, you can overwrite the default name (4 characters max.).
- Confirm your entry with ↵ and repeat the above steps for channel 2, etc.

You can write over "SEQ. NO. 4" if you wish to enter another name for the report sequence.

Gain

"auto", 5, [10], 20, 40 mm/mV; with "*auto", the unit will automatically determine the appropriate gain setting for the 6 simultaneous leads.

Speed

Changes the paper speed. Default: [25 mm/s]

Muscle filter/AC line filter

Elimination of muscle artifact and AC line interference
Muscle filter: [no], AC line filter: [yes]

Filter frequency

Cut-off frequency of the muscle filter: [40 Hz], 20 Hz.
The frequency range is indicated in the lower margin of the recording strip.
"0.08 - 40 Hz" (40-Hz muscle filter enabled)
"0.08 - 20 Hz" (20-Hz muscle filter enabled)
"0.08 - 150 Hz" (muscle filter off).

Anti-drift system (ADS)

In case of wandering baselines, the anti-drift system restores the baseline to its original position (signal delay with ADS approx. 2 s). Default: [no]

Auto paper feed

Before each recording, the recorder feeds the paper to the beginning of a new page (yes, [no]).

9.4 Arrhythmia Mode

- Use the cursor keys to position the bar cursor on "Arrhythmia" and confirm the selection with  .

The configuration menu for the Arrhythmia Mode will appear.

Report sequence

STD_CH: V1, V2, V3, V4, V5, V6
STD_RED: I, II, III, V2, V4, V6
STD_LI: I, II, III, aVR, aVL, aVF
CABR_LI: aVL, I, -aVR, II, aVF, III
NEHB: I, II, III, D, A, J
CH_HIGH: V1', V2', V3', V4', V5', V6'4
(you can configure a custom sequence with these leads):

- Position the cursor on "CH_HIGH".
- Press 

and create the report sequence as described in section 9.3.

Gain

*auto, 5, [10], 20, 40 mm/mV; with "*auto", the unit will automatically determine the gain setting.

Muscle filter

Elimination of muscle artifact: yes, [no]

AC line filter

Elimination of AC line interference: [yes[, no

Filter frequency

Cut-off frequency of the muscle filter: [40 Hz], 20 Hz.
The frequency range is indicated in the lower margin of the recording strip.
"0.08 - 40 Hz" (40-Hz muscle filter enabled)
"0.08 - 20 Hz" (20-Hz muscle filter enabled)
"0.08 -100 Hz" (muscle filter off).

Trend recording

The slow trend recording of 5 mm/s automatically begins at program start ([no]/yes).

Arrhythmia data

The recorder will document arrhythmias in the following situations:

– each time an arrhythmia occurs
– each time an arrhythmia occurs that is different from the preceding event
– arrhythmias are not documented
all [unequal], no

Episodes

Final report includes episode report, with episodes listed by one of the following criteria

– in chronological order
– according to priorities (see table 7-1)
– ventricular beats only
– no episode report
[chron.], prio., ventr., no.

9.5 General Device Settings

Ordering Physician / Referring Physician / Technician

In the field at left, you see the last name of the physician or technician selected as the default name.
When selecting "other", you will see a menu where you can enter up to 10 names (2-digit ID number, first name, last name). The default name (and ID) is automatically selected at power-up.
The "Referring Physician" is only relevant if you send ECGs to the MUSE CV system. This name will not be annotated on the ECG recording. To exit the menu, press  .

Hospital/Practice

The name entered here will be printed on each report page.

Cart number [1)]

4-place number, default: 1, range: 1 to 9999.

Site number [1)]

number of the MUSE CV system that is to receive the data, default: 1, range: 1 to 255.

Location number [1)]

3-place ID number of the location to which the ECG recorder is assigned, default: 1, range: 1 to 600.

Date/Time

Enter date and time (enter 4 digits for the year).

Lead fail beep

Audio signal to indicate electrode problems: yes, [no]

High HR beep

Audio signal to indicate that the heart rate exceeds the limit value: yes, [no] (only in Manual and Arrhythmia Modes). The limit value (220 - age) can be changed manually.

Lead labels

[IEC codes]: R, L, F, N, C1 to C6 or
AAMI codes: RA, LA, RL, LL, V1 to V6.

Date

Format: day.month.year or month/day/year.

Time

Time format: [24 hours] or 12 hours (am/pm)

Units

Units of measurement for the patient's height and weight: [cm/kg] or in/lb.

Mains

AC line frequency: Europe [50 Hz], USA 60 Hz.

LCD light off after

If operating controls are not activated within the selected period of time the display backlighting automatically switches off (system default [20 min], adjustment range l to 99 min).

Default mode

This is the operating mode the unit defaults to after power-up: [Automatic]

Language

To select the language.

[1)] The value selected here is the default value appearing in the patient data

Enable password protection

Select "yes" to protect the setup menu with a password You will be asked to enter a password and to repeat it. Then the password protection is active.
To change the password (only possible when password protection is active)

- select menu item "Enable password"
- enter the old password
- enter the new password
- repeat the new password

Test DATA

Used for demonstration purposes (yes). It should be set to [no] (default) for proper clinical use.

