CARDIOVASCULAR DISEASE IN AMERICAN INDIANS (PHASE III)

OPERATIONS MANUAL - VOLUME FOUR

MARQUETTE MAC PC SETUP

THE NATIONAL HEART, LUNG AND BLOOD INSTITUTE
OF THE NATIONAL INSTITUTES OF HEALTH
THE STRONG HEART STUDY
Cardiovascular Disease in American Indians (Phase III)

Operations Manual
Volume Four
Marquette MAC PC Setup

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1. MAC PC Setup

FUNCTION KEYS
SELECTS FUNCTION FROM LCD DISPLAY THAT IS DIRECTLY ABOVE KEY OR ALTERNATE FUNCTION (↑) KEY.*

DESTRUCTIVE BACKSPACE
DELETES ALPHANUMERIC CHARACTER IMMEDIATELY TO THE LEFT OF CURSOR.

LCD DISPLAY
PRESENTS EACH PROMPT OR MENU FOR ECG TEST.

STOP
RETURNS ECG CART TO MAIN MENU. TERMINATES PRINTING OF A REPORT.

RECORD RHYTHM
PRINTS A 3-LEAD OR 6-LEAD RHYTHM REPORT.

RECORD ECG
PRINT A 12-LEAD REPORT.

SHIFT/ALTERNATE FUNCTION KEY
CHANGES TO CHARACTER DISPLAYED ON TOP OF KEY OR ALTERNATE FUNCTION (↑) KEY.

RIGHT ARROW
MOVES CURSOR RIGHT ONE SPACE AT A TIME.

LEFT ARROW
MOVES CURSOR LEFT ONE SPACE AT A TIME.

SPACE BAR

SHIFTED CONTRAST KEYS
SHIF TED DOWN ARROW
PRESSED SIMULTANEOUSLY WITH THE SHIFT KEY. LIGHTENS THE LCD DISPLAY. SHIF TED UP ARROW PRESSED SIMULTANEOUSLY WITH THE SHIFT KEY, DARKENS THE LCD DISPLAY.

ENTER
COMPLETES INPUT-TELLS SYSTEM TO GO TO NEXT DISPLAY.

UP ARROW
RETURNS LCD DISPLAY TO PREVIOUS PROMPT OR MENU.

* FOR MOST FUNCTION KEY USES, PRESSING EITHER THE NORMAL OR THE ALTERNATE FUNCTION (↑) KEY PRODUCES THE SAME RESULTS.
1(a). Cardiograph Setup

Although your MAC PC will operate perfectly when you first receive it from the factory, you’ll want to ‘set up’ a lot of the details such as date and time, the name of your institution, types of reports you want printed, etc. Once these details are set, the cardiograph will retain them until you change the details again.

To turn on Power, press

To begin cardiograph setup, press to display the Main Menu:

\[\begin{array}{cccc}
\uparrow\text{Task} & 
V1 + II + V5 & 
\downarrow\text{PatInfo} & 
\text{Rhythm} & 
25\text{mm/s} & 
10\text{mm/mV} & 
100\text{Hz}
\end{array}\]

Next, press and at the same time to display the System Functions menu:

\[\begin{array}{ccccc}
\text{Storage} & 
\text{Setup} & 
\text{System Functions} & 
\text{Diag} & 
\text{RevXmit} & 
\text{Monitor}
\end{array}\]

Select Setup (F2) by pressing either or . The following display will appear if a Level 1 password has been entered:

Password: 

Press keys “L” and “l” (numeric one, not lowercase “l”), then press to display the first Cart Setup menu:
Each of the above steps is explained in the following pages.
<table>
<thead>
<tr>
<th>Step</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Date/Time</td>
</tr>
<tr>
<td>B.</td>
<td>Phone</td>
</tr>
<tr>
<td>C.</td>
<td>Lead Groups</td>
</tr>
<tr>
<td>D.</td>
<td>Report Formats</td>
</tr>
<tr>
<td>E.</td>
<td>Auto Dial</td>
</tr>
<tr>
<td>F.</td>
<td>Passwords</td>
</tr>
<tr>
<td>G.</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>H.</td>
<td>Defaults</td>
</tr>
<tr>
<td>I.</td>
<td>Timeout</td>
</tr>
</tbody>
</table>

**Step A: Date and Time Setup**

Press Backspace-Delete to erase.

Today's Date (DD-MM-YY):
DD=Day, MM=Month Name, YY=Year

Type day + dash + month + dash +year and press

Time (HH-MM):
HH=Hour, MM=Minute (24 Hr Clock)

Type hour + dash + minute and press

Press to return to the Main Menu.
Step B: Phone Setup

Some universities need 8 to get off campus, you need 9 or nothing. "#" gives a pause for off-campus dial tone. "1" is for long distance. The rest is the New York Hospital-Cornell Medical Center access number.

