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An agency of Industry Canada

CA 2337475 A1 2002/08/22

(21) 2 337 475

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(22) Date de dépôt/Filing Date: 2001/02/22

(41) Mise à la disp. pub./Open to Public Insp.: 2002/08/22

(51) Cl.Int.^{7}/Int.Cl.^{7} A61B 5/04, A61B 5/00, G01N 33/493, G01N 27/26

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(54) Titre : CARDIO-HEALTH-METER
(54) Title: CARDIO-HEALTH-METER

(57) Abrégé/Abstract:
Cardio-Health-Meter is an apparatus for indicating a predisposition to Heart Disease and Stroke. The apparatus contains a power supply, electronic circuits and a sensor for insertion into a sample of urine. The sensor is a means for measurement of the concentration of electrolytes in millimoles of solute per litre or molarity. Body and blood volumes are dependant on millimoles of electrolyte per litre. Body fluid is not just water, but is a solution containing a number of chemical substances. When a substance such as and electrolyte dissolves in body water is becomes separated into its constituent positive and negative particles. These charges particles are called ions and contribute to the ionization of the solutions. In normal health the concentration of various particles remains constant within very narrow limits and a balance will exist between the various ions. If for reasons of ill health the balance is upset, the concentration of these ions changes, the Cardio-Health-Meter reads how abnormal a sample of body water is. This new electronic device reads numeric values that indicate the number of particles or ratio of charged parts present in the system. This is the critical factor, this enables the user to monitor his of her health level and assure that no potentially dangerous conditions may be present. In the event the device indicates an excessive stress level, the user would be advised to Either take corrective action to lower the stress level or if the indications were sufficiently severe, to seek professional medical help. Cardio-Health-Meter delivers clear safety and peace of mind benefits.

CARDIO-HEALTH-METER

Abstract

Cardio-Health-Meter is an apparatus for indicating a predisposition to Heart Disease and Stroke. The apparatus contains a power supply, electronic circuits and a sensor for insertion into a sample of urine. The sensor is a means for measurement of the concentration of electrolytes in millimoles of solute per litre or molarity. Body and blood volumes are dependant on millimoles of electrolyte per litre. Body fluid is not just water, but is a solution containing a number of chemical substances.

When a substance such as and electrolyte dissolves in body water is becomes separated into its constituent positive and negative particles. These charges particles are called ions and contribute to the ionization of the solutions. In normal health the concentration of various particles remains constant within very narrow limits and a balance will exist between the various ions. If for reasons of ill health the balance is upset, the concentration of these ions changes, the Cardio-Health-Meter reads how abnormal a sample of body water is.

This new electronic device reads numeric values that indicate the number of particles or ratio of charged parts present in the system. This is the critical factor, this enables the user to monitor his of her health level and assure that no potentially dangerous conditions may be present. In the event the device indicates an excessive stress level, the user would be advised to Either take corrective action to lower the stress level or if the indications were sufficiently severe, to seek professional medical help. Cardio-Health-Meter delivers clear safety and peace of mind benefits.

CARDIO HEALTH METER

Product Description

The CARDIO HEALTH METER is a device for measuring the concentration of electrolytes in a sample of urine (typically approximately 100 milliliters) by means of a conductivity probe immersed in the urine sample and connected to a processing and display unit. The concentration of electrolyte in the urine is displayed on a Liquid Crystal Display (LCD).

The Liquid Crystal Display (LCD) may present information in four ways:

- As an indictor of electrolyte concentration
- As an indictor of osmotic pressure
- As an indicator of hydration level
- As a bar graph representing heart stress level.

Where the concentration of electrolyte falls outside the concentration considered acceptable by the medical profession, the LCD displays a message such as "LOW", "HIGH", or "DANGER" otherwise the LCD display the message "NORMAL".

The device can be used to self-monitor the condition of a person's circulatory system and to self-monitor the effects of dietary changes.

Description

The CARDIO HEALTH METER consists of a conductivity probe (1) connected by means of conductors (2) to a processing and display unit (3).

The processing and display unit consists of one or more circuit boards with related circuitry for measuring and processing the conductivity value sensed by the conductivity probe (1) and displaying the value on a liquid crystal display LCD (4). The LCD displays the information in four ways:

- As an indicator of electrolytic concentration (9)
- As an indicator of osmotic pressure (11)
- As an indictor of hydration level (10)
- As a bar graph representing heart stress level (12)

All values are derived from the conductivity value and converted by means of mathematical algorithms embedded on a chip on the circuit board.

Electrolyte concentration is displayed as a numerical value (9) from 100 to 240. If the concentration is below a threshold value of 100, then 000 is displayed.

Osmotic pressure is displayed as a numerical value (11) from 200 to 580. If the value is below 200, the 000 is displayed.

Hydration level is displayed as text (10) with the word "LOW" if the electrolytic concentration value is below 149, "NORMAL" if the value is between 150 and 199, "HIGH" if the value is between 200 and 240 "DANGER" if the value is above 240.

Heart stress is displayed as a horizontal 16-segment bar graph (12) where the number of active segments displayed is proportional to the electrolytic concentration value is below 100, 8 segments are active when the value is about 170 and all segments are active when the value reaches 240 or higher.

The processing and display unit has a push button (5) for starting the test and display sequence. The unit samples for a preset time period (for example five seconds) and then displays the result for a period of time, (for example 30 seconds). After the display time (typically 30 seconds) the unit switches off to conserve battery life. The unit may be switched off earlier by pressing the push-button (5).

The processing and display unit has a serial interface connector (8) so that the data from testing (as stored in memory on memory chips on the circuit board) can be downloaded through a serial cable to a computer and displayed using a spreadsheet program (such a Microsoft® Excel, or Lotus ®1-2-3). For example, one display could be graph showing change in electrolytic concentration over time.

User-replaceable batteries power the processing and display unit.

The system shuts off automatically after an appropriate length of time (for example 30 seconds) after the test is complete or when the push-button (5) is pushed ...

CARDIO HEALTH METER Product Description

Mathematical and Computer Algorithms

The device uses the following algorithms:

- Algorithms and related electronic circuitry to measure the conductance of the urine sample based on the geometry of the conductivity cell, the applied voltage and frequency, and the resultant current flow.

- Algorithms and circuitry to convert the measured conductivity of the sample to electrolyte concentration and display it digitally on the LCD display (9).

- Algorithms and circuitry to convert the measured conductivity to osmotic pressure and display it digitally on the LCD display (11).

- Algorithms and circuitry to convert the measured conductivity to a text message, such as LOW, NORMAL, HIGH, or DANGER depending on the conductivity measured (10).

- Algorithms and circuitry to convert the measured conductivity and to display it as an LCD bar graph where the higher the conductivity value, the more segments of the LCD are activated (12).

- Algorithms and circuitry to save the measured conductivity value to memory.

- Algorithms and circuitry to allow retrieval of the values stored in memory for downloading through a serial port to an attached computer.

- Algorithms and circuitry to define the sampling time for the measurement (for example 5 seconds) and the processing of the data received during the sampling time.

- Algorithms and circuitry to shut the sampling and display system off after a defined time (for example 30 seconds).

Table of Contents

Operating Instruction

The CARDIO HEALTH METER is an easy-to-use device to help you monitor your health by measuring the electrolytic concentration in a sample of your urine. The unit will provide you with years of trouble free service provided you follow these simple operating instructions.

Cautions for Use:

No device can replace the services of a skilled physician. You should continue to have regularly scheduled physical examinations and consult with your physician whenever you have concerns about your health.

The Liquid Crystal Display (LCD) presents information in four ways:

- As an indicator of electrolytic concentration
- As an indicator of osmotic pressure
- As an indicator of hydration level
- As a bar graph representing heart stress level.