Restore defaults

Selecting "yes" will restore the factory default settings (including the defaults of the three operating modes).
The electrocardiograph must be switched off and on again for the new settings to become effective.

Print Setup Lists

Selecting "yes" will display a menu with all available configuration lists.

- all lists
- General Settings / Communication / External Devices / Patient Data Setup
- Automatic
- Manual
- Arrhythmia

9.6 Communication

Protocol

The recorder offers two communication protocols: "A5" and "CSI" (**C**lient **S**erver **I**nterface, MAC 1200 only).
With the "A5" protocol, the 10-second resting ECG can be transmitted to CardioSys and CardioSoft.
The CSI protocol supports the transfer of resting ECGs from the electrocardiograph to a MUSE CV system.

Baud rate (HOST)

Transmission rate for the selected protocol. We recommend the default setting of [19200 baud].

Modem

Select the modem type. You can choose among the standard modems MultiTech (MT 19.32, 56.6), Elsa 28.8, Elsa 33.6, Elsa 56.6 and a user-defined modem.

When using one of the standard modems, all you have to enter is

- the dial mode (pulse or tone, depending on your telephone network)
- the telephone number (28 digits max.)
- the number to access the public telephone network (e.g. "0").

For a user-defined modem, enter

- the telephone number (28 digits max.)
- the init string (20 characters max.) (see modem operator's manual)
- the dial string (20 characters max.) (see modem operator's manual)
- the hangup mode (20 characters max.) (see modem operator's manual)

✂----------

The master password used to override all other passwords is
SYSTEM

9.7 Patient Data

The patient data menu can be set up to meet individual requirements. If you do not want to enter blood pressure readings, for instance, you can remove the corresponding prompts from the menu:

- Use the cursor keys to position the bar cursor on "Patient Data Setup" and confirm the selection with  .

The patient data setup menu will appear.

- Select "no" for prompts that you want to remove from the dialog.

Items
- Name
- First name
- Date of birth
- Patient ID

cannot be removed.

Items

– ID required (ID = patient ID number)
– 2nd patient ID
– 2nd ID required
– Last name required
– First name required
– Location Number
– Room
– Order Number
– Prompt 1 to 4

are disabled. They can be enabled from this menu.

"Required" Data Fields

If, for one of the data fields

– ID required
– 2nd ID required
– Last name required
– First name required

you choose "yes", an ECG can be recorded in Automatic Mode only if the corresponding patient data is entered.

Prompt 1 to 4

You can enter any text here (10 characters max.). When you have entered the text, you can select the format of the response field. There is a choice of 3 formats:

– alphanumeric field (17 characters max.)
– only numbers (9 numbers max.)
– yes or no

- To exit the menu, press  .

9.8 Option Code (MAC 1200 only)

In this menu you enter option codes to activate a number of optional software functions. The respective option becomes active after you have entered the code number. The code numbers are listed on the option code sheet supplied with the different software options.

- Use the cursor keys to position the bar cursor on "Option code" and confirm the selection with ↵.

The menu for entry of the option code will appear. There is a choice of 6 optional programs:

MEAS: measurement of the 10-second resting ECG
DIAG: measurement and interpretation of the 10-second resting ECG
MEMO: storage of up to 40 resting ECGs
C100: activates the three options MEAS, DIAG, MEMO for a maximum of 100 ECGs
C500: activates the three options MEAS, DIAG, MEMO for a maximum of 500 ECGs
EVAL activates the three options MEAS, DIAG, MEMO for a period of 4 weeks

- Using the cursor keys, position the bar cursor on the option that you want to activate.
- Enter the 12-digit code number and confirm the entry with ↵.
- The unit will accept the entered number only if it corresponds to the unit's serial number. The serial number is indicated at the top of the menu (Ser.No. = xxxxxxxxx). This number must be the same as printed on the nameplate (back of the device).
  When you enter the code number for DIAG and MEMO, the fields for C100, C500 and EVAL will disappear.
- Select ◇▽ to close the submenu.

9.9 ECG Transmission via Modem

- Select the Automatic Mode and press Config.
- Press ↵ to display the configuration menu for the Automatic Mode.
- Use the cursor keys to position the bar cursor on "Manual copy to HOST" and confirm the selection with ↵ ([HOST]).
- Press ◇▽ to clear the configuration menu.
- Use the cursor keys to position the bar cursor on "Communication" and confirm the selection with ↵.

Selecting the Communication Protocol

This adjustment is only necessary with MAC 1200 units, because only these devices can send data to CardioSys/CardioSoft or to MUSE. For MAC 1100 unit which can send data only to Cardio-Sys/CardioSoft, the communication protocol A5 is preselected.

