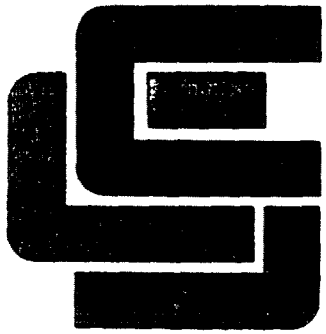
Owner's Manual

Model 7424 Calendar/Clock Module



California Computer Systems

CALIFORNIA COMPUTER SYSTEMS

APPLE II™ CALENDAR/CLOCK MODULE

MODEL 7424

OWNER'S MANUAL

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PREFACE

This manual is intended to provide as complete an understanding as possible of the hardware and software features of the CCS Model 7424 Calendar/Clock board. At the same time, we recognize that many APPLE owners want to be able to plug a board in and use it without having to wade through extensive discussions of hardware and software theory. For those of you in the latter category, Chapter 2 and Sections 1-4 of Chapter 3 provide all of the information necessary for the set-up, installation, and operation of the 7424. More curious users and those planning to write their own software will want to read the manual in its entirety.

A number of addresses referred to in the text depend on the number of the slot in which the 7424 is installed. We use "n" throughout the text to represent the slot number.

CHAPTER 1

THEORY OF OPERATION

The CCS Model 7424 Calendar/Clock Module is an addressable real time clock which counts seconds, minutes, hours, days-of-week, dates, months, and years. It automatically adjusts for leap year, and may be set for either a 12 hour (AM/PM) or 24 hour format. Normally operating on +5 volts from the APPLE II's power supply, the 7424 Calendar/Clock will continue time-counting functions down to +2.2 volts, allowing back-up batteries to preserve accurate time-keeping when the computer is powered down. Three on-board jumper-selectable drivers provide a range of capabilities without requiring a substantial time investment in software. For those users who want or need to create their own software, ample memory space is provided on-board.

1.1 THE 5832 CLOCK/CALENDAR CHIP

The heart of the 7424 Calendar/Clock Module is a 5832 Microprocessor Real-Time Clock/Calendar.

This device uses a 32.768 kHz crystal to count seconds, minutes, hours, days, months, and years. These counts are addressed one decimal digit at a time through inputs A0-A3, and are output in binary-coded-decimal (BCD) digits through D0-D3 when the READ input is high. A high to the WRITE input allows setting of the time data digit addressed through A0-A3. (See Table 3.1 for the address codes for each time data digit.) A high to the HOLD input maintains all counters in a static state, ensuring error-free reading and writing; accuracy is unaffected as long as HOLD is high for less than a second. A low to the CS input disables inputs and outputs, but does not affect time counting.

1.2 PROGRAM MEMORY

Three separate driver programs are available on-board in a 1Kx8 2708 EPROM (U1), each fitting into a 256-byte block. The fourth block is empty, and may be used to store user-generated programs. Jumpers A8 and A9 control address inputs A8 and A9 of the EPROM, allowing you to select which of the four 256-byte blocks will be enabled with the board (see Table 2.1).

Sockets are included on-board for the addition of two 256x4 RAMs or ROMs; the memory chips themselves must be provided by the user. Users who plan to create their own software for the 7424

may want to take advantage of the 256-byte ROM/RAM option rather than risk losing the three programs in the 2708 when burning in a fourth. If ROMs or RAMs are installed, the EPROM must be removed from the board.

1.3 SELECTION LOGIC

-I/O SEL and -DEV SEL, along with R/-W and A0, are the primary signals involved in the 7424's control logic. -I/O SEL low enables the Program EPROM. U9, a bi-directional data buffer, is enabled by a low on either -I/O SEL or -DEV SEL; when both inputs are high, a transistor shuts off power to U9 in order to conserve power. Direction of data transfer through U9 is determined by the R/-W line.

When -DEV SEL is low and A0 is high, the trailing (rising) edge of a low write pulse on R/-W clocks U8, the Clock Address Flip-Flops. Thus a write to an odd address between $C0(8+n)0 and $C0(8+n)F latches data from the 7424 data bus to the inputs of the 5832. Data bits D0-D3 address one of the 5832's BCD digits, D4 controls the Hold input, and D5 is tied to Chip Select. The digit addressed can be read at any even address between $C0(8+n)0 and $C0(8+n)F; Read is high when -I/O SEL is high and Write (see below) is low. A write to the same location changes the value of the digit addressed to the

value on data lines D3-D0 (or to 00 in the case of seconds). When A0 is low, lows on -DEV SEL and R/-W force the Write input high (if the input line is jumper-enabled).

1.4 INTERRUPTS

The 7424 is capable of generating interrupts periodically. The PI (Programmable Interrupt) jumpers 1-4 allow interrupts every 1/1024 second (#4), every second (#3), every minute (#2), or every hour (#1). Pulses with these intervals are available at D0-D3 when A0-A3, CS, and READ are all high and HOLD is low. (The last condition is not necessary for the 1024 Hz square wave on D0.) The pulses on D1-D3 have a duration of 122.1 microseconds. D1 and D2 pulse low, while D3 pulses high.

Interrupts are enabled when three conditions are met: 1) data bus lines D0-D3 are high; 2) D6 is high; 3) neither -I/O SEL nor -DEV SEL is active. D0-D3 high cause the periodic pulses to be output by the clock. A low on D6, -DEV SEL, or -I/O SEL pulls the Interrupt Flip-Flop's Preset input low, disqualifying the clocking of the flip-flop and forcing -IRQ (the flip-flop's Q output) high. This prevents generation of an interrupt request by a read from or write to the 5832.

The Interrupt Flip-Flop is clocked by the Phase 0 clock signal (pin 40). If one of the PIE jumpers is installed, a periodic pulse from the 5832 will be clocked into the flip-flop, forcing -IRQ low. Running the 7424 driver resets the Interrupt Flip-Flop, removing the interrupt request.

CHAPTER 2

SET-UP AND INSTALLATION

2.1 BATTERIES

If you wish to take advantage of the battery back-up capability of the 7424, you will need to purchase and install batteries. The batteries are readily available and easily installed. Batteries that will work include:

Eveready	E675
Mallory	M675
Burgess	Hg-675

To install the batteries, simply lift the tops of the clips and insert the batteries. Make sure that the batteries are securely in place before you install the 7424 in your APPLE.

If you do not install batteries, you will need to set the 7424 each time you turn the power on, and will need to leave the Write Enable jumper permanently set to EN.

2.2 SETTING THE JUMPERS

Before you install the 7424 in your system, you will need to configure the jumpers for the options you desire. If you plan to use one of the programs in the EPROM, you must set the A8 and A9 jumpers as indicated in Table 2.1 below. A "0" indicates an installed jumper.

A9	A8	ROUTINE
0	0	CLOCK INPUT
0	1	TIME STRING
1	0	SCREEN DISPLAY
1	1	EMPTY

Table 2.1

If you plan to install a pair of 256x4-bit ROMs or RAMs for storing a custom driver program, you must remove the EPROM from the board and set the ROM/RAM jumper appropriately.

The Write Enale jumper enables or disables writing to the 5832. It is a good idea to enable the line only when you want to set the 5832. You will need to set the jumper to EN before first installing the board. After you have installed the board and set the time and date (see Section 3.1), we recommend that you turn off the power to the APPLE (batteries must be installed) and set the jumper to the opposite (disabling) position. This prevents accidental writing to the 5832. In normal

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situations, you should not need to set the 5832 again for the life of the battery, except to adjust for daylight-saving time.

If you wish to enable programmable interrupts, jumper-connect PI header pin pairs 1, 2, 3, or 4 for the period desired, as shown in Table 2.2 below.