This information is derived from the measurement of the conductivity of a urine sample. Certain
Medical conditions might cause specific physiological conditions that could affect the accuracy of the results displayed.

Before making any significant changes to your diet, you should always consult with your physician.

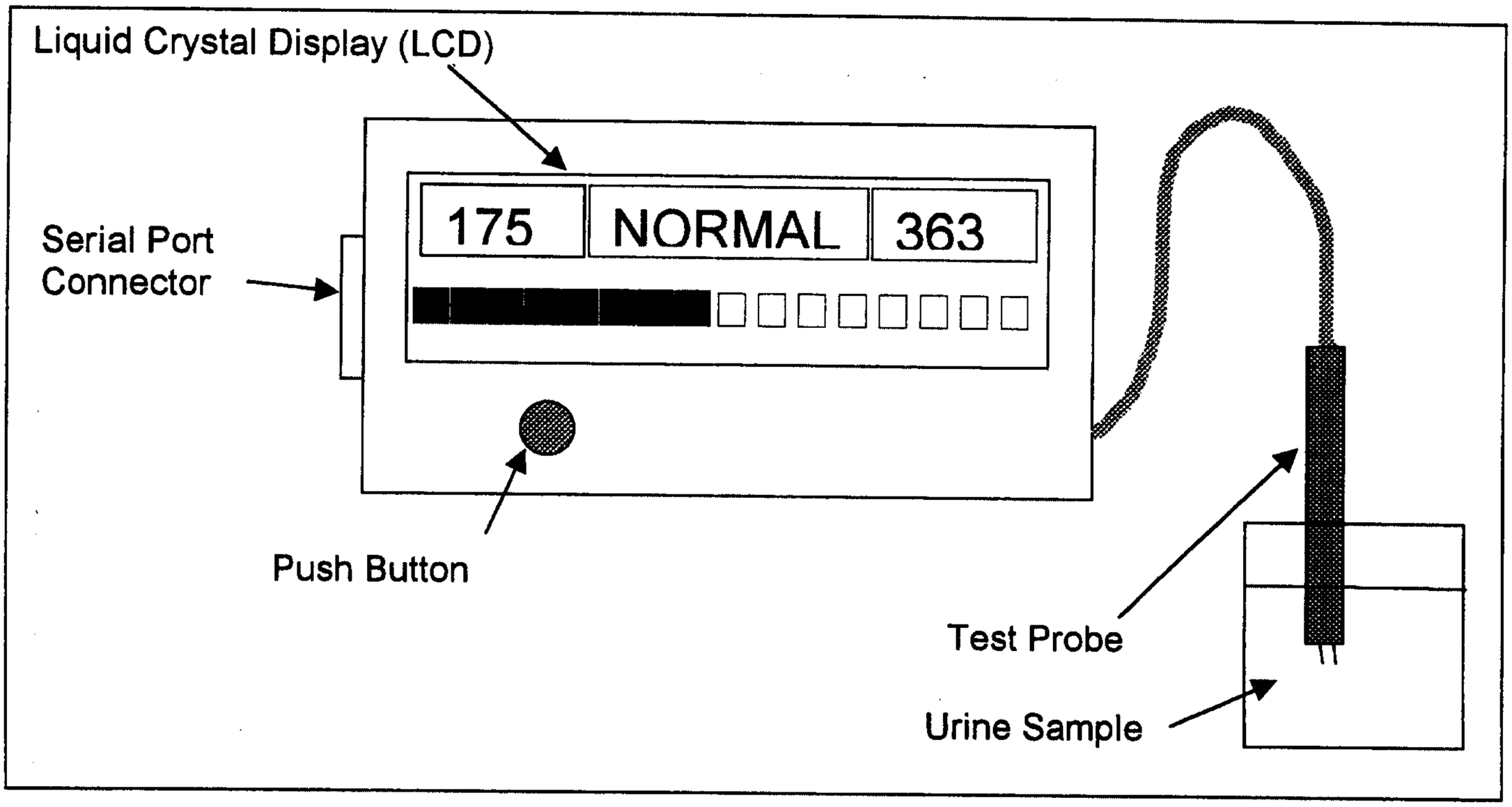
You should not use the ***CARDIO HEALTH METER*** if you are currently using medications or are following other directions given to you by a physician with the physician's advice and guidance.

If you have any concerns about your health, you should always consult with your physician before using the ***CARDIO HEALTH METER***.

Description

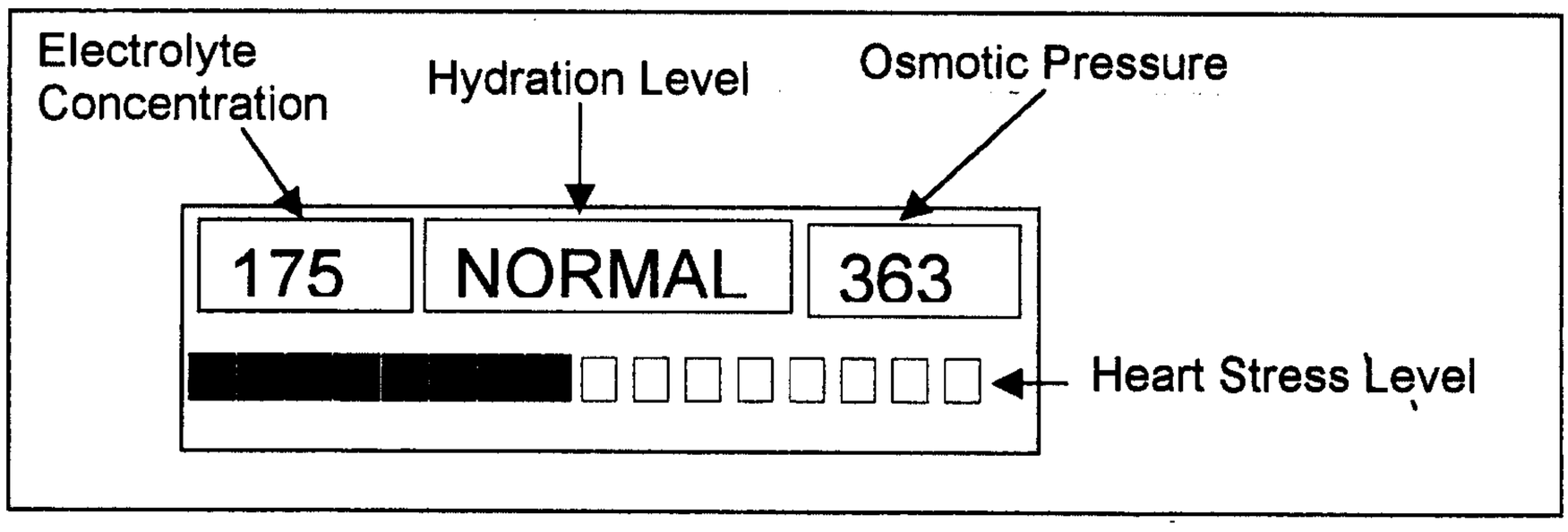
The ***CARDIO HEALTH METER*** measures the concentration of electrolytes in a sample of your urine. The concentration of electrolytes provides an indication of the overall health of your circulatory system.

The following diagram describes the ***CARDIO HEALTH METER***



CARDIO HEALTH METER

The Liquid Crystal Display (LCD) displays information about your health in four ways: as two numbers, a number on the left that represents the concentration of electrolytes in the urine sample and a number on the right that represents the osmotic pressure; a text box indicting hydration level as either **"LOW", "NORMAL", "HIGH"**, or **"DANGER",** and a bar graph that represents the level of stress on the heart. The following diagram describes the LCD.