Type phone number. Then press

Press to return to the Main Menu.

Step C: Lead Groups-Rhythm Leads Setup

These should never need to be changed.

Select a group. The previously chosen leads will appear. Then press
Number of Rhythm Leads: 3

Select the number of rhythm leads you want on writer reports. Then press after each selection. In the example below, the displays for the 12 available leads are shown for channel 1:

Ch 1: V1
I II III More

Ch 2: II
I II III More

Ch 3: V5
I II III More

After selecting a lead for each of the channels, the following will appear:

Rhythm Lead Groups
                    Standrd RMR 4 x 2.5

Press to return to the Main Menu.

Step D: Report Formats Setup

F1 F1↑ F2 F2↑

Report Formats for: Confirmed Unconfirmed

Do not configure confirmed. Press F2 for unconfirmed.

For each of the following LCDs press either F1 keys for “YES”, F2 keys for “NO”; and press to store the report information.
Clinic choice here. Marquette interpretation may be printed on ECG.

Phoenix enters F1 or F2 for "YES".

(1)
This is the ONLY format to be printed.
12 Lead (4x10):

- Yes
- No

- F1
- F1↑
- F2
- F2↑

12 Lead (2x5 at 50mm/s):

- Yes
- No

- F1
- F1↑
- F2
- F2↑

Report Formats for:

- Confirmed
- Unconfirmed

When you return to the start, press to return to the Main Menu.

From here, Press “RETURN” key.

**Step E: Modem Setup -- Auto Dial**

<table>
<thead>
<tr>
<th>Modem</th>
<th>Cart Setup</th>
<th>Passwds</th>
<th>Misc</th>
<th>Defaults</th>
<th>More</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>F1↑</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Speaker On:**

- Dialing Only
- Always

- F1
- F2

**Dialing:**

- Auto Dial
- Manual

- F2
- F2↑

**Dialing Format:**

- Touch Tone
- Pulse

- F1
- F2

Or “PULSE”, may vary by site.
Step F: Password Setup

Passwords are preset as L1 for Level 1 as all aspects of programmability.

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Cardiograph Setup
Step G: Miscellaneous Setup

For each of the following prompts, type in an appropriate response or press a function (F) key. Then press \[=\] to store that information.

**Line Frequency:** 60 Hz
- 60 Hz
- 50 Hz

**Cart ID:**
- 0 - 255

The Cart ID is site specific:
- Phoenix MAC PC = 43
- Phoenix MAC 12 = 44
- Oklahoma MAC PC 1 = 48 (Lawton)
- Oklahoma MAC PC 2 = 49 (Anadarko)
- Rapid City: Eagle Butte = 59
- Pine Ridge = 60
- Fort Totten = 61

**Site ID:** 3
- 1 - 255

**Institution Name:** Strong Heart Study
- Up to 40 characters

**Number of Patient ID Digits:** 11
- 1 - 12
This may be omitted in the SHS.

DOB = Date Of Birth.

Ask Blood Pressure Questions: NO

Ask Options Question: NO

Suppress Normal Statement: NO

Suppress Border & Abnormal Statement: NO

ECGs to Store/Transmit: ALL
SAVE. It is very important to change this to SAVE. By default the machine deletes ECGs as soon as they are transmitted, without waiting for confirmation from Cornell.

Store

25mm/s

Power Up Speed: 25mm/s

100 Hz

Power Up Filter: 100 Hz

NO

Screening Criteria: NO

Baseline Roll Filter: .16 Hz

QC Baseline Drift: NO
Step H: Defaults Setup

Never say yes to return original factory setup defaults, because that will set the machine to delete ECGs after transmission.

Return the MAC PC to its original factory setup defaults. Any setup changes that you made will be lost.

Setup I: Timeout Setup
This saves the battery.

Select F1 to set a 1-minute timeout, F2 to set a 5-minute timeout, F3 to set a 10-minute timeout, F4 to set a 30-minute timeout, or F5 to set an indefinite timeout length.

"Timeout" is the amount of time it takes for the LCD to go blank when the MAC PC is not being used.

If the "none(ac)" is selected, the timeout length will be indefinite only if a power module is attached to the MAC PC and the battery status (section 12) message indicates "OK" or "FULL." Otherwise, if a power module is NOT attached, then the timeout length will be set to 10 minutes.

Press 🔄 to return to the Main Menu.
1(b). Taking a resting ECG
Entering Patient Information

Note: It is NOT necessary to enter any patient information in order to take a resting ECG. You can record an ECG at any time -- if the Main Menu is displayed by just pressing 12. If you do not enter the patient’s name and identification number, the patient will be identified by the date and time when the ECG was taken.