JUMPER	INTERRUPT PERIOD
PI 4	1/1024 SECOND
PI 3	1 SECOND
PI 2	1 MINUTE
PI 1	1 HOUR

Table 2.2

2.3 INSTALLATION

Before you begin the installation procedure, turn the computer off and disconnect the power cord.

```
**************************************
*                                    *
*  WARNING:  Do not remove the cover *
*  of your computer if the power cord *
*  is plugged in.  You may injure    *
*  yourself  or damage your computer. *
*                                    *
*b************************************
```

Place the computer directly in front of you. Put the palms of your hands on the back of the computer and curl your

fingers around the rear edge. Gently but firmly pull up until you hear two distinct pops. Don't lift the cover any farther. Slide it to the rear to remove it from the computer. Inside, toward the rear of the computer, you will see eight 50-pin connecters. They are numbered 0 through 7 from left to right. Place the 7728 in any of these connectors, with the exception of #0, the leftmost; slot 0 does not have the 256-byte program area available. We suggest that you use slot 4 (allowing you to run programs written for Mountain Hardware's APPLE Clock™, which must reside in slot 4). Insert the card by holding it so that the component side of the card is to the right. Align the card edge into the chosen connector and gently push the card down until it is firmly seated. Replace the computer cover, and you are ready to try out the board.

2.4 CALIBRATION

All 7424 Calendar/Clock Modules are accurately set at the factory, but shipping vibrations may in some cases cause a board to be slightly fast or slow. Should you find that your board loses or gains time (from a few seconds up to a minute or two in 24 hours), you will need to adjust the variable capacitor C2, which fine-tunes the crystal-controlled clock frequency.

Most users who find that their calendar/clock modules need calibration will have to use the adjust-a-bit-and-check-the-results method. After determining the amount of time gained or lost per 24 hours, insert a small screwdriver blade into the slot at the top end of C2 and adjust slightly. Wait long enough to determine the effect of this adjustment, then readjust accordingly. Continue this process until you achieve the accuracy you desire.

For those of you who have access to a six-digit frequency counter, there is an easier way. Install P1 jumper #4, then

```
POKE 49281 + (16*n),111
```

to enable the 1 KHz square wave at P14. Adjust C2 as described above so that the frequency of the wave at P14 is 1024.00 ± .01 Hz.

The variable capacitor C2 also allows you to correct for another possible cause of diminished accuracy: crystal aging. Over the years, crystals undergo a very slight but detectable change in frequency. Since your 7424 should give you years of service, sometime in the future you will probably want to make a minor adjustment of C2.

CHAPTER 3

SOFTWARE

Three slot-independent drivers reside on-board the 7424 in a 1K EPROM, each routine occupying a 256-byte block. Which block will be enabled with the board depends on the A9 and A8 jumpers, as indicated in Table 2.1. User-written routines may be stored in the fourth block of the EPROM, or more safely in two 256x4 ROMs or RAMs.

3.1 SETTING THE CLOCK

When you have your 7424 set up and installed, you will want to set the clock/calendar to the correct date and time. You could do so by separately addressing each digit, but the task would be tedious. The BASIC program on the next page makes setting the clock easy and quick. Simply enter and run the program, answering the questions asked. (Be sure that the Write Enable jumper is set to EN.)

```
10  REM    BASIC PROGRAM TO SET TIME
20  REM  FIND OUT WHAT SLOT THE TIMER IS IN
30  INPUT "WHAT SLOT IS THE CLOCK IN? ";S
40  REM  COMPUTE SLOT BASE ADDRESS
50  BASE = - 16256 + (16 * S)
60  REM  SET YEARS
70  INPUT "WHAT YEAR (0-99)? ";A$
80  GOSUB 1000
90  REM  CHECK FOR ENTRY ERROR
100  IF A1 = 1000 THEN 70
110  POKE BASE + 1,59: POKE BASE,A1
120  POKE BASE + 1,60: POKE BASE,A2
130  REM  SET MONTH
140  INPUT "WHAT MONTH (1-12) ? ";A$
150  IF VAL (A$) † 12 THEN 140
160  GOSUB 1000
170  IF A1 = 1000 THEN 140
180  POKE BASE + 1,57: POKE BASE,A1
190  POKE BASE + 1,58: POKE BASE,A2
200  REM  SET DAYS
210  INPUT "WHAT DAY (1-31) ? ";A$
220  IF VAL (A$) † 31 THEN 130
230  GOSUB 1000
240  IF A1 = 1000 THEN 210
250  POKE BASE + 1,55: POKE BASE,A1
260  POKE BASE + 1,56: POKE BASE,A2
270  REM  FIND HOUR FORMAT
280  INPUT "WHAT HOUR FORMAT (12 OR 24) ? ";B$
290  REM  SET HOURS
300  INPUT "SET HOURS TO ? ";A$
310  IF VAL (A$) † THEN 300
320  GOSUB 1000
330  IF A1 = 1000 THEN 300
340  IF B$ = "12" THEN INPUT "AM OR PM ? ";C$
350  IF B$ = "24" THEN A2 = A2 + 8:C$ = ""
360  IF C$ = "PM" THEN A2 = A2 + 4
370  POKE BASE + 1,52: POKE BASE,A1
380  POKE BASE + 1,53: POKE BASE,A2
390  REM  SET MINUTES
400  INPUT "SET MINUTES TO ? ";A$
410  IF VAL (A$) † 60 THEN 400
420  GOSUB 1000
430  IF A1 = 1000 THEN 400
440  POKE BASE + 1,50: POKE BASE,A1
450  POKE BASE + 1,51: POKE BASE,A2
460  INPUT "HIT RETURN TO START TIME.  SECONDS
     SET TO 00 ";A$
470  POKE BASE + 1,49: POKE BASE,00
480  POKE BASE + 1,0: END
900  REM  ROUTINE TO GET VALUES TO SET
     TIME AND DATA
1000  A1 = LEN (A$)
1010  IF A1 = 1 THEN A2 = 0:A1 = VAL (A$): RETURN
1020  IF A1 = 2 THEN A2 = VAL ( LEFT$ (A$,1)):
      A1 = VAL ( RIGHT$ (A$,1)): RETURN
1030  A1 = 1000:A2 = 1000:RETURN
```


3.2 CLOCK INPUT ROUTINE

The first routine loads calendar/clock data into the first 17 locations of the keyboard input buffer. To use this routine in a BASIC program, four statements are necessary:

```
60  IN#n        (n=slot #)
70  INPUT X$
80  IN#0
90  PRINT X$
```

Line 60 changes locations $38 and $39, the APPLE's input vectors, to point to the 7424. Line 70, in which X may be any character, causes the data to be transferred to the input buffer. Input control is returned to the keyboard (slot #0) by line 80. Line 90 prints the data in the following format:

MM/DD hh;mm;ss.000

The above format ends with .000, which are dummy characters and will not change, in order to provide compatibility with the Mountain Hardware Apple Clock™, which counts thousandths of a second. Programs written for the Mountain Hardware clock in which fractions of a second are not critical will run with the CCS 7424.

3.3 TIME STRING ROUTINE

This program works only in APPLESOFT, which allows you to store up to 255 characters as a string. The 7424 Time String routine continually rewrites the correct hours, minutes, and seconds into an eight-character string. To use this routine, you must create a string TI$ with eight characters, including spaces. (Any characters can be used, so go ahead and express yourself.) You must enable periodic interrupts by installing one of the PI jumpers. Once it has been called and interrupt generation enabled, the routine will write the correct time into the string each time it interrupts.

To start the clock storing data in the TI$ location, CALL 49152 + (256 * n), the intialization entry point. The INIT subroutine will load the normal entry point of the routine into $3FE and $3FF, the interrupt vector addresses, so that when the processor is interrupted it will turn control over to the Clock Input routine. The routine searches the strings for TI$ and, if it finds it, transfers the correct time to the string's eight bytes of memory, then returns control to the processor. To read the time, all you need to do is type in a simple command, PRINT TI$. The time will be printed in the following format:

HH/MM/SS

If you set the clock to the 12 hour mode, the routine will not specify AM or PM.