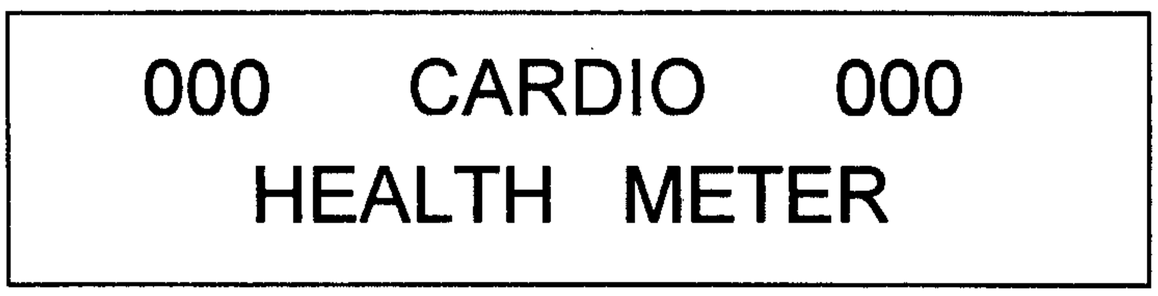
Using the *CARDIO HEALTH METER*

Measuring the electrolytic concentration in a sample of urine is simple and straightforward.
It is best to take the urine sample in the morning, immediately after waking up.

1. Use the container supplied with the ***CARDIO HEALTH METER*** to obtain a sample of approximately 100 milliliters of urine. Make sure the container is clean and dry before obtaining the sample.

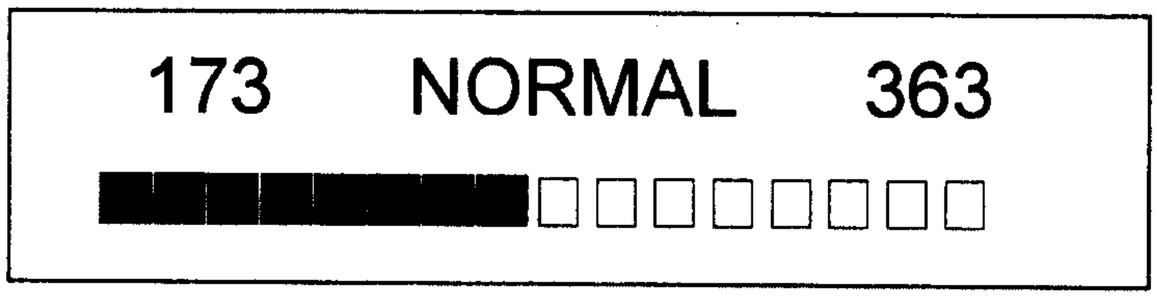
2. Press the push button on the front of the CARDIO HEALTH METER.

3. The LCD display



4. Place the test probe in the urine sample so that the liquid level is up to the red mark on the probe.

5. The ***CARDIO HEALTH METER*** will take a few seconds to measure the concentration and then freeze the numbers and display the results. For example:



6. Observe the readings on the LCD.

7. The ***CARDIO HEALTH METER*** will automatically turn off after an appropriate length of time. If you want to turn the meter off earlier, press the push button again.

8. After you have noted the readings, discard the urine sample and carefully clean and dry the urine container and the test probe.

9. Store the ***CARDIO HEALTH METER*** and the test probe and sample container in a safe place.

Interpreting the Test Results

The preferred electrolytic concentration reading is 150 to 199. A higher reading indicates the electrolytic concentration is above the preferred level.

If the electrolytic concentration reads above 200 and the hydration level displays **HIGH**, you should consider gradually reducing your daily intake of salt, sugar and proteins, and increasing the amount of fluids you consume. **You should always make changes to your diet slowly, and observe the effect as displayed on the *CARDIO HEALTH METER* on a daily basis. It may take several days to see a change as you change your eating habits.**

If the electrolytic concentration reads above 240 and the hydration level displays **DANGER**, the electrolytic concentration is quite high. You should gradually reduce you daily intake of salt, sugar, and proteins and increase the amount of fluids you consume. **You should always make changes to your eating habits slowly, and observe the effect as displayed on the CARDIO HEALTH METER on a daily basis. If the LCD continues to read DANGER after several days of gradually changing diet, you should consult with you physician.**

If the electrolytic concentration reads below **150** and the hydration level displays **LOW**, the concentration of electrolytes is below the preferred level. A lower reading is not normally cause for concern and may indicate that you are drinking a lot of fluids in comparison to you food intake.

An electrolytic concentration reading of **000** and a hydration level reading **LOW** indicate the concentration of electrolytes is much below the preferred level. If this reading persists for several days, you should consult with your physician.

If the unit fails to take an accurate reading, the unit will display **ERROR**. If this occurs, turn the unit off by pressing the button again, wait a few seconds and then press the button again to start a new test.

Using a Computer to Display Cumulated Results

Every time you take a reading using the CARDIO HEALTH METER, the reading is stored in memory. You can download these readings to a computer and view them using a spreadsheet program such as Microsoft ® Excel ™ or LOTUSE ® 1-2-3 ™.

To download the results, you will need a ***CARDIO HEALTH METER*** interface cable, available from the store where you purchased your ***CARDIO HEALTH METER.*** You will require a software program to download your data which is available from the store where you purchased the cardio health meter.

Open the spreadsheet program on the computer and download the data stored in the memory of the CARDIO HEALTH METER to the spreadsheet program. Use the spreadsheet program to display and graph the data.

When you remove the batteries from the CARDIO HEALTH METER any data stored in its memory is lost. If you want to maintain a continuous record of your data, before replacing the batteries you should download the data to your computer spreadsheet program and store the data in the computer.

Obtaining and Maintaining Good Health

The ***CARDIO HEALTH METER*** can help you monitor your diet to improve and maintain your health.

When using the CARDIO HEALTH METER:

DO:

Test regularly, at least once each day, preferably first thing in the morning
Adjust you diet to bring the numbers into the NORMAL range
Make adjustments to your diet slowly and monitor the results
Eat smaller amounts of protein
Drink lots of fluids
Cut salt intake to a minimum
Consult with your physician if you have any concerns about your health.

DON'T

Attempt to lower the numbers too fast
Go below a NORMAL reading on the meter
Eat junk food
Drink carbonated beverages

Drink excessive amounts of alcohol.

Maintaining the CARDIO HEALTH METER

The *CARDIO HEALTH METER* is designed to give you years of trouble-free service.

Always keep the CARDIO HEALTH METER clean.

Clean and dry the sample container and test probe after each use.
Clean the CARDIO HEALTH METER with a damp cloth or paper towel.

Do not immerse the unit in water. Do not use solvents or harsh abrasive cleaners to clean the unit or the test probe.

If you will not be using the unit for some time, remove the batteries.

Note: you will loose any data stored in memory when you remove the batteries.

If the unit indicates the batteries are low, or if the unit does not display a reading when you press the GO button, or you cannot adjust the brightness of the display, the batteries are probably worn out.

To replace the batteries, open the back of the case, remove the batteries and replace them with alkaline batteries of the same size. **Make sure to install the new batteries in the same direction as the old batteries so that the correct polarity is maintained**.

In the unlikely event that any other service is required, return the unit to the manufacturer.

CARDIO HEALTH METER

Claims

What is claimed is:

1. A device for indicating the health of an individual, the device consisting of a power source, a detection probe for insertion into a urine sample, a means for measuring the concentration of electrolytes in the urine sample using the probe, and a means of displaying the results.

2. A device as described in claim (1) where the detection probe measures conductivity.

3. A device as described in claim (2) where the detection probe includes a pair of electrodes whereby the electrodes are inserted into a urine sample and an alternating current is applied to determine the conductivity of the urine sample.

4. Probes may consist of any conductive material but are preferably made of materials gold, platinum or silver or other materials such as titanium, niobium coated with platinum, gold, or other inert or precious metal, or some form of mixed metal oxides.

5. A device as described in claim (1) where the display consists of numerical values representing electrolyte concentration and osmotic pressure.