Note: When a patient’s age is entered and the patient is 15 years old or less, then a pediatric 12SL analysis is performed on the ECG data. However, if NO age is entered, then the MAC PC will always performed an adult analysis.

If the Main Menu is not already displayed, then press  to return to it:

↑Task V1 + II + V5
PatInfo Rhythm 25mm/s 10mm/mv 100Hz

Hit either F1 or F1↑.

F1 1
F1↑ 2

Next, press either F1 or F1↑ to select PatInfo (F1). One of the following two prompts will appear:

Patient Last name:
A to Z, Space.

Enter names.

OR

New Patient:
Yes ❌ No

This won’t show up if the machine was just turned on. Hit either F1 button if it is a new person. Hit either F2 button if you want to correct an entry and/or take another ECG on the same person.

Patient First Name:
A to Z, 0 to 9, Space.

This is actually an 11 digit ID. Enter five (5) 0 followed by six (6) digits Strong Heart Study ID.

Patient ID:
Digits 0 to 9.

Referred By:
(Physician Name)

Skip over  

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Location Number: 0 to 99

Room Number: Any 5 characters

Date of Birth (DD - MM - YY)
DD = Day, MM = Month, YY = Year

Height: (in cm)

Weight: (in kg)

Sex:
Male  Female

Race:
Cauc  Black  Oriental  Hisp  More

Race:
Unknown  Indian

Medication:
one  Unknown  Add  Scroll

If on CARDIAC medication enter either F4. Find medication and enter. (This is not part of Strong Heart Study essential information)

The MAC PC is now ready to take a 12-lead ECG. Press 12 M to start.

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Taking a Resting ECG
Fault Detection Procedures

Should problems with noise or drift be encountered, electrodes are replaced. The following is a guide for determining which electrodes may be faulty. The underlined electrodes are the predominant determinants of the appropriate lead and therefore are most likely to be the faulty electrodes for a given lead. After adjustment or replacement of suspect electrodes, the electrocardiograph should be able to record 10 seconds of good data.

<table>
<thead>
<tr>
<th>Lead Affected</th>
<th>Possible Faulty Electrode</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>RL, RA, LA</td>
</tr>
<tr>
<td>II</td>
<td>RL, RA, LL</td>
</tr>
<tr>
<td>III</td>
<td>RL, LA, LL</td>
</tr>
<tr>
<td>aVR</td>
<td>RL, RA, LL, LA</td>
</tr>
<tr>
<td>aVL</td>
<td>RL, LL, RA, LA</td>
</tr>
<tr>
<td>aVF</td>
<td>RL, LL, RA, LA</td>
</tr>
<tr>
<td>V₁</td>
<td>RL, LL, RA, LA, V₁</td>
</tr>
<tr>
<td>V₂</td>
<td>RL, LL, RA, LA, V₂</td>
</tr>
<tr>
<td>V₃</td>
<td>RL, LL, RA, LA, V₃</td>
</tr>
<tr>
<td>V₄</td>
<td>RL, LL, RA, LA, V₄</td>
</tr>
<tr>
<td>V₅</td>
<td>RL, LL, RA, LA, V₅</td>
</tr>
<tr>
<td>V₆</td>
<td>RL, LL, RA, LA, V₆</td>
</tr>
</tbody>
</table>

Self-Evaluation of Technical Performance

This section allows technicians to monitor their own ECG technique. It is intended to help technicians who are having difficulty meeting the quality standards set by the ECG Reading Center. These data are not intended to be collected by the study.

The technician examines the ECG tracing to estimate the noise level and baseline drift. Based on the requirements of the Minnesota Code, acceptable and unacceptable levels of noise and baseline drift have been established. These levels are scored using the following table:

<table>
<thead>
<tr>
<th>Noise Grade</th>
<th>Overall (mm)</th>
<th>Beat-to-beat Drift (mm)</th>
<th>Quality Drift (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt; .25</td>
<td>&lt; 1</td>
<td>&lt; 1</td>
</tr>
<tr>
<td>2</td>
<td>&lt; .50</td>
<td>&lt; 2</td>
<td>&lt; 1.5</td>
</tr>
<tr>
<td>3</td>
<td>&lt; 1</td>
<td>&lt; 3</td>
<td>&lt; 2</td>
</tr>
<tr>
<td>4</td>
<td>&lt; 2</td>
<td>&lt; 4</td>
<td>&lt; 3</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 2</td>
<td>&gt; 4</td>
<td>&gt; 3</td>
</tr>
</tbody>
</table>
The grade levels given in this table are related to the ability of the analysis program to achieve the required accuracy. Quality Grade 5 is unacceptable. ECGs of Quality Grade 5 must be deleted from the machine's memory and retaken immediately.