There are two ways to stop this routine from interrupting your computer. One is to disable all interrupts by setting the interrupt status flag. To do this, CALL 49405 + (256 * n). The other way is to disable interrupt request generation by the 7424. To do this, POKE a byte in which at least one of bits 0, 1, 2, 3, 5 and 6 is low ($00 works fine) to $C0(8+n)1. In either case, the routine can be re-initialized as described above.

Note: This routine's interrupts should be disabled whenever you are adding lines to or deleting lines from a program. The routine uses the APPLESOFT string pointers to find TI$ and when lines are added there is a period of time when the pointers do not reflect the actual locations of the strings.

3.4 SCREEN DISPLAY ROUTINE

This routine interrupts the processor to maintain the correct time in the upper right-hand corner of your CRT screen. To use it you must enable the 1 kHz interrupts by jumpering PIE 1. The display format is similar to the TI$ format except that AM and PM can be specified and colons replace the slashes.

HH:MM:SS AM

To use this program you must call the enabling routine at $CnD0:

CALL 49360+(256 * n)

The periodic interrupts will continually update the clock. Other programs may be run as long as they are compatible with the interrupts; however, anything written in the screen position reserved for the time display will be overwritten at the next interrupt. Interrupts can be disabled by a CALL to 49395 + 256 * n ($CnF3), or by a POKE to $C0(8+n)1 as described in Section 3.3.

3.5 WRITING YOUR OWN SOFTWARE

There are too many possibilities with a board like the CCS 7424 for us to make more than general comments about writing software for it. Certain firmware routines of your APPLE are very useful. The program listings included in this chapter show how some of them can be used, but you should already have a pretty good idea of what is available in your firmware if you are going to be doing any very complicated programming for the 7424.

You will also need to know how to communicate with the clock itself. This is actually fairly simple. To latch the

address of a date or time digit, write $2x to $C0(8+n)1, where x is the code for the desired data as given in Table 3.1. (The format of the clock address byte is shown below. Bits 4 and 5 should be high to address the clock.) Data may be read at $C0(8+n)0. To enable interrupt request generation by the 7424, set the processor interrupt flag and write $6F to $C0(8+n)1 before exiting. (Bit 6 high enables interrupts when bits 0-5 are all high.)

BIT	7	6	5	4	3	2	1	0
5832 INPUT	-	INT	CS	HLD	A3	A2	A1	A0

5832 ADDRESS/DATA TABLE

ADDRESS				INTERNAL	DATA			
A0	A1	A2	A3	COUNTER	D0	D1	D2	D3
0	0	0	0	SECOND 1	X	X	X	X
1	0	0	0	SECOND 10	X	X	X	d
0	1	0	0	MINUTE 1	X	X	X	X
1	1	0	0	MINUTE 10	X	X	X	
0	0	1	0	HOUR 1	X	X	X	X
1	0	1	0	HOUR 10	X	X	a	b
0	1	1	0	DAY/WEEK	X	X	X	
1	1	1	0	DATE 1	X	X	X	X
0	0	0	1	DATE 10	X	X	c	
1	0	0	1	MONTH 1	X	X	X	X
0	1	0	1	MONTH 10	X			
1	1	0	1	YEAR 1	X	X	X	X
0	1	0	1	YEAR 10	X	X	X	X
1	1	1	1	REFERENCE	e	f	g	h

X. 0 or 1: BCD Digit
a. 0 for AM, 1 for PM
b. 0 for 12 hour, 1 for 24 hour format
c. 1 for 29 days in month 2 write
d. Seconds reset to 00 by write to clock
e. 1024 Hz square wave
f. 1 Hz pulse
g. 1/60 Hz pulse
h. 1/3600 Hz pulse