- Using the cursor keys, position the bar cursor on "Protocol". Select the protocol A5 if you will send data to CardioSys/CardioSoft, or select CSI to send data to MUSE.
- Use the cursor keys to position the bar cursor on "Modem, other" and confirm the selection with ↵.
- Choose the modem you use from the list and confirm the selection with ↵.
  If your modem is not included in the list, select "other" and enter the required modem commands (see also "Modem Setup" in section 5.5).
- When you have selected a standard modem, position the bar cursor on "Dial mode" and select the appropriate mode.
- Enter the telephone number of the receiving modem and the number to access the public telephone network and terminate the configuration with ◇▽.

9.10 Direct ECG Transmission

- Select the Automatic Mode and press Config.
- Press ↵ to display the configuration menu for the Automatic Mode.
- Use the cursor keys to position the bar cursor on "Manual copy to HOST" and confirm the selection with ↵ ([HOST]).
- Press ◇ ▽ to clear the configuration menu.
- Use the cursor keys to position the bar cursor on "Communication" and confirm the selection with ↵.
- Select the same baud rate as at the receiving modem (9600, 19200, 38400, 57600).

Selecting the Communication Protocol

This adjustment is only necessary with MAC 1200 units, because only these devices can send data to CardioSys/CardioSoft or to MUSE. For MAC 1100 unit which can send data only to Cardio-Sys/CardioSoft, the communication protocol A5 is preselected.

- Using the cursor keys, position the bar cursor on "Protocol".
  Select the protocol A5 if you will send data to CardioSys/CardioSoft, or select CSI to send data to MUSE.
- Use the cursor keys to position the bar cursor on "Modem, none" and confirm the selection with ↵.

10 Loading Chart Paper

Figure 10-1. Opening the paper compartment door

- Switch on the recorder.
- Holding the paper door at the handle, pull it up and fold it out (Figure 10-1).
- Remove the cardboard backing of the previous paper pad.

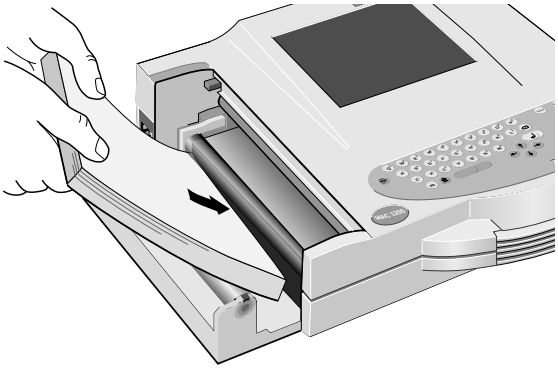


Figure 10-2. Inserting the new Z-fold pad

- Remove the cardboard from the top of the new pad and place the pad, including the cardboard backing at the bottom and with the arrow pointing towards the unit, into the paper compartment (Figure 10-2).

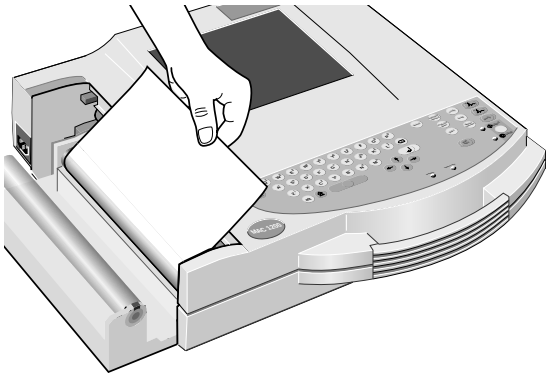


Figure 10-3. Guiding the leading paper edge over the guide roller

- Pull the top sheet from the compartment and guide it around the guide roller (Figure 10-3).

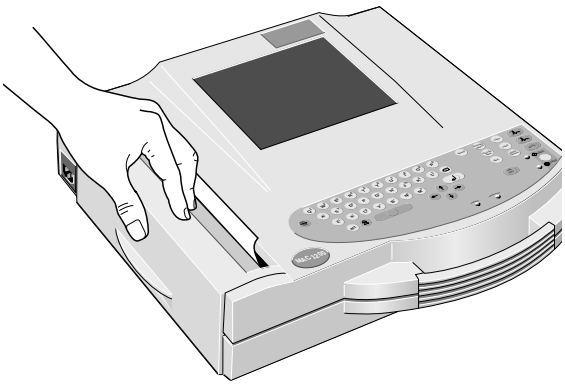


Figure 10-4. Closing the paper compartment door

- Holding the leading edge of the paper in place between the two markers on the recorder, close the paper door (Figure 10-4). Ensure that it locks into place on both sides.

When inserting an already started Z-fold pad, the grid side must face up and the first fold must point towards the paper compartment.

Note

Having inserted a new paper pad, be sure to acknowledge the message with ↵, not with ◇▽.

Note

- ***When closing the paper door, take care that it locks into place on both sides.***
- ***There is a window in the paper door that allows you to look inside the compartment and check the paper supply.***
- ***Use only the original Marquette Hellige writer paper.***
  This paper has a special coating that prevents
  - ***contamination and debris collecting on the printhead and***
  - ***electrostatic build up.***

  Furthermore, the thermosensitive layer and the printhead characteristics are exactly matched. Using other paper may result in recordings of poor quality.
  Moreover, the printhead may wear out prematurely. Use of other paper may void the warranty.