1. First, the tracing is examined for obvious errors such as right arm/left arm and other common lead misplacement (see Figure 4, negative p-waves in I indicate lead switch). These ECGs must be deleted from the machine's memory and retaken immediately.

2. The Quality Grade for noise is obtained by measuring the noises level ss vertical peak-to-peak values in terms of number of small paper divisions (smallest grid squares). Note that recording sensitivity is 1 mV per centimeter, (one small paper division = 1 mm = 0.1 mV). A noise level of more than 2 small paper divisions (> 0.2 mV peak to peak) is unacceptable (Figure 5).

3. The Quality Grade for overall drift is obtained by searching each of the 12-leads for the maximum and minimum baseline levels within that lead (as determined by the PR and/or TP segments) over the 10 second recording and measuring the vertical distance between them. A distance of more than 4 small paper divisions is unacceptable (Figure 6).

4. The Quality Grade for beat-to-beat drift is determined by searching for the pair of successive QRS complexes having the largest amplitude difference (vertical distance) between successive PR segments. A difference of more than 3 small paper divisions (> 0.3 mV) indicates an unacceptable record (Figure 7).

Improvement in technical quality will indeed result if the prescribed procedure for electrode position marking, electrode and skin preparation, electrode replacement and equipment use are carefully followed. Baseline drift problems, which are essentially caused by poor electrode-skin contact are particularly easy to remedy, as is 60-cycle interference.

Sixty-cycle interference is characterized by perfectly regular fine oscillations occurring at the rate of sixty per second (Figure 8).

Electrical equipment of any kind may be the source of AC interference on an ECG in all leads or only certain ones. Check quality of skin preparation and electrode contact. Check leadwires and resecure attachment of the alligator clip to the electrode. Make sure participant does not touch any metal part of the bed or other equipment. Proximity to a wall with hidden wiring or a partially broken cable may also cause this problem.
Muscle Tremor causes irregular oscillations of low amplitude and varying rapidity superimposed upon the ECG waveform (Figure 9). Muscle tremor is the involuntary muscle activity of a participant whose state is tense, apprehensive, or uncomfortable. This is why a clear explanation of the electrocardiogram test and reassurance are necessary for the participant. The participant is asked if the temperature of the room is too low for her/him and is covered with a blanket if so.

Original Hard Copy Record

The original 12-lead ECG record is filed at the field center. If the clinic needs a second "original" ECG, it can be printed from the machine's memory anytime before deletion of the ECG. The first hard copy ECGs are read locally by clinic physicians for notification and referral if needed. The records are then placed in participants' local data files. Double-check that this participant is correctly identified.
Figure 5. Unacceptable Noise Level

Figure 6. Unacceptable Overall Baseline Drift

Figure 7. Unacceptable Beat-to-Beat Baseline Drift
Figure 8. Sixty-Cycle Interference

Figure 9. Artifact Caused by Muscle Tremor
1(c). Transmitting ECGs by Telephone

Note: Only a MAC PC equipped with a modem can transmit ECG reports by telephone.

1. Prepare the MAC PC as described in section 1.
2. Connect a telephone cord from a telephone wall jack to the backpanel jack on the MAC PC.
3. If the Main Menu is not already displayed, press : 

<table>
<thead>
<tr>
<th>Task</th>
<th>V1 + II + V5</th>
<th>Rhythm</th>
<th>25mm/s</th>
<th>10mm/mv</th>
<th>100Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>PatInfo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Press and F1↑ to display the System Functions menu. Then press one of the two keys listed under each of the following displays:

- Storage Functions
  - Plot
  - Directory
  - Summary
  - Delete
  - More

- Storage Functions
  - Transmit
  - Edit
  - Format
  - More

- Transmission Type
  - Phone
  - Local
  - RS232
5. If the second display appears, type in the phone number of the location where you will be transmitting and press . The # and * are touch-tone symbols.

The , sign provides a 2-second pause and may be used repeatedly for longer parses. (For example, in the phone number 1,,8081112345 there will be a 6-second pause between the numbers “1” and “8” when dialing.)

The = sign is used to wait for a dial tone. (For example, in order to dial an outside number, your phone system may require you to dial “9” first. A sample number would look like this: 9=1234567.)

6. Next, patient data on each stored ECG will be displayed similar to the following:

Pressing No (F2) Bypasses this ECG. Pressing Yes... (F4) selects this ECG and all subsequent ECGs.

123456789 ALLEN, No BRADLEY Yes...

Pressing Yes (F1) selects this ECG. Pressing No... (F3) bypasses this ECG and all subsequent ECGs. Pressing Expand (F3) provides additional patient information such as date and time of the ECG. Use this function to verify which single ECG to save and transmit on each participant.