Table 3.1

3.6 CLOCK INPUT ROUTINE LISTING

```
                    CLOCK INPUT ROUTINE
                *
                * THIS ROUTINE INPUTS DATA WHEN CALLED.
                * THE SLOT NUMBER IS SIGNIFIED BY n.
                *
                *
                *
                *
                *
                *
Cn00            BUF     EQU     $0200
Cn00            ADDR    EQU     $C081
Cn00            DATA    EQU     $C080
Cn00            *
Cn00            *       ORG     $Cn00
Cn00            *
Cn00            *
Cn00            ENT     PHP             Save P Register
Cn00-08                 SEI             Disable CPU Interrupts
Cn01-78                 TYA             Save Y
Cn02-98                 PHA
Cn03-48                 JSR     $FFCB   Get Slot Number
Cn04-20 CB FF
Cn07-BA                 TSX
Cn08-BD 00 01           LDA     $100,X
Cn0B-0A                 ASL     A       Multiply by 16
Cn0C-0A                 ASL     A
Cn0D-0A                 ASL     A
Cn0E-0A                 TAY             Save In Y Reg
Cn0F-A8                 LDA     #$2A    Get Months Tens
Cn10-A9 2A
Cn12-99 81 C0           STA     ADDR,Y
Cn15-B9 80 C0           LDA     DATA,Y
Cn18-8D 00 02           STA     BUF+0   Input
```

```
Cn1B-A9 29          LDA   #$29      Get Months Ones
Cn1D-99 81 C0       STA   ADDR,Y
Cn20-B9 80 C0       LDA   DATA,Y
Cn23-8D 01 02       STA   BUF+1     Input
Cn26-A9 AF          LDA   #$AF      ASCII /
Cn28-8D 02 02       STA   BUF+2
Cn2B-A9 28          LDA   #$28      Get Date Tens
Cn2D-99 81 C0       STA   ADDR,Y
Cn30-B9 80 C0       LDA   DATA,Y
Cn33-8D 03 02       STA   BUF+3     Input
Cn36-A9 27          LDA   #$27      Get Date Ones
Cn38-99 81 C0       STA   ADDR,Y
Cn3B-B9 80 C0       LDA   DATA,Y
Cn3E-8D 04 02       STA   BUF+4     Input
Cn41-A9 A0          LDA   #$A0      ASCII Space
Cn43-8D 05 02       STA   BUF+5
Cn46-A9 25          LDA   #$25      Get Hours Tens
Cn48-99 81 C0       STA   ADDR,Y
Cn4B-B9 80 C0       LDA   DATA,Y
Cn4E-29 03          AND   $#03      Mask Format Flags
Cn50-8D 09 02       STA   BUF+6     Input
Cn53-A9 24          LDA   #$24      Get Hours Ones
Cn55-99 81 C0       STA   ADDR,Y
Cn58-B9 80 C0       LDA   DATA,Y
Cn5B-8D 0A 02       STA   BUF+7     Input
Cn5E-A9 23          LDA   #$23      Get Minutes Tens
Cn60-99 81 C0       STA   ADDR,Y
Cn63-B9 80 C0       LDA   DATA,Y
Cn66-8D 0C 02       STA   BUF+9     Input
Cn69-A9 22          LDA   #$22      Get Minutes Ones
```



```
Cn6B-99 81 C0       STA   ADDR,Y
Cn6E-B9 80 C0       LDA   DATA,Y
Cn71-8D 0D 02       STA   BUF+$A    Input
Cn74-A9 21          LDA   #$21      Get Seconds Tens
Cn76-99 81 C0       STA   ADDR,Y
Cn79-B9 80 C0       LDA   DATA,Y
Cn7C-8D 0F 02       STA   BUF+$C    Input
Cn7F-A9 20          LDA   #$20      Get Seconds Ones
Cn81-99 81 C0       STA   ADDR,Y
Cn84-B9 80 C0       LDA   DATA,Y
Cn87-8D 10 02       STA   BUF+$D    Input
Cn8A-A2 20          LDX   #$20      Set Up Index
Cn8C-A9 BF    LP1   LDA   #$BF      Make All ASCII
Cn8E-3D 00 02       AND   BUF,X
Cn91-9D 00 02       STA   BUF,X
Cn94-CA             DEX
Cn95-10 F5          BPL   LP1       Next Character
Cn97-A9 BB          LDA   #$BB      Get ";"
Cn99-8D 08 02       STA   BUF+8
Cn9C-8D 0B 02       STA   BUF+$B
Cn9F-A9 AE          LDA   #$AE      Get "."
CnA1-8D 0E 02       STA   BUF+$E    Put After Seconds
CnA4-A9 B0          LDA   #$B0      Get 0
CnA6-8D 0F 02       STA   BUF+$F    Put 3 After "."
CnA9-8D 10 02       STA   BUF+$10
CnAC-8D 11 02       STA   BUF+$11
CnAF-A2 12          LDX   #$12      Put Length In X
CnB1-68             PLA             Get Back Y
CnB2-A8             TAY
CnB3-A9 8D          LDA   #$8D      Return CR to End
CnB5-8D 12 02       STA   BUF+$12   End String with CR
CnB8-28             PLP
CnB9-60             RTS             Return
```

```
Cn00              *                    TI$ ROUTINE
Cn00              *
Cn00              *  THIS PROGRAM CONTINUALLY REWRITES A STRING TI$
Cn00              *  WITH  HOURS,  MINUTES,  SECONDS  IN THE FORMAT
Cn00              *  HH/MM/SS.  SLOT NUMBER IS SIGNIFIED BY n.
Cn00              *
Cn00              *
Cn00              TEMP1   EQU     $4F8-$C0
Cn00              PNT     EQU     $69       STRING POINTER
Cn00              BUFF    EQU     $2F0      DATA BUFFER
Cn00              DATA    EQU     $C080     CLOCK DATA LOC
Cn00              CNTRL   EQU     $C081     CLOCK ADDR LOC
Cn00              IOSAVE  EQU     $FF4A     REGISTER SAVE ROUTINE
Cn00              IOREST  EQU     $FF3F     REGISTER STORE ROUTINE
Cn00              *
Cn00                      ORG     $Cn00
Cn00              *
Cn00              *
Cn00-58           STRT    CLI               Enable Interrupts
Cn01-08                   PHP               Save Status Word
Cn02-78                   SEI               Disable Interrupts
Cn03-2C CB FF             BIT     $FFCB     Set V Flag for Init Entry
Cn06-70 03                BVS     FSLOT     Go Find Slot
Cn08-A5 45        INENT   LDA     $45       Intrpt Entry Point
Cn0A-B8                   CLV               Clear V for Intrpt Entry
Cn0B-48           FSLOT   PHA               Save Registers
Cn0C-98                   TYA
Cn0D-48                   PHA
Cn0E-8A                   TXA
Cn0F-48                   PHA
Cn10-20 CB FF             JSR     $FFCB     Get Slot Number
```



```
Cn13-BA                   TSX
Cn14-BD 00 01             LDA     $100,X
Cn17-AA                   TAX
Cn18-0A                   ASL     A         Multiply by 16
Cn19-0A                   ASL     A
Cn1A-0A                   ASL     A
Cn1B-0A                   ASL     A
Cn1C-9D 38 04             STA     TEMP1,X   Store Result
Cn1F-70 31                BVS     INIT      Branch If Init Entry
Cn21-A0 00                LDY     #$00      Clear Y Index
Cn23-B1 69        SRCH    LDA     (PNT),Y   Search for TI In String Table
Cn25-C9 54                CMP     #$54      Look for T
Cn27-D0 08                BNE     NXT       Branch If Not
Cn29-C8                   INY               If T Found, See If Next Is I
Cn2A-B1 69                LDA     (PNT),Y
Cn2C-C9 C9                CMP     #$49+$80
Cn2E-F0 0C                BEQ     FND       String Found; Go Get Time
Cn30-88                   DEY
Cn31-98           NXT     TYA               Go Find Next $
Cn32-18                   CLC               Clear Carry for Add
Cn33-69 07                ADC     #$07      Point to Next String
Cn35-A8                   TAY               Put New Index In Y
Cn36-90 EB                BCC     SRCH      Go Check Next String
Cn38-B0 1E                BCS     EXIT      Exit If TI$ Not Found
Cn3A-C8           FND     INY               Point to Lentgh of String
Cn3B-A5 46                LDA     $46       Save 46 and 47 on Stack
Cn3D-48                   PHA
Cn3E-A5 47                LDA     $47
Cn40-48                   PHA
Cn41-C8                   INY               Point to First Byte of $
Cn42-B1 69                LDA     (PNT),Y   Get Data Pointer
```

```
Cn44-85 46          STA   $46        Store It
Cn46-C8             INY               Point to Second Byte
Cn47-B1 69          LDA   (PNT),Y     Get Pointer
Cn49-85 47          STA   $47         Store It
Cn4B-BC 38 04       LDY   TEMP1,X     Store Y Index
Cn4E-50 1E          BVC   SDTA        Always Branch
Cn50-8E FF 03 INIT  STX   $3FF        Set Intrpt Vectors for Clock
Cn53-A9 08          LDA   #$08
Cn55-8D FE 03       STA   $3FE
Cn58-BC 38 04 EXIT  LDY   TEMP1,X
Cn5B-A9 6F          LDA   #$6F        Enable Clock Interrupts
Cn5D-99 81 C0       STA   CNTRL,Y
Cn60-70 06          BVS   SHT
Cn62-68             PLA               Restore 46 and 47
Cn63-85 47          STA   $47
Cn65-68             PLA
Cn66-85 46          STA   $46
Cn68-68       SHT   PLA               Restore Registers
Cn69-AA             TAX
Cn6A-68             PLA
Cn6B-A8             TAY
Cn6C-68             PLA
Cn6D-40             RTI               Return
Cn6E-8A       SDTA  TXA               Store A Reg on Stack
Cn6F-48             PHA
Cn70-A2 00          LDX   #$00        Set X Index to 0
Cn72-A9 25          LDA   #$25        Get Hours x 10
Cn74-99 81 C0       STA   CNTRL,Y
Cn77-B9 80 C0       LDA   DATA,Y
Cn7A-29 F3          AND   #$F3        Mask Format Codes
Cn7C-81 46          STA   ($46,X)     Store in String
```



```
Cn7E-E6 46          INC   $46         Next Position
Cn80-D0 02          BNE   S1          Incr Hi Byte If Lo Byte $00
Cn82-E6 47          INC   $47
Cn84-A9 24    S1    LDA   #$24        Get Hours x 1
Cn86-99 81 C0       STA   CNTRL,Y
Cn89-B9 80 C0       LDA   DATA,Y
Cn8C-81 46          STA   ($46,X)     Store In String
Cn8E-E6 46          INC   $46         Next Position
Cn90-D0 00          BNE   S2
Cn92-E6 46    S2    INC   $46         Skip space for /
Cn94-D0 04          BNE   S3          Incr Hi Byte If Lo Byte $00
Cn96-D0 C0    X1    BNE   EXIT        Passing through
Cn98-E6 47          INC   $47
Cn9A-A9 23    S3    LDA   #$23        Get Minutes by 10
Cn9C-99 81 C0       STA   CNTRL,Y
Cn9F-B9 80 C0       LDA   DATA,Y
CnA2-81 46          STA   ($46,X)     Store In String
CnA4-E6 46          INC   $46         Next Position
CnA6-D0 02          BNE   S4          Incr Hi Byte If Lo Byte $00
CnA8-E6 47          INC   $47
CnAA-A9 22    S4    LDA   #$22        Get Minutes x 1
CnAC-99 81 C0       STA   CNTRL,Y
CnAF-B9 80 C0       LDA   DATA,Y
CnB2-81 46          STA   ($46,X)     Store In String
CnB4-E6 46          INC   $46         Next Position
CnB6-D0 00          BNE   S5
CnB8-E6 46    S5    INC   $46         Skip Space for /
CnBA-D0 02          BNE   S6          Incr Hi Byte If Lo Byte $00
CnBC-E6 47          INC   $47
CnBE-A9 21    S6    LDA   #$21        Get Seconds x 10
CnC0-99 81 C0       STA   CNTRL,Y
```

```
CnC3-B9 80 C0           LDA     DATA,Y
CnC6-81 46              STA     ($46,X)     Store In String
CnC8-E6 46              INC     $46         Next Position
CnCA-D0 02              BNE     S7          Incr HI Byte If Lo Byte $00
CnCC-E6 47              INC     $47
CnCE-A9 20      S7      LDA     #$20        Get Seconds x 1
CnD0-99 81 C0           STA     CNTRL,Y
CnD3-B9 81?C0           LDA     DATA,Y
CnD6-81 46              STA     ($46,X)     Store In String
CnD8-38                 SEC                 Go Back to Front of String
CnD9-A5 46              LDA     $46
CnDB-E9 07              SBC     #$07
CnDD-85 46              STA     $46
CnDF-B0 02              BCS     S8          Decr HI Byte If Low Byte < 7
CnE1-C6 47              DEC     $47
CnE3-A0 07      S8      LDY     #$07
CnE5-A9 3F      LP1     LDA     #$3F        Loop for Making ASCII
CnE7-31 46              AND     ($46),Y
CnE9-91 46              STA     ($46),Y
CnEB-88                 DEY
CnEC-10 F7              BPL     LP1
CnEE-A9 2F              LDA     #$2F        Get ASCII /
CnF0-A0 02              LDY     #$2         Insert Between Digit Pairs
CnF2-91 41              STA     ($46),Y
CnF4-A0 05              LDY     #$5
CnF6-91 41              STA     ($46),Y
CnF8-68                 PLA                 Restore A Reg
CnF9-AA                 TAX
CnFA-D0 9A              BNE     X1
CnFC-78                 SEI                 Disable Interrupts
CnFD-60                 RTS                 Done
```



```
Cn00                *   SCREEN DISPLAY ROUTINE
Cn00                *
Cn00                * THIS ROUTINE INTERRUPTS TO REWRITE  TIME
Cn00                * ON CRT SCREEN.  SLOT NUMBER IS SIGNIFIED
Cn00                * BY n.
Cn00                *
Cn00                *
Cn00                BASE    EQU     $C080
Cn00                ADD     EQU     BASE+1
Cn00                SCRN    EQU     $0400
Cn00                IOSAVE  EQU     $FF4A
Cn00                IOREST  EQU     $FF3F
Cn00                *
Cn00                *       ORG     $Cn00
Cn00                *
Cn00                *
Cn00-A5 45          INTRP   LDA     $45         Get A Reg
Cn02-20 4A FF               JSR     IOSAVE      Save Registers
Cn05-BA                     TSX                 Get Slot Number from Stack
Cn06-BD 00 01               LDA     $100,X
Cn09-0A                     ASL     A           Multiply by 16
Cn0A-0A                     ASL     A
Cn0B-0A                     ASL     A
Cn0C-0A                     ASL     A
Cn0D-A8                     TAY                 Put Result In Y
Cn0E-A2 24                  LDX     #$24        Set Screen Posit Index
Cn10-A9 20                  LDA     #$20        Get Seconds
Cn12-99 81 C0               STA     ADD,Y
Cn15-B9 80 C0               LDA     BASE,Y
Cn18-29 BF                  AND     #$BF        Make ASCII
```

```
Cn1A-9D 00 04          STA     SCRN,X      Display
Cn1D-CA                DEX                 Next Space to Left
Cn1E-A9 21             LDA     #$21        Get Seconds
Cn20-99 81 C0          STA     ADD,Y
Cn23-B9 80 C0          LDA     BASE,Y
Cn26-29 BF             AND     #$BF        Make ASCII
Cn28-9D 00 04          STA     SCRN,X      Display
Cn2B-CA                DEX                 Next Space to Left x 10
Cn2C-A9 BA             LDA     #$BA        Get :
Cn2E-9D 00 04          STA     SCRN,X      Display It
Cn31-CA                DEX                 Next Space to Left
Cn32-A9 22             LDA     #$22        Get Minutes
Cn34-99 81 C0          STA     ADD,Y
Cn37-B9 80 C0          LDA     BASE,Y
Cn3A-29 BF             AND     #$BF        Make ASCII
Cn3C-9D 00 04          STA     SCRN,X      Display
Cn3F-CA                DEX                 Next Space to Left
Cn40-A9 23             LDA     #$23        Get Minutes x 10
Cn42-99 81 C0          STA     ADD,Y
Cn45-B9 80 C0          LDA     BASE,Y
Cn48-29 BF             AND     #$BF        Make ASCII
Cn4A-9D 00 04          STA     SCRN,X      Display
Cn4D-CA                DEX                 Next Space to Left
Cn4E-A9 BA             LDA     #$BA        Get :
Cn50-9D 00 04          STA     SCRN,X      Display It
Cn53-CA                DEX                 Next Space to Left
Cn54-A9 24             LDA     #$25        Get  Hours
Cn56-99 81 C0          STA     ADD,Y
Cn59-B9 80 C0          LDA     BASE,Y
Cn5C-29 BF             AND     #$BF        Make ASCII
```