End-of-Paper Indication

A stripe marks the last 10 pages of the Z-fold pad.

When the writer runs out of paper during a recording, it will emit an audio signal and displays the message "End of paper or paper jam, if OK, press ↵".

- Insert a new paper pad and acknowledge the message with ↵.

Aging Stability

The standard ECG writer paper CONTRAST® is designed to guarantee full contrast for a period between 3 and 5 years if it is handled as described below before and after recording:

- Store the paper in suitable rooms at a temperature between 18° and 24° and a relative humidity between 40 % and 60 %.
- Avoid direct contact of the paper with
  - carbon and carbonless forms
  - chart papers and adhesives containing tributyl phosphate, dibutyl phthalate, or any other organic solvents
  - document protectors, envelopes, and sheet separators containing plasticizers.
    Caution: The above components may also be found in recycled papers.
  - solvents or solvent-based products containing alcohols, ketones, esters, or other substances from this chemical group.
- We recommend archiving ECG recordings on our ECG filing cards only (P/N 217 043 03).
- If longer storage periods are required, we suggest using our ARCHIVIST 30 chart paper (image legibility up to 30 years) or other image storage technologies.

11 Cleaning, Disinfection and Maintenance

Cleaning and Disinfecting the Recorder Housing

Warning

Shock Hazard — Disconnect the device from the power line before cleaning or disinfecting its surface.

- Wipe the monitor clean with a moist cloth. Do not let liquid enter the monitor. All cleaning agents and disinfectants that contain alcohol and are commonly used in hospitals are suitable, but do not use disinfectants on a phenol base or peroxide compounds.

Cleaning and Disinfecting the Patient Cable

- Disconnect the cable from the recorder before cleaning or disinfecting it. When disconnecting the cable, be sure to pull on the connector, not on the cable.
- **Clean** the cable by rubbing it down with a cloth moistened with soap water. Use a disinfectant for **disinfection**. Do not immerse the cable in liquid.

Cleaning and Disinfecting the Electrodes

In addition to the information given in this manual, observe the instructions for use of the respective electrode types.

- Discard disposable adhesive electrodes immediately after use to prevent that they are reused.
- Clean reusable electrodes immediately after removing them from the patient.
- Peel off the adhesive foil before cleaning the electrodes (rests of the adhesive can be removed with benzine).
- Then use warm water and a small brush to clean the electrodes of cream or gel. Do not use pointed or sharp objects for cleaning.
- Disinfect the electrodes with alcohol-free disinfectant. Ensure that connectors and sockets do not become wet.
- The only approved sterilization method is gas sterilization.
  Frequently sterilizing the electrodes with ethylene oxide gas reduces the life of the plastic material.

Maintenance

Checks before each use

Before each use, visually inspect the device, the leads and electrodes for signs of mechanical damage.

If you detect damages or impaired functions that may adversely affect the safety of the patient or user, do not use the device before it has been repaired.

Technical Inspections

For safety, the devices require regular maintenance. To ensure functional and operational safety of the MAC 1100 / MAC 1200 units, Technical Inspections should be carried out on an annual basis.

These checks should be performed by persons with adequate training and experience.

The checks can be carried out by Marquette Hellige within the framework of a service contract. The inspections include the following checks:

- Visually inspect the device and the accessories for signs of mechanical damage that may impair the device functions.
- Check that the device labeling relevant for safety is legible.
- Run a performance test as described in the operator's manual.
- Measure the resistance of the non-fused, earthed conductor and the equivalent leakage current as per local regulations.

The device does not require any other maintenance.

Disposal at the End of Its Service Life

Note

At the end of their service life, the device described in this manual and its accessories must be disposed of in compliance with the applicable local waste control regulations. If you have questions regarding the disposal of the product or of the accessories, please contact Marquette Hellige GmbH or its representatives.

12 Troubleshooting

Symptom	Cause	Remedy
Periodic superimposition of AC line interference (50 Hz) (Figure 12-1)	interference from the power line	Ground bed, verify position of the leadwires, switch on AC line filter
Superimposition of irregular AC line interference (Figure 12-2)	Muscle artifact caused by patient movements, hiccup, coughing	The patient should be warm enough and resting comfortably (place cushions under arms and knees). Comfort or distract patient, enable muscle filter (20 Hz / 40 Hz), if necessary.
The printed date and time are incorrect	Built-in lithium battery is depleted. The battery has a life of approx. 5 years	Notify service to check and/or replace battery
The green indicator **24** does not light up, although the recorder is connected to the power line	Defective AC power adapter or fuse	Notify service to check and/or replace fuse
The recorder does not write over the entire paper width	Paper compartment not properly closed	Paper door must lock into place on both sides
In Automatic Mode, the recorder does not stop and continues to feed paper. This does not happen in Manual Mode.	The paper pad was inserted the wrong way round so the recorder cannot detect the cue mark	Insert the paper pad as instructed
Recorder does not start after activation of the ◇/▽ key, or the recording is aborted.	Unit operated on battery power: battery discharged	Connect recorder to the power line. After a few minutes, the recorder is able to resume operation. Always connect recorder to the power line when indicator **23** lights up. The battery capacity depends on age, temperature and charge level (chapter 3 "Putting the Recorder into Operation").
No recording in Automatic Mode	Failure of at least one electrode	Check all electrodes or enable Override function (section 9.2 "Automatic Mode").
Paper jam		Open paper compartment and removed jammed sheet, place beginning of paper between the marks, close paper compartment and press ↵.