6. A device as described in claim (1) where the display may consist of a text statement similar to LOW, NORMAL, HIGH or DANGER, to indicate the electrolyte concentration.

7. A device as described in claim (1) where the display may consist of a bar graph or other indication to represent the stress level on the heart.

8. A device as described in claim (7) where the bar graph or other indicator is made up of a number of elements to indicate the concentration of electrolyte, where low concentration activates on elements of the bar graph, a normal concentration activates half the elements, and a dangerously high concentration activates all the elements.

9. A device as described in claim (1) where the display consists of a combination of one or more of all the displays described in (5), (6), (7) and (8).

10. A device as described in claim (1) where the following algorithms and electronic circuits may be used:

CARDIO HEALTH METER Claims

11. Algorithms and related electronic circuitry to measure the conductance of the urine sample based on the geometry of the conductivity cell, the applied voltage and frequency, and the resultant current flow.

12. Algorithms and circuitry to convert the measured conductivity of the sample to electrolyte concentration and display it numericaly on the LCD display (5).

13. Algorithms and circuitry to convert the measured conductivity to a text message, such as LOW, NORMAL, HIGH or DANGER depending on the conductivity measured (6).

14. Algorithms and circuitry to convert the measured conductivity and to display it as an LCD bar graph where the higher the conductivity valve, the more segments of the LCD are activated (7).

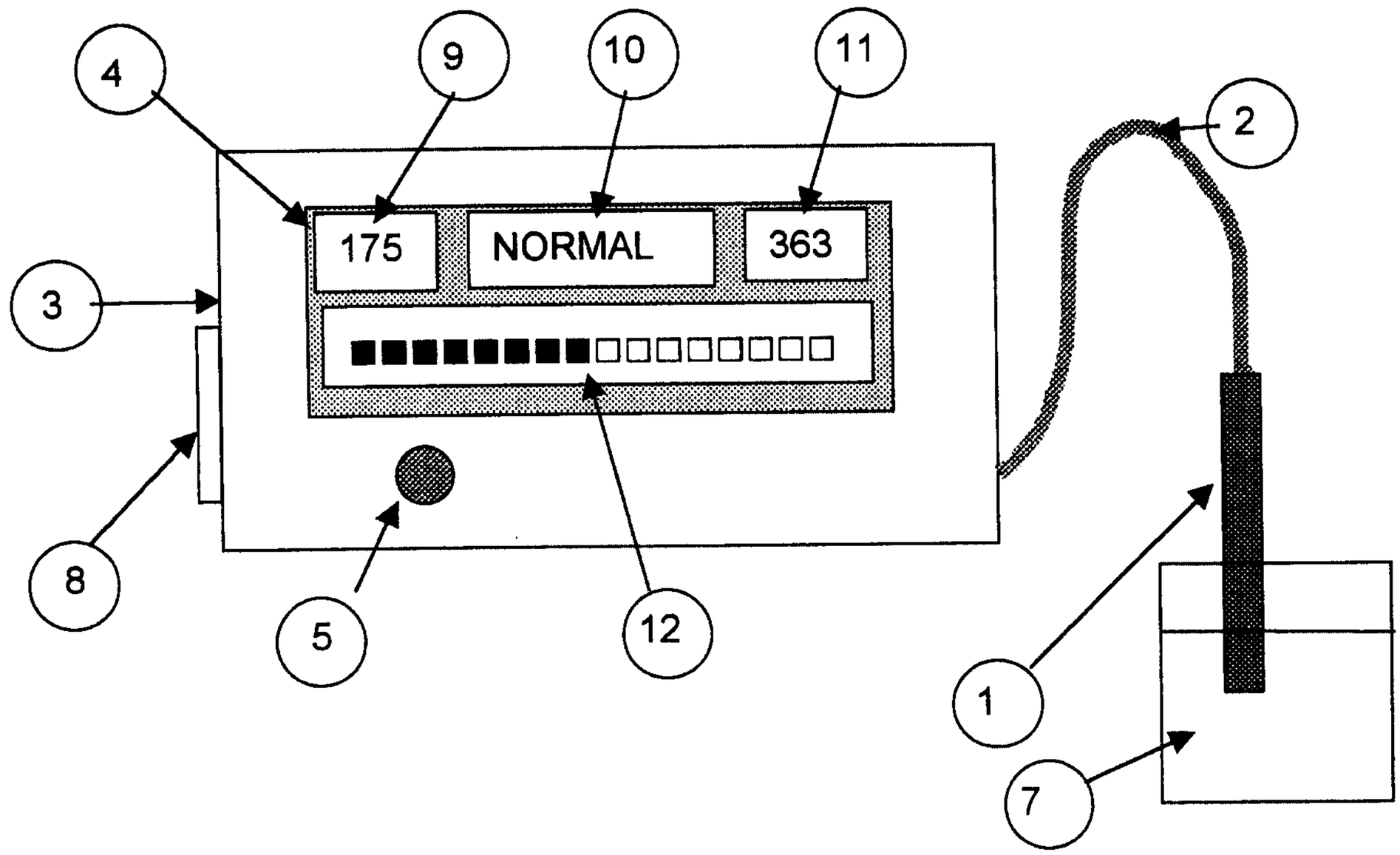
15. Algorithms and circuitry to save the measured conductivity value to memory.

16. Algorithms and circuitry to allow retrieval of the values stored in memory for downloading through a serial port to an attached computer.

17. Algorithms and circuitry to define the sampling time for the measurement (for example 5 seconds) and the processing of the data received during the sampling time.

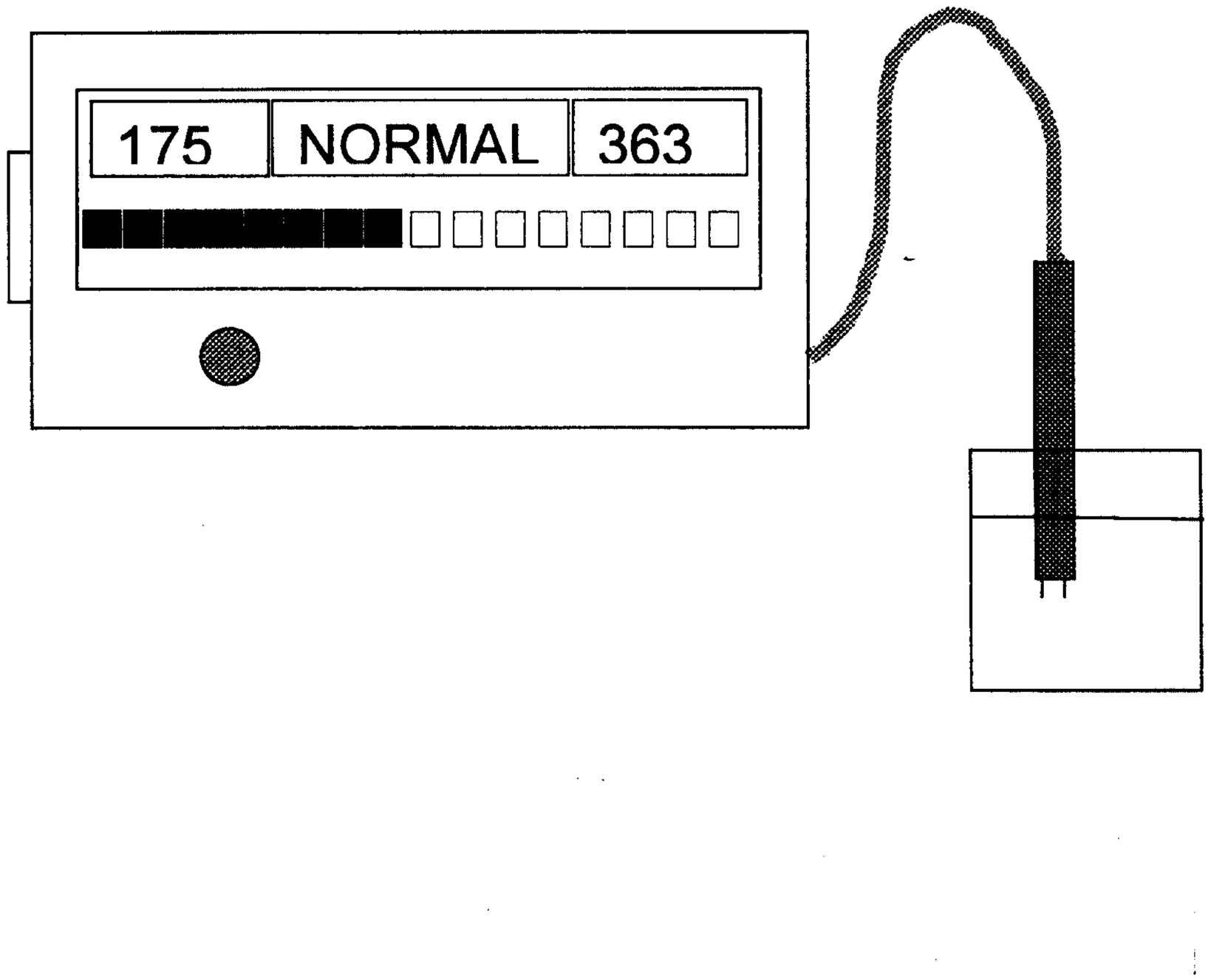
18. Algorithms and circuitry to shut the sampling and display system off after a defined time (for example 30 seconds).