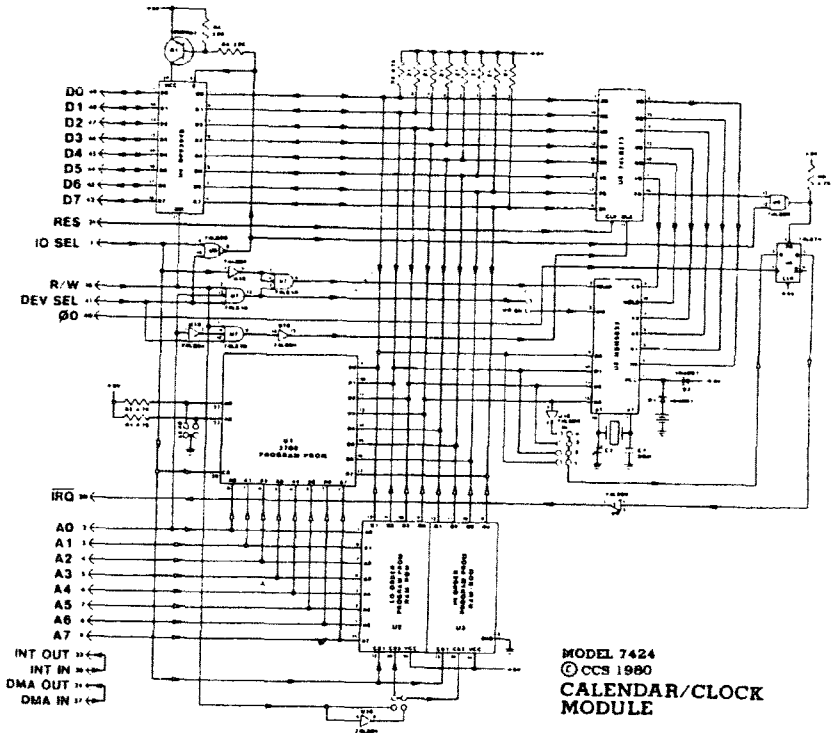
```
Cn5E-9D 00 04          STA     SCRN,X      Display
Cn61-CA                DEX                 Next Space to Left
Cn62-A9 25             LDA     #$25        Get Hours x 10
Cn64-99 81 C0          STA     ADD,Y
Cn67-B9 80 C0          LDA     BASE,Y
Cn6A-48                PHA                 Save on Stack
Cn6B-29 08             AND     #$08        12 or 24 Format?
Cn6D-F0 16             BEQ     AMPM        Branch If 12
Cn6F-68        AMPM1   PLA                 Reget Hours x 10
Cn70-29 B3             AND     #$B3        Make ASCII
Cn72-9D 00 04          STA     SCRN,X      Display
Cn75-CA                DEX                 Next Space to Left
Cn76-A9 A0             LDA     #$A0        Get Space
Cn78-9D 00 04          STA     SCRN,X      Display It
Cn7B-A9 6F     EXIT    LDA     #$6F        Enable Clock Interrupts
Cn7D-99 81 C0          STA     BASE+1,Y
Cn80-20 3F FF          JSR     IOREST      Restore Registers
Cn83-40                RTI                 Return
Cn84-68        AMPM    PLA                 Reget Hours x 10
Cn85-48                PHA                 Save on Stack
Cn86-29 04             AND     #$04        AM or PM?
Cn88-D0 04             BNE     PM          Branch If PM
Cn8A-A9 C1     AM      LDA     #$C1        Get A
Cn8C-D0 02             BNE     ST          Always Branch
Cn8E-A9 D0     PM      LDA     #$D0        Get P
Cn90-8D 26 04  ST      STA     SCRN+38     Display A or P
Cn93-A9 CD             LDA     #$CD        Get M
Cn95-8D 27 04          STA     SCRN+39     Display M
Cn98-38                SEC
Cn99-B0 D3             BCS     AMPM1       Always Branch
```

```
                        ORG     $CnD0       Start-up Routine
CnD0-08                 PHP                 Save A and X
CnD1-48                 PHA
CnD2-8A                 TXA
CnD3-48                 PHA
CnD4-20 CB FF           JSR     $FFCB       Get Slot
CnD7-BA                 TSX
CnD8-BD 00 01           LDA     $100,X      Store Slot High Address
CnDB-8D FF 03           STA     $3FF          In Interrupt Vector High
CnDE-0A                 ASL     A           Multiply Slot Number by 16
CnEF-0A                 ASL     A
CnE0-0A                 ASL     A
CnE1-0A                 ASL     A
CnE2-AA                 TAX                 Store Result In X
CnE3-A9 00              LDA     #$00        Set Interrupt Vector
CnE5-8D FE 03           STA     $3FE          Low to Zero
CnE8-A9 6F              LDA     #$6F        Enable Clock Interrupts
CnEA-9D 81 C0           STA     #C081,X
CnED-68                 PLA                 Restore Registers
CnEE-AA                 TAX
CnEF-68                 PLA
CnF0-28                 PLP
CnF1-58                 CLI                 Enable Interrupts at Processor
CnF2-60                 RTS                 Return
CnF3-78                 SEI                 Disable Interrupts at Processor
CnF4-60                 RTS                 Return
```