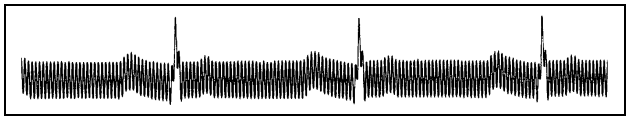


Figure 12-1. Regular AC line interference

Note

In the presence of very strong AC line interference in all leads, the thermal printhead may interrupt the recording. Activate the AC line filter (50 Hz/60 Hz) in these situations.

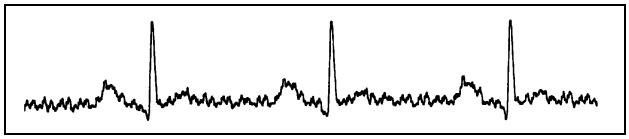


Figure 12-2. Irregular AC interference

13 Technical Specifications

Recording

Direct recording of waveforms and alphanumeric characters with rectangular coordinates by means of thermal-array printhead printing on thermosensitive paper.

- 3 or 6recording channels, or 12 in Automatic Mode, overlapping
- baseline pitch 3 channels: 62 mm (arrhythmia)
  6 channels: 31 mm (manual)
  12 channels: 16 mm (autom.)
- writing width 200 mm max.
- annotation of recorder settings, date, time and entered patient name in the margin of the recording strip
- with appropriate software, documentation of analysis results in the respective operating mode
- resolution of the recording:
  vertical 8 dots/mm
  horizontal 25 µm at 25 mm/s

Printer paper

HELLIGE CONTRAST® / ARCHIVIST® Z-fold pad , 150 pages per pad, equivalent to a chart length of approx. 45 m

paper width: 210 mm or 8,5" (215,9 mm; US format)

sheet length: 300 mm or 11" (279.4 mm; US format)

To prevent damage to the printhead use only the original HELLIGE CONTRAST® /ARCHIVIST® paper.

Paper transport

- paper speed
  5-25-50 mm/s, key selectable
  error limits at 25 and 50 mm/s, typ. ±l%
  at 5 mm/s, ±10% max.
- At paper end, the recorder emits an audio signal and stops recording
  the last pages of the pad bear a colored stripe in the lower margin

Membrane keypad

Pushbuttons with tactile feedback

- function keys for all routine operations
- alphanumeric keyboard for entry of text

Display

graphics display with 24 x 40 characters, contrast adjustment

resolution of 320 x 240 pixels with display backlighting

Indicators (LEDs)

For mains power, battery status and start/stop function

Lead Selection

Manual selection of different lead combinations or automatic lead sequencing.

- Lead programs (**c**):
  EINTHOVEN, GOLDBERGER, WILSON, NEHB,
  CABRERA lead sequence and user-specific combinations in Manual and Arrhythmia Modes

Automatic functions

They assist and facilitate operation by

- automatic amplifier blocking
- automatic control of lead selection, paper feed, calibration (**c**)
- report formatting (**c**)
- automatic baseline adjustment
- anti-drift system compensating for polarization voltage fluctuations (**c**)

Detection of pacer pulses

- pulse length between 0.1 and 2.5 ms
- pacer pulse marker independent of pulse polarity
- pulse amplitude between ± 5 mV and ± 700 mV

Heart rate indication

derivation of the heart rate from all ECG signals

- display range 30 to 300 bpm
- display update with every heart beat, maximum every 2 seconds

Signal inputs

isolated patient signal input, IEC type CF, high-voltage protection for all lead connections and neutral electrode, interference compensation via neutral electrode, monitoring for open leads

- electrode connections for R, L, F, N, Cl ... C6, Nax, Nst, Nap (= C4)
- input impedance for differential signals between any two electrode connections > 10 MΩ at 10 Hz
- input impedance for common-mode signals referred to neutral electrode > 50 MΩ up to 60 Hz
- dynamic range for differential signals between any two electrode connections for AC voltage ±10 mV, for superimposed DC voltage (polarization voltage) ±600 mV
- dynamic range for common-mode signals referred to neutral electrode ±l V, referred to chassis 263 V AC (rms)
- quiescent input current via any electrode connection for l kΩ termination referred to neutral electrode < 50 nA
- patient leakage current (rms values) according to IEC, class CF: in normal condition < 10 μA, in single-fault condition (e.g. patient in contact with line voltage) < 20 μA
- non-destructive range for lead-electrode connections and the neutral electrode connection referred to neutral electrode ±50 V, referred to chassis ±1500 V
- pulse voltage resistance of all lead electrode connections and of the neutral electrode connection referred to chassis (either polarity, e.g. defibrillation) 5000 V
- monitoring of each electrode for open leads: R, L, F, N, Cl, C2, C3, C4, C5, C6, Nap, Nax, Nst. Audible lead fail signal at program start.