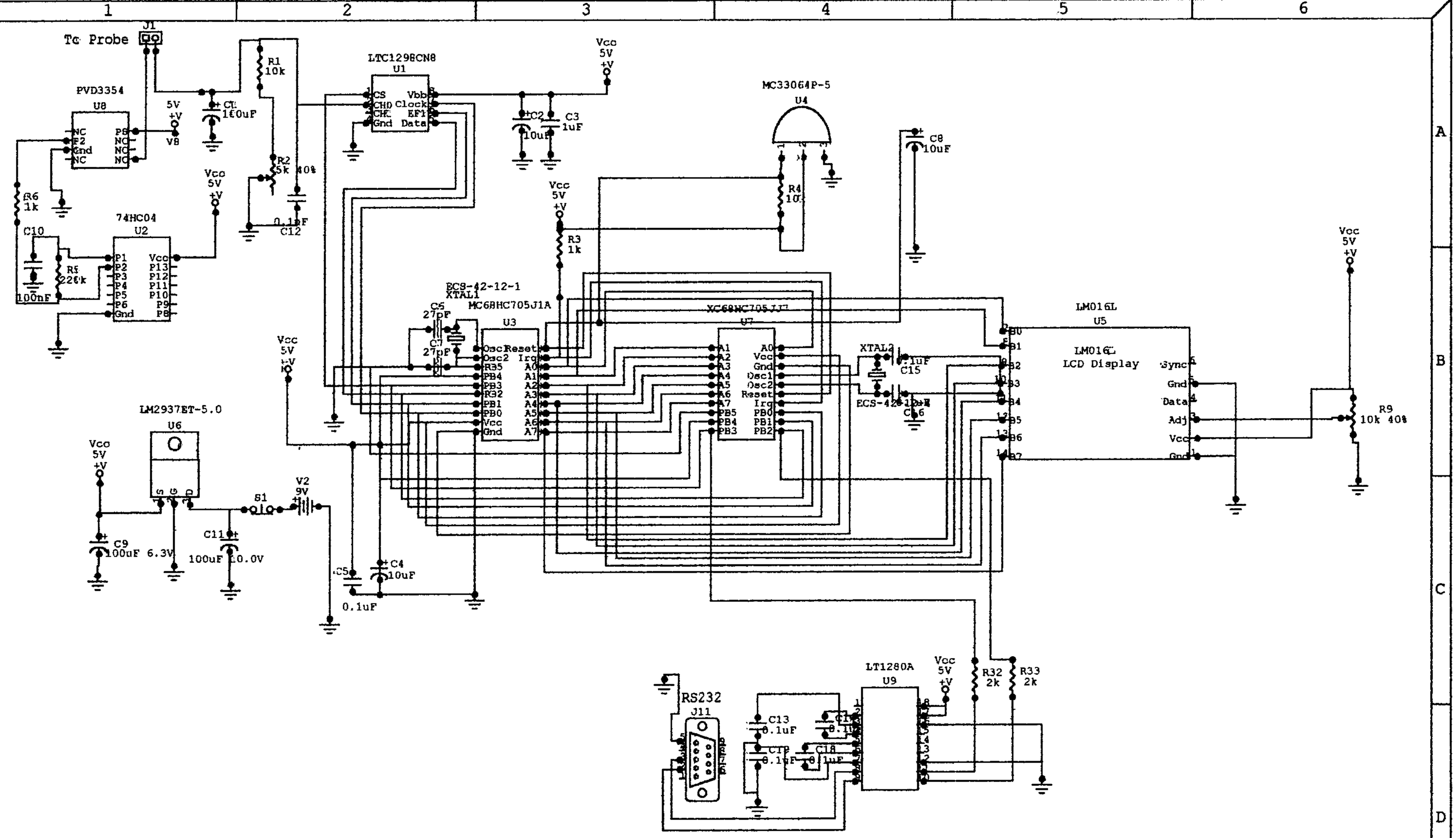
Drawing of CARDIO HEALTH METER



CARDIO HEALTH METER

Operating Instructions





Name:	CATHODIC TECHNOLGGY LIMITED
Title:	CIRCUIT FOR BRIAN REID
Project 1	
Rev	ID
Date: March 2000	Page: 1 of 1

CA 023374?5 2001-02-22

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*                    ÜÜÜ 19 IX 2000 ÜÜÜ                    °
*                       DMV for Brian                      °
* 4194304Hz    1c = 1/2097152Hz = 476.837158ns    OTP 75 °
*ááááááááááááááááááááááááááááááááááááááááááááááááááì


* search for ???

*ááááááááááááááááááááááááááááááááááááááááááááááááááá¢
    ORG $00C0 ;64byte ram start C0-FF                      °
*ááááááááááááááááááááááááááááááááááááááááááááááááááì
raw         RMB 2
Volts       RMB 1
n1          RMB 2
n2          RMB 2
col0s       RMB 1
bar-graph   RMB 1
fbit        RMB 1
m15s        RMB 1
fle         RMB 1 ;flash HIGH enable

RAMRUN
m1 RMB 4
m2 RMB 4

*ááááááááááááááááááááááááááááááááááááááááááááááááááá¢
    ORG ROM          ;1232 bytes 300-7CF                   °
*ááááááááááááááááááááááááááááááááááááááááááááááááááì


*ááááááááááááááááááááááááááááááááááááááááááááááááááá
```

```
ME0   DB "19 IX 2000" ;???
ME1   DB "          "
ME2   DB " LOW      "
ME3   DB "NORMAL    "
ME4   DB " HIGH     "
ME5   DB "DANGER    "
ME6   DB "CARDIO"
ME7   DB "HEALTH METER"

* messages below are not used

ME8   DB "program "
ME9   DB "s cycle"
MEA   DB "GMT "

*message#   0   1   2   3   4   5   6   7   8   9   A   B-nu-needed-for SUB
MESADR DB 00,0A,11,18,1F,26,2D,33,3F,47,4E,52
* ??? change if # of bytes in messages changes - get from .LST file