4.1 SPECIFICATIONS

SIZE:	5" long x 2.75" high x .75" wide
WEIGHT:	less than 5 ounces
REQUIRED POWER:	+5V DC
CLOCK FEATURES:	Second, Minute, Hour, Day, Date, Month, Year Decimal Digits Separately Addressed and Set 12 and 24 Hour Formats Automatic Leap Year Adjustment Jumper-Selectable Periodic Interrupts 32.768 kHz Crystal Control Battery Back-up Maintains Timekeeping When System Is Powered Down
PROGRAM MEMORY:	2K bytes of PROM: Three 256-Byte Controller Programs 256 Bytes Unburned for User Program Circuitry for 256 Byte ROM/RAM
OTHER FEATURES:	Auto-Power-Down for High-Consumption DP8304B Interrupt Daisy Chain Support with Jumpered-Selectable IRQ Generation DMA Daisy Chain Pass-Through Component Silkscreen Glass Epoxy (FR-4) PC Board Gold-Plated Connector Fingers Solder Mask Both Sides of Board

4.2 SCHEMATIC/LOGIC DIAGRAM

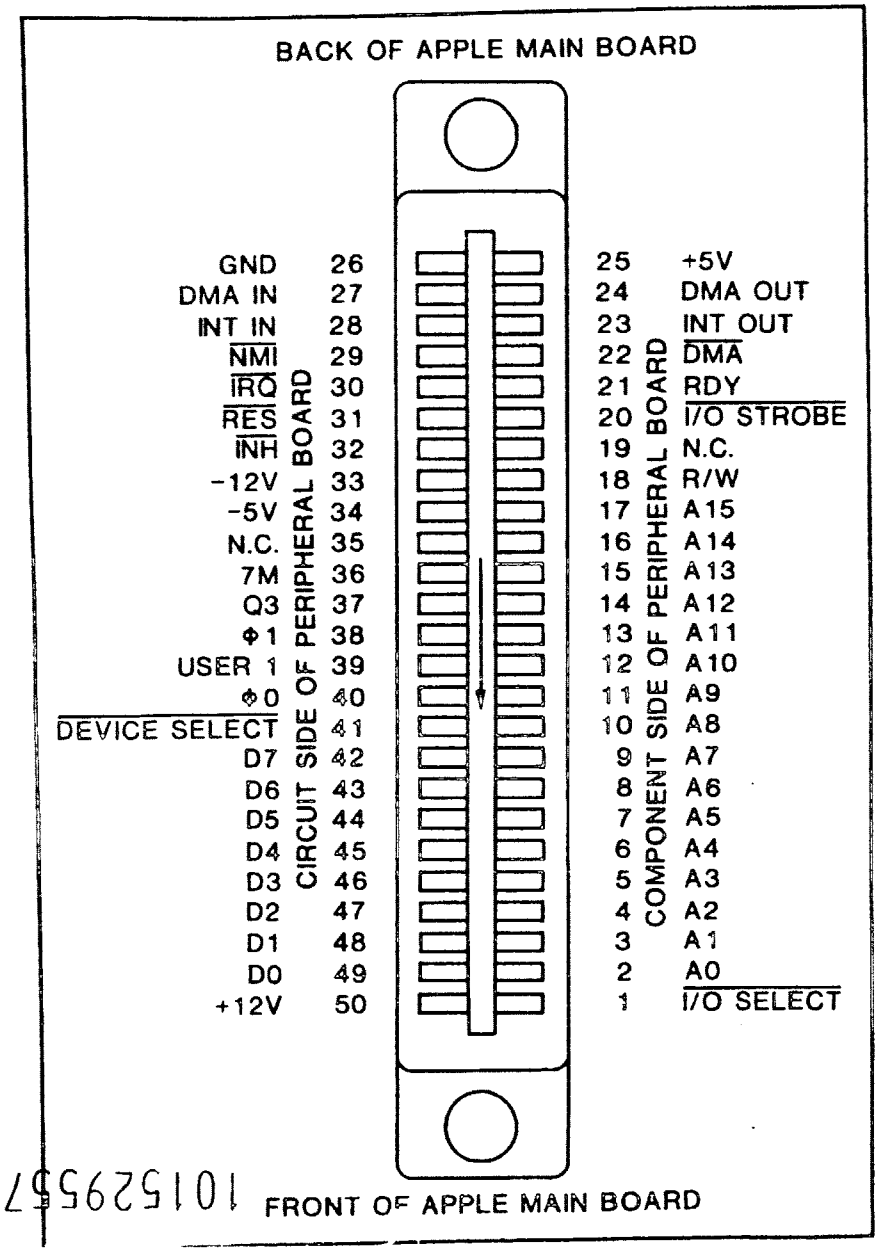


4.3 PARTS LIST

QTY	REF	DESCRIPTION	CCS PART #
Integrated Circuits			
1	U1	2708 2K EPROM, burned	00000-07624
1	U4	DP8304B octal drvr/rcvr	30900-08304
1	U5	5832 clock/calendar	31000-05832
1	U6	74LS74 dual D flip-flop	30000-00074
1	U7	74LS10 tri 3-in NAND	30000-00010
1	U8	74LS273 oct D flip-flop	30000-00273
1	U9	74L309 quad 2-in AND	30000-00009
1	U10	74LS04 hex inverters	30000-00004
Capacitors			
1	C1	33pf, Mica, 500v, 10%	42215-53305
1	C2	5-25pf trimmer	42504-42500
1	C3	.1uf, mono, 50v, 20%	42034-21046
Resistors			
4	R1-3,6	4.7K ohm, 1/4W, 5%	40002-04725
2	R4,5	220 ohm, 1/4W, 5%	40002-02215
1	Z1	4.7K ohm x 7, sip, 20%	40930-74726