Data interface

one serial RS232 interface for exchange of data with suitable external devices and software handshake

RS232 interface (standard V.24 interface):

- input voltage range. ± 15V max.
- output voltage range ±5 V min.
- interface protected from electrostatic discharge for ±10 kV max.

Transfer of ECGs with the CSI protocol between the MAC 1200 and the following units

MUSE CVIS	SW version 004A and later
MAC 5000	SW version 001B and later
MAC VU	SW version 002A and later
MAC 1200	SW version V5.01 and later

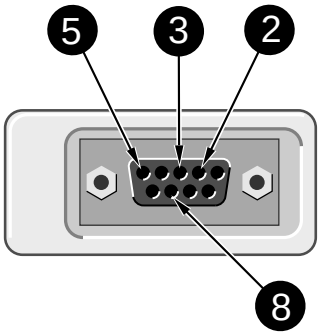
Receiving data with the CSI communication protocol from the following units

CardioSmart	SW version V4.21 and later
CardioSmart ST	SW version V4.21 and later

Sending ECGs to the following units with the A5 protocol

CardioSys / CardioSoft SW version V1.0 and later

Pin assignment of data port



2 RXDE
3 TXDE
5 circuit reference
8 remote start

Remote start (hardware)

Paper feed via remote control connection (depending on selected operating mode). External make contact referred to chassis via circuit reference:

- source impedance $R_i < 300\ \Omega$
- contact dwell > 100 ms
- non-destructive load ± 10 V
- ESD interface protection up to ± 10 kV

Signal Transmission

Patient input to recording

After lead formation and digitization simultaneous transmission of all electrode signals to the digital processing system; muscle filter, AC filter, pacing pulse identification, automatic or manual sensitivity adjustment, automatic baseline adjustment and drift compensation by means of the anti-drift system (A.D.S.) can be enabled or disabled simultaneously for all channels; digital output of processed signals via thermal-array printhead.

- low cut-off frequency (-3 db limits) 0.08 Hz, equivalent to a time constant of 2.04 s
- high cut-off frequency (3 dB limits) operating mode: Auto, Manual 150 Hz (IEC/AHA) operating mode: Arrhy 100 Hz (IEC)
- signal sampling rate: 1000/s
- resolution, referred to the input 5 µV
- output rate to recorder 2000/s
- for all leads, gain adjustment in four steps: 40-20-10-5 mm/mV
- with active muscle filter (low-pass characteristic) 3-dB drop of the amplitude frequency response at approx. 40 or 20 Hz
- with active AC line filter detection and compensation of periodic 50 or 60 Hz frequency components (depending on recorder model) attenuation >40 dB
- non-linear distortion below values specified in IEC and AHA recommendations
- coincidence error limits between any two channels ±0,5 mm
- detection of pacer pulses in C2 or other C leads and marking in all channels for signals referred to patient input:
  duration ≥ 0.1 ms, amplitude > 5 mV
- noise in the signal transmission path below values specified in IEC and AHA requirements:
  ≤ 2,5 µV rms
- common-mode rejection for 50 or 60-Hz signals (depending on recorder model) with AC filter switched on >140 dB

ECG calibration

automatic recording of a defined voltage step, valid for all channels

- calibration voltage, referred to ECG signal input: l mV
  calibration pulse width on recording depends on paper speed
  25 mm/s 5 mm
  50 mm/s 10 mm
  5 mm/s l mm

Automatic ECG gain adjustment

The gain automatically adapts to the incoming signal. The maximum amplitude of the lead group or of all leads determines the gain setting.

- automatic adjustment range 5 ... 40 mm/mV
- amplitude range (6 channels) 18 to 31 mm

Baseline

automatic adjustment of the baseline to the optimal recording range, in dependence of the signal amplitude

Anti-drift system (ADS)

automatic compensation of baseline fluctuations caused by polarization voltage fluctuations at the lead electrodes (delay in recording: 4.2 s)

ECG storage

in Automatic Mode, storage of approx. 40 ECGs

- stored ECGs can be deleted (individually or all in one pass), printed, transferred and patient data can be edited
- in Arrhythmia Mode, storage of up to 6 event episodes

Blocking

rapid charge reversal of the coupling capacitors in the preamplifiers after electrode application

Electrode monitoring

audible and visual indication on the LCD of disconnected electrodes or line break; each single electrode is monitored

Text input

patient and user data as well as comments can be entered via the panel keyboard and are annotated on the recording strip