*áááááááááááááááááááááááááááááááááááááááááááááááááááááá
MES-LCD ;CODE           ;display message on LCD
                        ;X must be 0 2 4 6 ... - message number
                        ;load 4 bytes of ram first with D6030081
        LDA #$81        ;RTS
        STA m1+3
        LDA MESADR,X
        STA m1+2
        LDA #$03
        STA m1+1
        LDA #$D6 ;D60300 is code for LDA ME1-1,X
```

```
        STA m1
        LDA MESADR+1,X ;next message address
        SUB MESADR,X
        STA m2
        CLRX
MES-LCD1
        JSR RAMRUN
        BSR L-D
        INCX
        TXA
        EOR m2
        BNE MES-LCD1
        RTS
*áááááááááááááááááááááááááááááááááááááááááááááááááááááá
MES0
        CLRX    ;X=0 message 0
        BSR MES-LCD
        RTS
MES1
        LDX #!1 ;X=1 message 1
        BSR MES-LCD
        RTS
MES2
        LDX #!2 ;X=2 message 2
        BSR MES-LCD
        RTS
MES3
        LDX #!3 ;X=3 message 3
        BSR MES-LCD
        RTS
```

```
MES4

        LDX #!4 ;X=4 message 4

        BSR MES-LCD

        RTS

MES5

        LDX #!5 ;X=5 message 5

        BSR MES-LCD

        RTS

MES6

        LDX #!6 ;X=6 message 6

        BSR MES-LCD

        RTS

MES7

        LDX #!7 ;X=7 message 7

        BSR MES-LCD

        RTS

*áááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá
W500us                  ;wait 500us=1048c 6+2+172*6+6=1046c

        LDA #!172       ;2c   JSR 5c-6c

W500usa

        DECA            ;3c

        BNE W500usa     ;3c

        RTS             ;6c

*áááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá
W5ms

        LDX #!10

W5msa

        BSR W500us

        DECX
```

```
        BNE W5msa

        RTS

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*ááááááááááááááááááááááááááááááááááááááááááááááááááá¢

*                          delays                         °

*ááááááááááááááááááááááááááááááááááááááááááááááááááá¡

W10ms

        LDX #!20

W10msa

        BSR W500us

        DECX

        BNE W10msa

        RTS

**********

W100ms

        LDX #!200

W100msa

        BSR W500us

        DECX

        BNE W100msa

        RTS

**********

W200ms

        BSR W100ms

        BSR W100ms

        RTS
```

```
**********

W1s

        LDA #!10

        STA co10s

W1sa

        BSR W100ms

        DEC co10s

        BNE W1sa

        RTS



LCDCODES DB 0C,06,38

*               °   °   °

*               °   °   âáá 8 bit, 2 lines, 5*7 dots

*               °   °   âáááá cursor will move +1, display will not

*               âáááááááá display on, cursor off

*ááááááááááááááááááááááááááááááááááááááááááááááááááá



*ááááááááááááááááááááááááááááááááááááááááááááááááááá¢

*                   Hitachi LM016L   2 * 16                 °

*ááááááááááááááááááááááááááááááááááááááááááááááááááá¬

L-D                         ;send data to LCD from A

        BSET 4,PORTB        ;H data

SBL-                        ;send byte to LCD from A

        STA PORTA

        BSET 5,PORTB
```

```
        BCLR 5,PORTB    ;latch on LCD
        LDA #!42
SB-LL                   ;wait 120us
        DECA            ;3c
        BNE SB-LL ;3c
        RTS
*ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá
SIL                     ;send instruction to LCD from A
        BCLR 4,PORTB ;L instruction
        BRA SB-L
*ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá
L-L ;move cursor left X positions, LCD-left
        LDA #$10 ;cursor left
        BSR SIL
        DECX
        BNE L-L
        RTS

L-R ;move cursor left X positions, LCD-right
        LDA #$14 ;cursor right
        BSR SIL
        DECX
        BNE L-R
        RTS
*ááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá
SB-L                    ;send byte to LCD from A
        BSR SBL-
        LDA #!42
SB-L1                   ;wait 120us
        DECA            ;3c
```

```
        BNE SB-L1 ;3c

        RTS

*áááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá

L-C

        LDA #$01 ;clear LCD

        BSR SIL

        BSR W5ms

        RTS


*áááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá

L-H

        LDA #$02 ;cursor home

        BSR SIL

        BSR W5ms

        RTS


* LTC1298CN8   12 bit A/D   2 inputs


PIN2                    ;selects pin 2 of LTC1298CN8

        BCLR 2,PORTB ;DIN 0 pin 2

        RTS


PIN3                    ;selects pin 3 of LTC1298CN8

        BSET 2,PORTB ;DIN 0 pin 3

        RTS


AD-a

        BCLR 3,PORTB ; CS 0 active
```

```
        BSET 2,PORTB ;DIN 1 start bit
        BSET 0,PORTB ;CLK 1 a
        BCLR 0,PORTB ;CLK 0

                     ;DIN 1 single ended conversion
        BSET 0,PORTB ;CLK 1 b
        BCLR 0,PORTB ;CLK 0
        RTS

AD-b                 ;select pin before running this
        BSET 0,PORTB ;CLK 1 c
        BCLR 0,PORTB ;CLK 0

        BSET 2,PORTB ;DIN 1 MSB 1st on DOUT
        BSET 0,PORTB ;CLK 1 d
        BCLR 0,PORTB ;CLK 0

        BCLR 2,PORTB ;DIN 0 null bit
        BSET 0,PORTB ;CLK 1 e

                     ;end of A/D startup code
        CLR raw
        CLR raw+1    ;clear 16bits

        LDX #!4      ;bits 11 10 9 8
G11-8                ;get bits 11-8
        BCLR 0,PORTB ;CLK 0
        CLC          ;0->C
        BRCLR 1,PORTB,IS0 ;br if DOUT 0
```

```
        SEC             ;1->C
IS0
        ROL raw         ;C->b0   b7->C
        BSET 0,PORTB ;CLK 1
        DECX
        BNE G11-8
```

```
        LDX #!8         ;bits 7 6 5 4 3 2 1 0
G7-1                    ;get bits 7-1
        BCLR 0,PORTB ;CLK 0
        CLC             ;0->C
        BRCLR 1,PORTB,IZ0 ;br if DOUT 0
        SEC             ;1->C
IZ0
        ROL raw+1       ;C->b0   b7->C
        BSET 0,PORTB ;CLK 1
        DECX
        BNE G7-1
                ;12bit raw A/D value in raw

        BCLR 0,PORTB ;CLK 0
        BSET 3,PORTB ; CS 1 disabled

        RTS
```

```
AD-2                ;read pin 2 of A/D
        BSR AD-a
        BSR PIN2
        BSR AD-b
```

```
        RTS


AD-3                ;read pin 3 of A/D
        BSR AD-a
        BSR PIN3
        BSR AD-b
        RTS

*áááááááááááááááááááááááááááááááááááááááááááááááááá¢
CONVERT-V ;       convert A/D to V AC                    °
*áááááááááááááááááááááááááááááááááááááááááááááááááá¬
                    ;ab c * 256 / = ih
        LDA raw+1   ;LSB, b convert V
        LDX #!16
                    ;ad * 256   ad * 16
                    ;-------- = -------
                    ;  4096       256
                    ;
MUL                 ;b*c=de
STX n1+1            ;d
LDA raw             ;MSB  a
LDX #!16
MUL                 ;a*c=fg
ADD n1+1            ;g+d=h
STA n1+1
TXA                 ;f
ADC #$00
STA n1              ;i
RTS
```

```
*áááááááááááááááááááááááááááááááááááááááááááááááááááá¢
CONVERT-mV ;      convert A/D to mV DC                        °
*áááááááááááááááááááááááááááááááááááááááááááááááááááá¬