QTY	REF	DESCRIPTION	CCS PART #
Sockets			
4	XU6,7, 9,10	14 pin dip	58102-00140
2	XU2,3	16 pin dip	58102-00160
1	XU5	18 pin dip	58102-00180
2	XU4,8	20 pin dip	58102-00200
1	XU1	24 pin dip	58102-00240
Miscellaneous			
2	D1,2	Diode, IN4001-2	37000-41480
1	Q1	Transistor, PNP2907	36100-02907
1	X1	Crystal, 32.768 KHz	48033-27680
8		Hdr, 1 x 2, straight	56004-01002
1		Hdr, 1 x 3, straight	56004-01003
9		Berg jumper plugs	56200-00001
2		Battery clip	60015-00001
2		Battery cup	60015-00002
2		Bat clp insulator ring	60015-00003
2		Bat clp insulator sheet	60015-00004
4		Screw, 6-32 x 5/16 PPH	71006-32051
4		PEM nut,6-32	72606-32250
		Wire, bus, 22 AWG	51000-01220
1		PC Board, 7424 Rev A	07424-00002

4.4 APPLE II I/O CONNECTOR PINOUT



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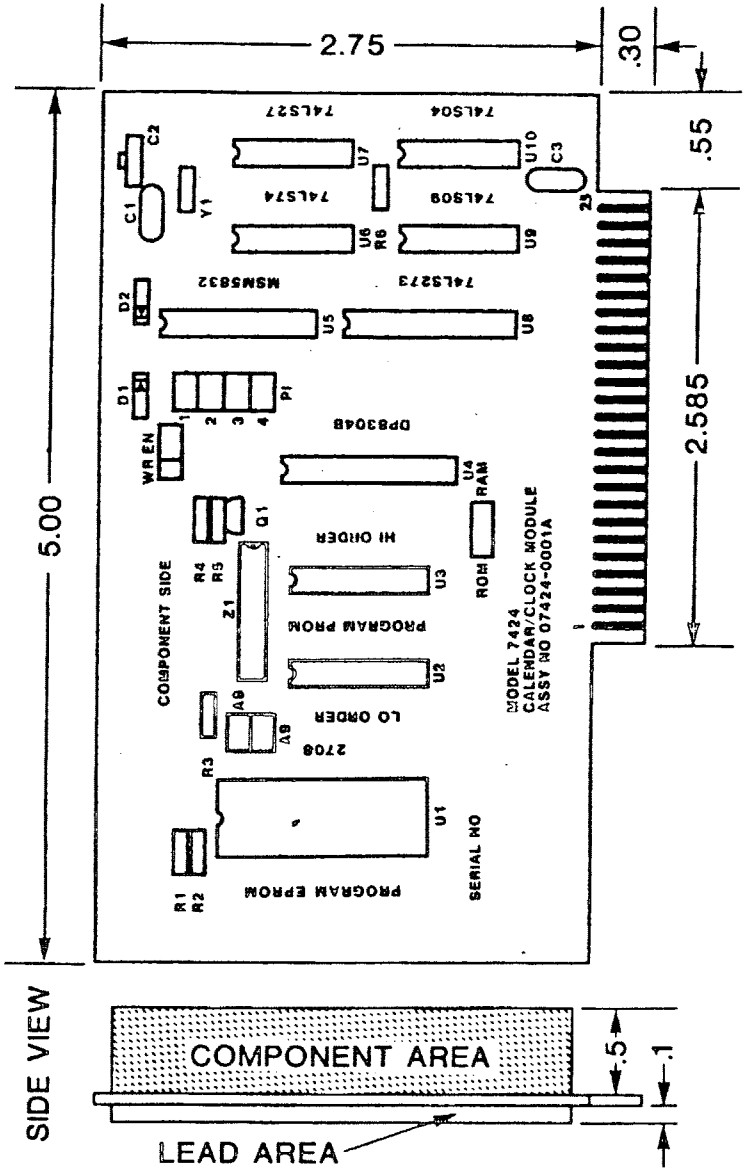
4.5 BOARD DIMENSIONS AND LAYOUT



APPENDIX A

LIMITED WARRANTY

California Computer Systems (CCS) warrants to the original purchaser of its products that its CCS assembled and tested products will be free from materials defects for a period of one (1) year, and be free from defects of workmanship for a period of ninety (90) days.

The responsibility of CCS hereunder, and the sole and exclusive remedy of the original purchaser for a breach of any warranty hereunder, is limited to the correction or replacement by CCS at CCS's option, at CCS's service facility, of any product or part which has been returned to CCS and in which there is a defect covered by this warranty. CCS will correct any defect in materials and workmanship free of charge if the product is returned to CCS within ninety (90) days of original purchase from CCS; and CCS will correct defects in materials in its products and restore the product to an operational status for a labor charge of $25.00, provided that the product is returned to CCS within one (1) year. All such returned products shall be shipped prepaid and insured by original purchaser to:

Warranty Service Department
California Computer Systems
250 Caribbean Drive
Sunnyvale, California
94086

CCS shall have the right of final determination as to the existence and cause of a defect, and CCS shall have the sole right to decide whether the product should be repaired or replaced.

This warranty shall not apply to any product or any part thereof which has been subject to

(1) accident, neglect, negligence, abuse or misuse;

(2) any maintenance, overhaul, installation, storage, operation, or use, which is improper; or

(3) any alteration, modification, or repair by anyone other than CCS or its authorized representative.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED OR STATUTORY INCLUDING THE WARRANTIES OF DESIGN, MERCHANTABILITY, OR FITNESS OR SUITABILITY FOR USE OR INTENDED PURPOSE AND OF ALL OTHER OBLIGATIONS OR LIABILITIES OF CCS. To any extent that this warranty cannot exclude or disclaim implied warranties, such warranties are limited to the duration of this express warranty or to any shorter time permitted by law.

CCS expressly disclaims any and all liability arising from the use and/or operation of its products sold in any and all applications not specifically recommended, tested, or certified by CCS, in writing. With respect to applications not specifically recommended, tested, or certified by CCS, the original purchaser acknowledges that he has examined the products to which this warranty attaches, and their specifications and descriptions, and is familiar with the operational characteristics thereof. The original purchaser has not relied upon the judgement or any representations of CCS as to the suitability of any CCS product and acknowledges that CCS has no knowledge of the intended use of its products. CCS EXPRESSLY DISCLAIMS ANY LIABILITY ARISING FROM THE USE AND/OR OPERATION OF ITS PRODUCTS, AND SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL OR INCIDENTAL OR COLLATERAL DAMAGES OR INJURY TO PERSONS OR PROPERTY.

CCS's obligations under this warranty are conditioned on the original purchaser's maintenance of explicit records which will accurately reflect operating conditions and maintenance preformed on CCS's products and

establish the nature of any unsatisfactory condition of CCS's products. CCS, at its request, shall be given access to such records for substantiating warranty claims. No action may be brought for breach of any express or implied warranty after one (1) year from the expiration of this express warranty's applicable warranty period. CCS assumes no liability for any events which may arise from the use of technical information on the application of its products supplied by CCS. CCS makes no warranty whatsoever in respect to accessories or parts not supplied by CCS, or to the extent that any defect is attributable to any part not supplied by CCS.

CCS neither assumes nor authorizes any person other than a duly authorized officer or representative to assume for CCS any other liability or extension or alteration of this warranty in connection with the sale or any shipment of CCS's products. Any such assumption of liability or modification of warranty must be in writing and signed by such duly authorized officer or representative to be enforceable. These warranties apply to the orginal purchaser only, and do not run to successors, assigns, or subsequent purchasers or owners; AS TO ALL PERSONS OR ENTITIES OTHER THAN THE ORIGINAL PURCHASER, CCS MAKES NO WARRANTIES WHATSOEVER, EXPRESS OR IMPLIED OR STATUTORY. The term "original purchaser" as used in this warranty shall be deemed to mean only that person to whom its product is originally sold by CCS.