Copy function

in Automatic Mode, after ECG recording, copies of the ECG can be printed from memory and/or transferred to a connected PC (**c**)

Test

automatic performance test upon power up, including verification of the signal path starting at the signal input

stored test data for demonstration of the device functions

Power supply

from the power line or from a built-in rechargeable battery, automatic switchover; automatic battery charging during line-power operation from integrated AC adapter module

Mains operation

- instrument design in protection class I according to IEC 60601-1
- rated voltage range 95 to 240 V
- operating voltage range 85 to 264 V, 49 to 65 Hz
- rated current 0.2 to 0.6 A
- fuse: 2 x T (slow-blow) 1.25 A, 5x20
- typical power consumption battery charging 14 W
- maximum power consumption 29 W

Battery operation

- type: nickel-cadmium
- rated battery voltage 18 V
- rated battery capacity 1.3 Ah
- Fully charged battery sufficient for up to 50 Automatic Mode 1-page ECGs, provided recorder is only switched on to record the ECGs.
- charge time for depleted battery approx. 4 hours (min. charge time for 1 Automatic Mode ECG: 10 minutes)

- battery life approx. 2 to 3 years, replacement by service only
- lithium battery for built-in clock, battery life approx. 5 years, replacement by service only

Operational readiness

After successful selft-test, approx. 10 s after power-up.

Operating position

horizontal

Environment

Operation

- temperature between +10 and +40 °C
- relative humidity between 25 and 95%
- atmospheric pressure between 700 and 1060 hPa

Transport and storage

- temperature between -30 and +60 °C (including battery)
- relative humidity between 25 and 95%
- atmospheric pressure between 500 and 1060 hPa

Recorder dimensions

- width 370 mm
- height 95 mm
- depth 320 mm (incl. handle)

Weight

recorder with battery approx. 5.6 kg

14 Order Information

Subject to change. Always refer to latest list of accessories.

Options

455 045 01	ECG Measurement MEAS (MAC 1200)
455 046 01	Interpretation DIAG (MAC 1200) + ECG Measurement
455 050 01	Interpretation DIAG (if MEAS is already implemented)
455 044 01	Memory MEMO (MAC 1200)

General Accessories
Patient Cables

223 387 01	Patient cable, 10-lead, 4-mm connector, IEC, 2.2 m
223 387 02	Patient cable, 10-lead, 4-mm connector, AHA, 2.2 m
223 418 08	Patient trunk cable, 10-lead, IEC (MultiLink)
223 418 09	Patient trunk cable, 10-lead, AHA (MultiLink)
384 018 16	Set of leadwires, 4-mm connector, 10 leads, defib-proof, IEC
384 018 17	Set of leadwires, 4-mm connector, 10 leads, defib-proof, AHA

Electrodes

217 225 03	Adhesive electrodes for babies, 13 mm diam., with 4-mm socket, 60-cm lead, fixation with adhesive rings 927 224 00
217 110 03	Adhesive electrodes for children, 22 mm diam., with 4-mm socket, fixation with adhesive rings 217 123 01
217 320 01	Adhesive electrodes for children, 22 mm diam., with press stud, fixation with adhesive rings 217 123 01
217 321 01	Adhesive electrodes for adults, 35 mm diam., with press stud, fixation with adhesive rings 927 223 00
504 648 56	Limb lead electrode for adults (stainless steel plate electrode), 31 x 40 mm, with 4-mm socket
923 096 47	Rubber strap for electrode 504 648 56 and 301340 00
301 340 00	Button-shaped electrode for adults, 30 mm diam., with 4-mm socket
217 194 01	Chest electrode for electrode belt, 30 mm diam.
217 196 01	Electrode belt for electrodes 21719401 and 301340 00
217 144 01	Chest suction electrode, 22 mm diam., small suction bulb, with 4-mm socket
217 144 02	Chest suction electrode, 22 mm diam., large suction bulb, with 4-mm socket
919 202 32	Clip electrode for limb leads, pkg. of 4 electrodes (red, yellow, green, black)
303 442 96	Adapter for connection of electrodes with press stud to patient cable with 4-mm connector

ECG Accessories, NEHB

223 403 05	Patient trunk cable, 12 leads, NEHB, IEC
384 017 65	Set of leadwires, 10 leads, defibrillation-proof, IEC, with 4-mm plug
384 017 66	Set of leadwires, 2 leads, NEHB, IEC, with 4-mm plug (in addition to 384 017 65), defibrillation-proof