7. To display additional patient information, press Expand (F5) and a message similar to the one below will be displayed:
123456789 ALLEN, E 01-JAN-86 12:13
0 U C001 L001 S001 Cont

1. Patient identification number.
2. Last name, first name of patient or the date and time when ECG was recorded.
3. Select to return to former display.
4. MUSE site number where ECG was recorded.
5. Location number where ECG was recorded.
6. Cart number of the unit where ECG was recorded.
7. Date and time of ECG acquisition. This is a unique identifier if more than one ECG was saved on a particular subject.
8. A U means that the ECG is unconfirmed. An C means that the ECG is confirmed. Use the Edit function described in section 6 to change an unconfirmed ECG to a confirmed ECG.
9. Type of Data. E stands for ECG.

8. Depending on which ECGs you want to transmit or bypass, press the appropriate function (F) key.

9. After selecting the ECGs you want to transmit, displays similar to the following will appear:

** Batch Transmission **
Waiting for Dial Tone

THEN

** Batch Transmission **
Dialing 1112345

THEN

** Batch Transmission **
Waiting for an Answer Tone

THEN

** Batch Transmission **
123456789 JONES, JACK

10. After the last ECG has been transmitted, a message indicating the number of ECGs that were transmitted vs the number you selected to transmit will be displayed similar to the following:

5 of 5 Transmitted
Type Any Key to Continue

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Transmitting ECGs
11. Pressing any key displays the following:

<table>
<thead>
<tr>
<th>Phone</th>
<th>Transmission Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Local</td>
</tr>
<tr>
<td></td>
<td>RS232</td>
</tr>
</tbody>
</table>

Press to return to the Main Menu.

12. If, despite previously mentioned safeguards, you have still erroneously transmitted a tracing with improper ID #, time, or a non-SHS ECG, please FAX this data to Dr. Okin immediately at (212) 746-8451.

13. All transmitted ECGs should be logged at the study field clinic.

A copy of this log page should be faxed to Dr. Okin weekly on Monday to verify ECG authenticity before ECGs are sent to Minneapolis.

Erroneous ECGs consumed much time during Phase I.
<table>
<thead>
<tr>
<th>Patient ID #</th>
<th>Date (from ECG)</th>
<th>Time (from ECG)</th>
<th>Patient Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>
1(d). Receiving ECGs by Telephone

Receiving By Telephone

Note: Only a MAC PC equipped with a modem can receive ECG reports by telephone.

Note: If 75% or more of the MAC PC’s memory is used, then the message “Plotter Output Only” will appear. This means that incoming data will be printed but NOT stored. In this case, if you want to store incoming data, then delete some ECGs from the MAC PC before you begin receiving data (refer to section 9).

1. Prepare the MAC PC as described in section 1.
2. Connect a telephone cord from a telephone wall jack to the backpanel jack on the MAC PC.
3. If the Main Menu is not already displayed, press  

<table>
<thead>
<tr>
<th>Task</th>
<th>V1 + II + V5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PatInfo</td>
<td>Rhythm 25mm/s 10mm/mv 100Hz</td>
</tr>
</tbody>
</table>

4. Press  and F1↑ to display the System Functions Menu:

<table>
<thead>
<tr>
<th>System Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Setup Diag RevXmit Monitor</td>
</tr>
</tbody>
</table>

F4 7  F4↑ 8

5. Select RevXmit (Reverse Transmission) to display:

<table>
<thead>
<tr>
<th>Transmission Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone Local RS232</td>
</tr>
</tbody>
</table>

F1 1  F1↑ 2

6. Select Phone (F1) and one of the following two message will appear:

- No Data Storage - Plotter Output Only
- Type Any Key to Continue

OR

Select Option:

<table>
<thead>
<tr>
<th>Store</th>
<th>Plot</th>
</tr>
</thead>
</table>

F1 1  F1↑ 2  F2 3  F2↑ 4

Strong Heart Study III 6/1/97  IV- 28  Receiving ECGs
If the second display appears, select Store (F1) to store and print out the ECG(s) you receive, or select Plot (F2) to just print out the ECG(s) without storing them. Then a display similar to the following will appear:

```
** Reverse Transmission **
Check the Phone Line
```

If the following message appears, then the telephone line is not attached:

```
** Reverse Transmission **
Phone Line Not Attached
```

Otherwise, the following series of message will be displayed for each ECG that is received:

```
** Reverse Transmission **
Ready to Receive

THEN

** Reverse Transmission **
Answer the Phone

THEN

** Reverse Transmission **
Receiving Data

THEN

** Reverse Transmission **
End of Data Packet

THEN

** Reverse Transmission **
Page_xx of_xx

After all ECGs have been received, following will appear:

```
** Reverse Transmission **
End of Transmission

THEN

** Reverse Transmission **
Ready to Receive

If no other ECGs will be received, then press to return to the Main Menu. NOTE: Use the Directory function (section 8) to check that all ECGs have been received.
1(e). Deleting an ECG

Since most ECG storage is only temporary, there will probably be times when you want to delete recordings from the MAC PC's memory. Also, there may be times when the memory is almost full, and the MAC PC itself suggests that you delete ECGs. (Refer to the Section on "Forced Deletion".) ECGs taken in the Strong Heart Study should be kept in memory until confirmed copy is returned. The machine will not automatically delete ECGs except that procedures are carried out as described in "Forced Deletion".