                  ;ab c * 256 / = ih
        LDA raw+1 ;LSB  b
        LDX #!38
                  ;ad * 600   ad * 38
                  ;-------- = -------   38 * 256 = 608
                  ;  4096       256
                  ;
MUL               ;b*c=de
STX n1+1          ;d
LDA raw           ;MSB  a
LDX #!38
MUL               ;a*c=fg
ADD n1+1          ;g+d=h
        STA n1+1
        TXA       ;f
        ADC #$00
        STA n1    ;i
        RTS


*áááááááááááááááááááááááááááááááááááááááááááááááááááá¢
DIV-10 ;                  divide                              °
*áááááááááááááááááááááááááááááááááááááááááááááááááááá¬
* divides max 9999 in n1 by 10, result in n2
* remainder in n1

        CLR n2
```

```
        CLR n2+1
        LDX #$0A
        CLC
        ROL n1+1
        ROL n1    ;bits15 14 always 00
T4      CLC
        ROL n1+1
        ROL n1    ;1001 max bits 13-10
        LDA n1
        SUB #$50
        BCC T1
        BCS T2
T1      SEC
        STA n1
        BRA T3
T2      CLC
        BRA T3
T3      ROL n2+1
        ROL n2
        DECX
        BNE T4
        LSR n1
        LSR n1
        LSR n1
        RTS

DISP1
        LDA n1
        TAX
        LDA n2
```

```
        STA n1
        LDA n2+1
        STA n1+1
        RTS


DISP-V                  ;display number stored in n1 n1+1 in hex as 123 - 12.3VAC
        LDX #!2
        JSR L-R

        BSR DIV-10
        BSR DISP1
        TXA
        ORA #$30
        JSR L-D     ;digit 3

        LDX #!2
        JSR L-L
        BSR DIV-10
        BSR DISP1
        TXA
        ORA #$30
        JSR L-D     ;digit 2

        LDX #!2
        JSR L-L
        BSR DIV-10
        BSR DISP1
        TXA
        ORA #$30
        JSR L-D     ;digit 1
```

```
        RTS


DISP-mA                 ;display number stored in n1 n1+1 in hex as 123
        LDX #!2
        JSR L-R
        JSR DIV-10
        BSR DISP1
        TXA
        ORA #$30
        JSR L-D     ;digit 3


        LDX #!2
        JSR L-L
        JSR DIV-10
        JSR DISP1
        TXA
        ORA #$30
        JSR L-D     ;digit 2


        LDX #!2
        JSR L-L
        JSR DIV-10
        JSR DISP1
        TXA
        ORA #$30
        JSR L-D     ;digit 1


        RTS
```

```
*ááááááááááááááááááááááááááááááááááááááááááááááá¢
START ;                 1st word                        °
*ááááááááááááááááááááááááááááááááááááááááááááááái
* all 14 pin have pulldowns on reset if MOR b3=0
* timer interrupts disabled by reset

      LDA #%01000000 ;port A to LCD LM016
*           °°°°°°°°
*           °°°°°°°âá PA0 p18
*           °°°°°°âáá PA1 p17
*           °°°°°âááá PA2 p16
*           °°°°âáááá PA3 p15
*           °°°âááááá PA4 p14
*           °°âáááááá PA5 p13
*           °âáááááá PA6 p12
*           âáááááááá PA7 p11
      STA PORTA       ;
      LDA #%11111111 ;1-out 0-inp
      STA DDRA        ;make all out
      LDA #%11111111 ;pulldowns 1-no 0-yes
      STA PDRA        ;port A pulldown register

      LDA #%001000 ;port B
*           °°°°°°  p19
*           °°°°°âá PB0 CLK  LTC1298
*           °°°°âáá PB1 data from LTC1298
*           °°°âáááá PB2 data to LTC1298
```

```
*               °°âáááá PB3 CS of LTC1298
*               °âáááá PB4 L-instruction H-data
*               âáááááá PB5 LHL - HL latches LCD data
        STA PORTB
*               543210
        LDA #%111101 ;1-out 0-inp
        STA DDRB     ;

        LDA #%111111 ;pulldowns 1-no 0-yes
        STA PDRB     ;port B pulldown register


                     ;LCD initialize
        LDX #$03
LCD-I
        LDA LCDCODES-1,X
        JSR SIL
        DECX
        BNE LCD-I


*                ;message 0
*       JSR L-C
*       LDX #!2
*       JSR L-R ;line 1 position 4
*       JSR MES0
*       JSR L-H
*       LDX #!43
*       JSR L-R ;line 2 position 4
*       JSR MES6
*       JSR W1s
*       JSR L-C
```

```
        JSR L-C
        LDX #!5
        SR L-R ;line 1 psition 6 CARDIO
        JSR MES6
        JSR L-H
        LDX #!42
        JSR L-R ;line 2 position 3 HEALTH METER
        JSR MES7
        JSR W1s
        JSR L-C


*       LDA #!90    ;15s measured in operation
        LDA #!30    ; 5s
        STA m15s

LOOP
                    ;pin2 00.0V AC to 25.0V AC
        JSR AD-2
        JSR CONVERT-V
        LDA n1+1    ;V AC
        STA Volts
        JSR L-H
        LDX #!1
        JSR L-R     ;line 1 position 2

                    ;check if V below 10.0V AC
        LDA Volts
        SUB #!99    ;Volts-9.9V
```

```
BHI DVO      ;br if Volts >= 10.0V AC

             ;Volts < 10.0V AC

JSR L-C

LDX #!1

JSR L-R

JSR DI-000

        LDX #!8

        JSR L-R

        JSR DI-000

*       JSR L-H

*       LDX #!42

*       JSR L-R ;line 2 position 3

*       JSR MES7

JSR L-H

LDX #!5

JSR L-R ;line 1 position 6 CARDIO

JSR MES6

JSR L-H

LDX #!42

JSR L-R ;line 2 position 3 HEALTH METER

JSR MES7

        JMP SKIP-GE

DVO

        JSR DISP-V  ;display Volts only if 10.0V or more
```

```
* 7 lines below disconnected 14 VI 2000 on Brian's request
*                    ;pin3 000mA DC to 600mA DC
*       JSR AD-3
*       JSR CONVERT-mV
*       JSR L-H
*       LDX #!12
*       JSR L-R      ;line 1 position 13
*       JSR DISP-mA


* 10 lines below connected 14 VI 2000 on Brian's request
* pin 3 of A/D will not be used
        JSR L-H
        LDX #!12
        JSR L-R      ;line 1 position 13


* 5 lines below 2* disconnected 27 VI 2000
*       LDA Volts
*       LDX #!2
*       MUL          ;2*Volts in XA
*       STX n1       ;MSB
*       STA n1+1     ;LSB

        JSR MUL-2035 ;Volts * 2.035


        JSR DISP-mA
```

```
JSR L-H

LDX #!5      ;line 1 position 6 - start of message

JSR L-R


BCLR 0,fle   ;clear bit 0 L - flash disable


             ;check V range

LDA Volts

SUB #!150    ;Volts-15.0V

BLO LOW      ;br if Volts < 15.0


LDA Volts

SUB #!210    ;Volts-21.0V

BLO NORMAL   ;br if Volts < 21.0


             ;Volts >= 21.0


LDA Volts

SUB #!250    ;Volts-25.0V

BLO HIGH0    ;br if Volts <   25.0 HIGH solid


*       LDA Volts

*       SUB #!250    ;Volts-25.0V

*       BLO HIGH-F   ;br if Volts <   25.0 HIGH flashing
```

```
* 7 lines below disconnected 14 VI 2000 on Brian's request
*                       ;pin3 000mA DC to 600mA DC
*       JSR AD-3
*       JSR CONVERT-mV
*       JSR L-H
*       LDX #!12
*       JSR L-R      ;line 1 position 13
*       JSR DISP-mA