Consumables

226 166 11	HELLIGE ARCHIVIST® 30 writer paper, non-fading, A4, pkg. of 10 pads
226 166 05	HELLIGE CONTRAST® writer paper, A4, pkg. of 10 pads
226 166 06	HELLIGE CONTRAST® writer paper, B4, pkg. of 10 pads
217 083 06	Electrode gel, 10 tubes, 100 ml each
217 083 05	Electrode cream, 10 tubes, 100 ml each
217 083 18	Electrode cream, refill, 250 ml
217 083 14	Electrode cream, 5-l container
930 115 82	Dispenser, 30 ml
217 307 01	Electrode contact spray, 200-ml bottle
217 307 05	Electrode contact spray, 2-l refill
927 224 00	500 adhesive rings for electrodes 217 225 ..
217 123 01	500 adhesive rings for electrodes 217 320 .., 217 110 ..
927 223 00	500 adhesive rings for electrodes 217 321..
217 007 01	Electrode paper, 200 sheets, for electrode 504 648 56
217 148 01	Electrode paper, 200 sheets, for electrode 217 144 01/02
217 043 02	ECG filing cards (50 cards)

Electrode Application Systems

216 121 13	Electrode Application System KISS 10 (10-lead system, w/o. pump)
216 124 13	as above, but with pump
216 122 03	Electrode Application System KISS 12 (12-lead system NEHB, w/o. pump)
216 125 01	as above, but with pump
303 443 77	Swivel arm for KISS
384 015 84	Table-top clamp with pole
384 013 30	Wall fixture for swivel arm
303 444 21	Clip adapter for adhesive electrodes

Miscellaneous

227 492 02	Operator's Manual
931 098 80	Instrument bag
227 477 01	Physician's Guide for ECG Interpretation Program HEART V4.3
4616791-001	12SL ECG-Analysis Program Physician’s Guide
217 041 02	ECG ruler (GUTZER)
919 062 00	Power cord, 3 m
401855-107	Power cord CH, 3 m
919 203 37	Power cord UK, 3 m
919 201 81	Power cord US, 2.5 m

Connection Cables

223 362 03	Connection cable (MAC 1100 / MAC 1200 to CardioSys)
223 378 01	Connection cable (MAC 1100 / MAC 1200 to modem, 9-pin)
223 378 02	Connection cable (MAC 1100 / MAC 1200 to modem, 25-pin)
223 362 03	Connection cable (EC 560 / ECG 561 or MAC 1100/MAC 1200 to CardioSys)
223 330 04	Connection cable (M700 to MAC 1100/MAC 1200)
223 366 04	Connection cable (EC 1200 to MAC 1100 / MAC 1200)

Appendix

Entering Special Characters

The following special characters (not for the Czech language) can be entered by means of the appropriate keystroke combination.

character	keystroke combination
\	Alt + Q
@	Alt + W
#	Alt + E
$	Alt + R
&	Alt + Y
¿	Alt + D
—	Alt + F
Ç	Alt + G
Å	Alt + K
Ü	Alt + L
î	Alt + X
Ñ	Alt + C
"	Alt + V
Ø	Alt + B
Ö	Alt + N
Ä	Alt + M
Á	Alt + I, then A
É	Alt + I, then E
Í	Alt + I, then I
Ó	Alt + I, then O
Ú	Alt + I, then U
À	Alt + O, then A (enter È, Ì, Ò, Ù in the same manner)
Â	Alt + P, then A (enter Ê, Î, Ô, Û in the same manner)
ÿ	Alt + U, then Y (enter Ï, Ä, Ö, Ü in the same manner)
Ã	Alt + H, then A (enter Ñ, Õ in the same manner)
Đ	Alt + A
Æ	Alt + J
Ƶ	Alt + T, then Z
Š	Alt + T, then S
¡	Alt + X

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A GE Medical Systems Company

EC Declaration of Conformity

Document No. 01-00

Marquette Hellige GmbH
Munzinger Strasse 3, D-79111 Freiburg, Germany

We herewith declare that the product(s)

Electrocardiograph MAC 1100/1200, product status **Version 1.1**
(including system components and accessories, UMDNS-Code: 16-231)

fulfill the requirements of the following directives, standards and normative documents:

1. Council Directive 93/42/EEC of 14 June 1993 concerning medical devices

2. EN 60601-1:1990 + A1:1993 + A2:1995 / IEC 60601-1:1988 + A1:1991 + A2:1995
   EN 60601-1-4:1996 / IEC 60601-1-4:1996
   EN 60601-2-25:1995 / IEC 60601-2-25:1993

3. EN 60601-1-2:1993 / IEC 60601-1-2:1993
   EN 55011:1991 / CISPR 11:1990 modified,
   device group 1, **class B**

Compliance of a representative sample of the designated product with the "essential requirements" of Annex I of the Directive 93/42/EEC has been certified by

Marquette Hellige GmbH, Quality Management and Certification, Munzinger Str. 3, D-79111 Freiburg, Germany, Test Report No. CE-H-023 of 17 January 2000.

The medical device has been assigned to class **IIa** as specified in Annex IX of the Directive 93/42/EEC. It bears the mark

CE-0366

The designated product has been designed, manufactured and tested under a quality management system according to EN ISO 9001, EN 46001 and Annex II Section 3.2 of Directive 93/42/EEC concerning medical devices. The conformity of the quality management system has been certified by:

VDE Testing and Certification Institute

Date 21 January 2000

Hubert Renck
Director Engineering
The technical documentation is filed in Marquette Hellige GmbH, RA/QA

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