Routine Deletion

ECGs are usually deleted after you print a paper copy of the ECG, when more than one ECG per patient has been stored or when the ECG is transmitted to another location. To delete one or more ECGs, follow these steps:

1. Prepare the MAC PC as previously described.

2. If the Main Menu is not already displayed, press $\Box$:

<table>
<thead>
<tr>
<th>Task</th>
<th>V1 + II + V5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PatInfo</td>
<td>Rhythm 25mm/s</td>
</tr>
<tr>
<td></td>
<td>10mm/mv 100Hz</td>
</tr>
</tbody>
</table>

3. Press $\Delta$ and F1↑ at the same time to display the System Functions menu. Then press one of the two keys listed under each of the following displays:

<table>
<thead>
<tr>
<th>System Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Setup</td>
</tr>
<tr>
<td>Diag RevXmit Monitor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Storage Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot Directory</td>
</tr>
<tr>
<td>Summary Delete More</td>
</tr>
</tbody>
</table>

4. After selecting Delete (F4) a message similar to the following one will be displayed:

   Pressing Save (F2) saves this ECG.
   Pressing Expand (F5) provides additional patient information such as date and time of the ECG.

   Pressing Delete (F1) Deletes this ECG.
   Pressing Save... (F3) saves this ECG and all Subsequent ECGs.
   Pressing Quit (F4) leaves the Delete function.
5. To display additional patient information, press Expand (F5) and a message similar to the one below will be displayed:

![ECG Data Diagram]

- **a.** Percentage of memory used by this ECG.
- **b.** Patient identification number.
- **c.** Last name, first name of patient or the date and time when ECG was recorded.
- **d.** Select to return to former display.
- **e.** MUSE site number where ECG was recorded.
- **f.** Location number where ECG was recorded.
- **g.** Cart number of the unit where ECG was recorded.
- **h.** Date and time of ECG acquisition. This is a unique identifier if more than one ECG was saved on a particular subject.
- **i.** A U means that the ECG is unconfirmed. An C means that the ECG is confirmed. Use the Edit function described in section 6 to change an unconfirmed ECG to a confirmed ECG.
- **j.** Type of Data. E stands for ECG.

6. Depending on what you want to delete, save, or bypass, press the appropriate function (F) key.

7. After you have decided which ECGs you want to delete, you have another chance to change your mind. For instance, if you have decided to delete two ECGs, this message would be displayed:

- **Delete 2 ECG(s) ?:**
  - **Yes**
  - **No**

  ![Keyboard Options]

  **F1 1**
  **F1↑ 2**
  **F2 3**
  **F2↑ 4**

  **Cancels the Delete.**

  **Deletes the selected ECGs.**
If the ECG you are recording requires more memory than the MAC PC is able to spare, a prompt will appear after the Processing ECG for Storage display:

ECG storage: Insufficient Space Available
Type Any Key to Continue

1. Pressing any key to continue causes this message to be displayed:

<table>
<thead>
<tr>
<th>Select</th>
<th>Option:</th>
<th>Delete</th>
<th>Xmit</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>1</td>
<td>F1↑</td>
<td>F3↑</td>
</tr>
<tr>
<td>2</td>
<td>F2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>F3</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Select Delete (F1) to display one of the ECGs stored in the MAC PC’s memory. A small explanation of how each function key affects ECGs stored in the MAC PC follows.
- Select Quit (F2) to return to the “ECG Storage: Insufficient Space Available” display.
- Select Xmit (F3) if you want the MAC PC to transmit the ECG you just acquired instead of storing it. (Xmit will only appear if your MAC PC is equipped with a modem.)

2. If you select Delete, a display similar to the following will appear:

| (5%) 24% | 123456789 | ALLEN, | BRADLEY |
| Delete  | Save      | Quit   | Expand  |

Pressing Expand (F5) provides additional patient information such as date and time of the ECG.

Pressing Delete (F1) deletes this ECG. Pressing Save (F2) saves this ECG. Pressing Quit (F4) return to the “Insufficient Storage” display.