* 10 lines below connected 14 VI 2000 on Brian's request
* pin 3 of A/D will not be used
        JSR L-H
        LDX #!12
        JSR L-R      ;line 1 position 13


* 5 lines below 2* disconnected 27 VI 2000
*       LDA Volts
*       LDX #!2
*       MUL          ;2*Volts in XA
*       STX n1       ;MSB
*       STA n1+1     ;LSB

JSR MUL-2035 ;Volts * 2.035


JSR DISP-mA
```

```
JSR L-H
LDX #!5      ;line 1 position 6 - start of message
JSR L-R

BCLR 0,fle   ;clear bit 0 L - flash disable

             ;check V range
LDA Volts
SUB #!150    ;Volts-15.0V
BLO LOW      ;br if Volts < 15.0

LDA Volts
SUB #!210    ;Volts-21.0V
BLO NORMAL   ;br if Volts < 21.0

             ;Volts >= 21.0

        LDA Volts
        SUB #!250    ;Volts-25.0V
        BLO HIGH0    ;br if Volts <   25.0 HIGH solid

*       LDA Volts
*       SUB #!250    ;Volts-25.0V
*       BLO HIGH-F   ;br if Volts <   25.0 HIGH flashing

                     ;Volts >= 25.0 DANGER
*       JSR MES5     ;DANGER
*       JMP END-M
        JSR FLASH-DANGER
        BSET 0,fle           ;set bit 0 H - flash enable
```

```
        JMP END-M


*HIGH-F
*       JSR FLASH-HIGH
*       BSET 0,fle              ;set bit 0 H - flash enable
*       JMP END-M


* 00.0V AC - 09.9V AC   do not display Volts
* 10.0V AC - 13.9V AC   LOW
* 14.0V AC - 17.9V AC   NORMAL
* 18.0V AC - 21.0V AC   HIGH
* 21.1V AC - 25.5V AC   HIGH    flashing


HIGH0
        JSR MES4     ;HIGH
        JMP END-M


NORMAL
        JSR MES3     ;NORMAL
        JMP END-M
LOW
        JSR MES2     ;LOW

END-M
                ;bar graph on line 2 only if 10.0V or more

                ;display bar graph on line 2
```

```
JSR L-H
LDX #!40
JSR L-R      ;line 2 position 1

             ;check if 10.0V or more
LDX #!16     ;needed for 16 spaces on line 2
LDA Volts
SUB #!100    ;Volts-10.0V
BLO FRS      ;br if Volts < 10.0

LDA Volts    ;100 to 255
SUB #!100    ;  0 to 155
STA n1+1
CLR n1
JSR DIV-10
LDA n2+1
        ADD #!1      ;  1 to  16
        STA bar-graph

        LDX bar-graph
DBG1
        LDA #$FF
        JSR L-D
        DECX
        BNE DBG1

             ;fill remainder of line 2 with spaces
LDA #!16
SUB bar-graph ;16-x   0 to 15
TAX
```

```
        BEQ SKIP-GE     ;br if 0
FRS                     ;1 to 15 in X
        LDA #$20
        JSR L-D
        DECX
        BNE FRS

        DEC m15s        ;reduce 15s counter only if 10.0V AC or more

SKIP-GE
        JSR W100ms
        JSR W100ms ;19 IX 2000
        TST m15s
        BEQ IT-IS-15s

        JMP LOOP    ;br - it is not 15s yet

IT-IS-15s

        BRSET 0,fle,KEEP-FLASHING ;br if bit0 of fle = 1
                                  ;      bit0 of fle = 0
        JMP $       ;15s passed, stop

KEEP-FLASHING
        JSR L-H
        LDX #!5     ;line 1 position 6 - start of message
        JSR L-R
*       JSR FLASH-HIGH
        JSR FLASH-DANGER
        JSR W100ms
```

```
        JMP KEEP-FLASHING



DI-000

        LDA #$30

        JSR L-D

        LDA #$30

        JSR L-D

        LDA #$30

        JSR L-D

        RTS



*FLASH-HIGH

FLASH-DANGER

        LDA fbit

        EOR #$01

        STA fbit                ;       bit0 of fbit toggled

        BRSET 0,fbit,FLASH ;br if bit0 of fbit = 1

                                ;       bit0 of fbit = 0

*       JSR MES1 ;spaces only - erases HIGH disc. 19 IX - no flashing

        JMP FEND

FLASH

*       JSR MES4     ;HIGH

        JSR MES5     ;DANGER

FEND

        RTS



MUL-2035                ;2035    521    0209h

                        ;---- = --- = -----
```

```
                ;1000   256    256
LDA Volts
LDX #$09
MUL             ;in XA
STX n1+1        ;LSB
LDA Volts
LDX #$02
MUL
ADD n1+1
STA n1+1        ;LSB
TXA
ADC #$00
STA n1          ;MSB
RTS
```

```
*Öáááááááááááááááá¿
*°      CARDIO      °
*°   HEALTH METER   °
*âáááááááááááááááái
* VAC            mVDC
*Öáááááááááááááááá¿
*° 123 NORMAL 167 ° 123 is 12.3V AC    167 is 167mA DC
*°ÜÜÜÜÜ           °
*âáááááááááááááááái
*Öáááááááááááááááá¿
*° 000 CARDIO 000 ° LCD when Volts are < 10.0V
*°   HEALTH METER   °
*âáááááááááááááááái
```

```
*
* bar graph
*
*
* Ü                    0 10.0V
* ÜÜ                   1
* ÜÜÜ                  2
* ÜÜÜÜ                 3
* ÜÜÜÜÜ                4
* ÜÜÜÜÜÜ               5
* ÜÜÜÜÜÜÜ              6
* ÜÜÜÜÜÜÜÜ             7
* ÜÜÜÜÜÜÜÜÜ            8
* ÜÜÜÜÜÜÜÜÜÜ           9
* ÜÜÜÜÜÜÜÜÜÜÜ          10
* ÜÜÜÜÜÜÜÜÜÜÜÜ         11
* ÜÜÜÜÜÜÜÜÜÜÜÜÜ        12
* ÜÜÜÜÜÜÜÜÜÜÜÜÜÜ       13
* ÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜ      14
* ÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜ     15

*ááááááááááááááááááááááááááááááááááááááááááááááááá¢
*                    J1 rom end 7CF                   °
*ááááááááááááááááááááááááááááááááááááááááááááááááá¬

*ááááááááááááááááááááááááááááááááááááááááááááááááá¢
*                  Mask Option Register               °
*ááááááááááááááááááááááááááááááááááááááááááááááááá¬
    ORG $7F1  ;
 DB %01100010 ;MOR
```

```
*    °°°°°°°°
*    °°°°°°°âáááb0=0 COP watchdog disabled
*    °°°°°°°âáááb1=1 int on rising edge of PA3-PA0 or H
*    °°°°°°          int on falling edge & L on IRQ p19
*    °°°°°âáááááb2=0 PA3-PA0 can not act as IRQ
*    °°°°âáááááááb3=0 SWPDI pulldowns allowed p9-4
*    °°°âáááááááab4=0 STOP will initiate stop mode
*    °°âáááááááab5=0 no resistor, 1 connects 2Mohm pins 1 2
*    °âáááááááab6=1 access to eprom denied
*    âáááááááááb7=0 POR/STOP recovery delay 4064 cycles

*ááááááááááááááááááááááááááááááááááááááááááááááááááá¢
*                    user vectors                        °
*ááááááááááááááááááááááááááááááááááááááááááááááááááái
    ORG $7F8
 DW START     ;7F8 timer vector - nu
 DW START     ;7FA external interrupt vector - nu
 DW START     ;7FC software interrupt vector - nu
 DW START     ;7FE reset vector

*ááááááááááááááááááááááááááááááááááááááááááááááááááá¢
*                      software end                      °
*ááááááááááááááááááááááááááááááááááááááááááááááááááái
```