3. To display additional patient information, press Expand (F5) and a message similar to the one below will be displayed:

(5%) 24% 123456789 ALLEN, BRADLEY
E U 23-MAR-88 09:53 C001 L001 S001 Cont

a. Percentage of storage that must be deleted to provide room for the ECG just acquired. This number decreases as ECGs are selected for deletion.

b. Location number where ECG was recorded.

c. Cart number of the unit where ECG was recorded.

d. Location number where ECG was recorded.

e. Cart number of the unit where ECG was recorded.

Deleting an ECG
b. Percentage of memory used by this ECG.

c. Patient identification number.

d. Last name, first name of patient or the date and time when ECG was recorded.

e. Select to return to former display.

f. MUSE site number where ECG was recorded.

i. Date and time of ECG acquisition. This is a unique identifier if more than one ECG was saved on a particular subject.

j. A U means that the ECG is unconfirmed. An C means that the ECG is confirmed. Use the Edit function described in section 6 to change an unconfirmed ECG to a confirmed ECG.

k. Type of Data. E stands for ECG.

4. After you have either Saved or Deleted all stored ECGs, one of the following two displays will appear:

Not enough ECG(s) selected for deletion
Type Any Key to Continue

OR

Delete 2 ECG(s) ? :

Yes  No

F1  F1↑  F2  F2↑

1  2  3  4

If the first display appears, then you will return to the “ECG Storage: Insufficient Space Available” display. In this case, you will have to start the deletion process all over.

If the second display appears, or one like it, then select Yes (F1) to delete the selected ECGs or No (F2) to return to the “ECG Storage: Insufficient Space Available” display.

5. If you selected Yes (F1), the ECG you just recorded will be stored. The this message will be displayed:

** ECG Storage Complete **
Type Any Key to Continue

Pressing any key to return you to the Main Menu.
2. STANDARD ECG INSTRUCTIONS

1. BASELINE ECGs

1.1 Introduction

During the baseline examination, a standard supine 12-lead resting ECG is recorded at least one half hour after ingestion of glucose.

1.2 Procedure for Recording Baseline ECG

The standard electrocardiograph for the Strong Heart Study is the MAC PC Personal Cardiography by Marquette Electronics, Inc. The standard configuration for the MAC PC is shown in Appendix A. A 12-lead resting ECG tracing is obtained consisting of 2.5 seconds of each of the leads simultaneously (I, II, III, aVR, aVL, aVF, V1-V6) with a 10 second lead Rhythm Strip.

Procedures for charging the battery of the MAC PC: The MAC PC runs only from its battery. The battery can be charged by plugging the unit into a wall outlet. The MAC PC will record and print about 50 ECGs on one charge. The amount of charge left is displayed for one-half second when the machine is turned on. It takes about 10 hours to charge the battery.

Plug in the unit each evening after transmitting data to Cornell. Unplug the unit in the morning. It is not good for the machine to spend several days in either the fully charged or completely drained state. For weekends and holidays the machine may be left plugged in, or, if the brief charge display shows at least 25 ECGs remaining, it may be left unplugged.

1.3 Electrode Position Measuring and Marking

Because it is essential for the study to be able to compare baseline ECG data with subsequent records, a uniform procedure for electrode placement and skin preparation is required. The method and procedure for standardizing electrode locations are outlined below.
The participant, stripped to the waist, is instructed to lie on the recording bed with arms relaxed at the sides. The individual is asked to avoid movements which may cause errors in marking the electrode locations, but encouraged to converse with the technician. Prior experience with electrocardiograms is discussed, as is the purpose of the ECG recording. The participant should be told this is a research ECG to be used for statistical analysis later in the study. However, it can also be used by the clinic physician for general diagnostic purposes, and a copy can be sent to the individual's private physician.

For best electrode/skin interface, place the electrodes on the skin at least 2-3 minutes before taking the ECG. Patient information can be entered on the MAC PC during this time. This waiting time is not so critical with the suction electrodes, if it is anticipated that data entry will take > 3 minutes, you may want to enter data first when using these electrodes. It is recommended that the stick-on electrodes be applied 2-3 minutes prior to acquiring the ECG.

A good felt tip pen is used to mark the six chest electrode positions. Wipe the general area of the following 10 electrode sites with a sterile alcohol prep to remove skin oil and perspiration. It is extremely important that care be taken to locate these positions accurately. Therefore, the procedure given below must be meticulously followed. Electrode positions in women with large, pendulous breasts must be determined in relation to the anatomic points described below - as for all participants. The electrodes must then be placed on top of the breast (in the correct position).

1.3.1 Chest Leads (Figure 1)

1. Electrode V₂

Locate the sternal angle and second left rib between the index and middle fingers of your right hand. Count down to the fourth rib and identify the fourth intercostal space below it. Locate V₂ in the fourth intercostal space immediately to the left of the sternal border.

2. Electrode V₁

Locate electrode V₁ in the fourth intercostal space at the right sternal border. This should be at the same level as V₂ and immediately to the right of the sternum.
3. Anterior 5th Interspace Marker (E Point)

Identify the fifth rib and fifth intercostal space below V₂ by counting down ribs as described for V₂. Follow this space horizontally to the midsternal line and mark this point. This is the "E" point.

4. Electrode V₆

Locate the V₆ electrode at the same level as the E point in the midaxillary line (straight down from the center of the armpit). If breast tissue is over the V₆ area, mark the V₆ location on the breast.

Do not attempt to move the breast in order to mark V₆ on the chest wall, unless doing so is absolutely necessary to achieve better anatomic position.

5. Electrode V₄

Electrode V₄ is located using the E-V₆ Halfpoint Method. Using the medical tape measure employed in anthropometry, measure the distance between the E point and the V marking. The tape should be resting lightly on the skin, not pressing into the flesh. The E and V₆ marks should be clearly seen. Place electrode V₄ midway between E and V₆.

6. Electrode V₃

Using the medical tape measure employed in anthropometry, mark the location of electrode V₃ midway between the locations of V₂ and V₄.

7. Electrode V₅

Using the medical tape measure employed in anthropometry, mark the location of electrode V₅ midway between the locations of V₄ and V₆.
Figure 7. Precordial points from which chest leads are derived.
Figure 8. Electrode and leadwire placement
1.3.2 Limb Leads (Figure 2)

Locate electrode LL on the left ankle (inside).
Locate electrode RL on the right ankle (inside).
Locate electrode LA on the left wrist (inside).
Locate electrode RA on the right wrist (inside).

1.4 Skin Preparation

Skin preparation is undertaken only in the presence of observed technical problems due to poor electrode contact. As a first step it may be sufficient to rub the skin lightly with a tongue depressor or piece of gauze to produce reddening. If this does not resolve the problem, then:

1. With the participant's consent, remove any excess hair from each electrode site on the chest using a shaver.

2. At each electrode location in turn the outer horny layer of the epidermis is removed by gentle dermal abrasion with a piece of gauze. Only three passes (in the form of an asterisk) at each site using light pressure are required.

If the skin preparation has removed the felt pen marking at any of the electrode sites, these are accurately re-established by carefully repeating the procedure described in Electrode Position Measuring and Marking. It is important that the electrode sites be marked using the exact technique described.

1.5 Application of Electrodes

Either disposable or suction electrodes are used in the Strong Heart Study. Adaptors are used with the leadwires to connect the "banana" plug from the MAC PC leadwire to the disposable electrode via a clip.

When placing each electrode, massage it in a small circular motion to maximize the pre-gel contact with the skin but avoid overlap of gel from one electrode to the next.

Center the four limb electrodes on the inside of the wrist or ankle with the tab for the clip pointing toward the head. Center the six chest electrodes on the chest markings with the tabs pointing down. Do not let the electrodes overlap or touch each other if possible.
Clip the appropriate leadwire to each electrode (Figure 1). Do not pull or jerk tangled wires. To untangle wires, disconnect lead wires from electrodes.

1.6 Recording the 12-lead ECG

Change the roll of paper as needed. Each roll is 75 feet long; each patient takes approximately one foot of paper.

Each ECG is automatically stored in memory until it is deleted. After placing the electrodes on the skin, enter the participant information into the MAC PC (Figure 3) according to Appendix B. Disposable electrodes particularly must be on the skin for at least 2-3 minutes before taking the ECG. Make a final check of the electrodes and lead wires. Ask the participant to relax and keep still, then press the RECORD key.

The machine will display "Acquiring Data" and the left side of the display will show a count. If there are technical problems the display will show which lead is involved and will keep counting until it gets 10 seconds of good data. Check electrode contacts and leadwires, then check the display again. If the display counts past 75, push the STOP key and remove the electrodes. Prepare the electrode sites as discussed in Skin Preparation and follow the above protocol for exact relocation of electrodes. Press RECORD ECG. The machine will tell you to "enter a new patient or press RECORD." Press RECORD ECG a second time to start the ECG. The machine will automatically print the ECG after it has acquired 10 seconds of good data (Appendix C).

Tear the ECG off the machine and file it in your records.
Press RECORD ECG. The machine will tell you to “enter a new patient or press RECORD.”
Press RECORD ECG a second time to start the ECG. The machine will automatically print the ECG
after it has acquired 10 seconds of good data (Appendix C).

Tear the ECG off the machine and file it in your records.

Figure 3. The MAC PC Keyboard and LCD Display by Marquette Electronics Inc.