Unless otherwise agreed, in writing, and except as may be necessary to comply with this warranty, CCS reserves the right to make changes in its products without any obligation to incorporate such changes in any product manufactured theretofore.

This warranty is limited to the terms stated herein. CCS disclaims all liability for incidental or consequential damages. Some states do not allow limitations on how long an implied warranty lasts and some do not allow the exclusion or limitation of incidental or consequential damages so the above limitations and exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

```
LIST: REM IS 30

5  REM : COPYRIGHT HENFREY ENG &
     DEV LTD, DEC 1981
10  GOTO 22000
805  REM
806  FOR A = 1 TO 100: NEXT A
815 IC = 13
816  PRINT D$;"INC4": INPUT "";TI
     $: PRINT D$;"INC 0":PO =  VAL
     ( MID$ (TI$,10,2))
817 CP = CRP:MC = 13: GOSUB 3900:
     IF CE = 1 THEN 4000
818  HOME : GOTO 21650
820  FOR A = 11 TO 12
827  IF XD = 11 THEN 11000
830  IF A9(10,A) = 13 THEN 900
860 N = A
870  GOSUB 2200:VL(A) = V * A9(7,
     A) + A9(8,A):D9(13,A) =  FN
     R4(VL(A))
880 T(A) = VL(A)
890  GOSUB 2100
900  IF A = 12 THEN 4900
980  GOSUB 2900
982  GOSUB 3900: IF CE = 11 THEN
     3800
985  REM
990  GOSUB 4950
995  GOTO 2400
2100 CU(A) = 13:CD(A) = 13
2101  IF F4(A) = 11 THEN  GOSUB 1
     1050
2103  IF T(A) > A9(12,A) - A9(17,
     A) + DY(A) OR T(A) < A9(12,A
     ) + A9(17,A) + DY(A) THEN 21
     09
2105 DX = (A9(12,A) + DY(A) - T(A
     )) * A9(3,A)
2107 A9(15,A) = A9(15,A) + DX
2109 A9(11,A) = A9(12,A) + A9(15,
     A) + DY(A)
2110  IF A9(17,A) = 13 THEN C1 =
     12: GOTO 2140
2120 C1 = (T(A) - A9(11,A)) / A9(
     17,A)
2125 C1 = 18 * C1 * C1
2130 C1 =  INT (C1)
2140  IF T(A) > A9(11,A) THEN CD(
     A) = C1: GOTO 2150
2145 CU(A) = C1
2150 A9(11,A) = A9(12,A)
2155  RETURN
2200  POKE AI,N - 11
2210 V =  PEEK (AI + 11) * 256 +
      PEEK (AI)
2220  RETURN
2400 U = 13:C1 = 11: FOR D = 11 TO
```

```
3005  VTAB 23
3010  INPUT "RECALIBRATE? (0=NO,1
      =YES)      ";F
3015  VTAB 21: CALL    958: VTAB
      3: CALL    868
3020  IF F = 1 THEN  GOTO 2700
3030  IF F = 3 THEN  GOTO 2705
3040  GOTO 3000
3050  HOME : VTAB 5
3055 PREN$(EX) = ""
3060  PRINT "CHANNEL "EX" NAME ?
      ";: INPUT "";EN$(EX)
3070 EN$(EX) =  LEFT$ (EN$(EX),9)

3080  RETURN
3100 N = A
3110  GOSUB 2200:VL(A) = V * A9(7
      ,A) + A9(8,A):D9(E3,A) =  FN
      R4(VL(A))
3120  GOTO 980
3150  GOTO 3225
3155 B8 = 1
3160  FOR A2 = 1 TO 12
3170  IF A9(10,A2) = E3 THEN  GOTO
      3210
3175 B8 = B8 + 1
3185  IF  LEN (EN$(A2))  5 THEN
      PREN$(A2) = EN$(A2)
3190  IF  LEN (EN$(A2))  4 AND P
      REN$(A2) = "" THEN  GOSUB 35
      00
3200 A9(11,A2) = A9(10,A2)
3210  NEXT
3215  IF SR = 5 THEN  RETURN
3220  HOME : PRINT "PRINTER INITI
      ALIZED": PRINT : PRINT : GOTO
      3254
3225  HOME : PRINT "TO INITIALIZE
       PRINTER SELECT": PRINT
3227  PRINT "INITIALIZATION": PRINT
      : PRINT
3230  PRINT "TO ALTER ANY OF THE
      PRINTER VARIABLES": PRINT
3235  PRINT "SELECT RESET": PRINT
      : PRINT
3237  PRINT "      0 = NO ACTION":
       PRINT
3240  PRINT "      1 = INITIALIZE
      PRINTER": PRINT
3245  IF XP = 1 THEN  PRINT "
       2 = RESET PRINTER": PRINT
3246  INPUT "? ";SR
3247  IF SR = 0 THEN  GOTO 22250
3248  IF SR = 2 THEN  GOTO 5350
3249  IF SR = 1 THEN  GOTO 3155
3250  GOTO 3225
3254 XC = E3:XP = 1
3255  FOR A2 = 1 TO 12
3260  IF XC = 9 THEN  GOTO 3350
3270  IF A9(11,A2) = E3 THEN  GOTO
      3320
3290  PRINT XC"      "PREN$(A2)
3300  PRINT
3310 XC = XC + 1
3320  NEXT
3330  GOTO 3410
3350  VTAB 4
3355  FOR A3 = A2 TO 12
```

```
3350  VTAB 4
3355  FOR A3 = A2 TO F2
3360  IF A9(11,A3) = F3 THEN  GOTO
      3400
3370  PRINT ,XC"      "PREN$(A3)
3380  PRINT
3390 XC = XC + F1
3400  NEXT
3405  VTAB 21
3410 XM = F1: INPUT "PRINT INTERV
      AL (MIN) ? ";CBC: IF CBC = F
      3 THEN  CALL    960: VTAB 21
      : INPUT "PRINT INTERVAL (CYC
      LES) ? ";CBC:XM = CBC
3411  PRINT : INPUT "CYCLE IDENTI
      FICATION ? ";CI$
3412  HOME : VTAB 4:SR = F3
3414  PRINT D$;"PR#1": PRINT  CHR$
      (27) CHR$ (69): PRINT "ELECT
      ROLUX MICROCOMPUTER CONTROLL
      ED FERMENTATION": PRINT
3416  PRINT  CHR$ (27) CHR$ (70):
      GOSUB 5600
3417  PRINT  CHR$ (18): IF BB = 1
      0 THEN  PRINT  CHR$ (15)
3418  PRINT  SPC( 6);: FOR A2 = F
      1 TO F2
3419  IF A9(11,A2) = F3 THEN  GOTO
      3427
3424  PRINT PREN$(A2);
3425  PRINT  SPC( 5 -  LEN (PREN$
      (A2)));
3427  NEXT A2
3428  IF SR = F1 THEN  RETURN
3429 F$ = ""
3430  PRINT  CHR$ (13)
3435  GOSUB 4350
3437  PRINT D$;"PR#0"
3440  GOTO 22250
3500  HOME : VTAB 5
3505  PRINT "ENTER ABBREVIATED NA
      ME FOR "
3510  PRINT
3520  PRINT "      "EN$(A2)
3523  PRINT
3525  INPUT PREN$(A2)
3527 PREN$(A2) =  LEFT$ (PREN$(A2
      ),4)
3530  RETURN
3650  VTAB 23
3672  PRINT D$;"IN#4": INPUT "";T
      I$: PRINT D$;"IN#0";TP$ =  MID$
      (TI$,7,5): VTAB 21
3673 BUFF$ = TP$ + " "
3675  FOR A4 = F1 TO F2
3680  IF A9(11,A4) = F3 THEN 3710

3685 BUFF$ = BUFF$ +  STR$ (D2(F3
      ,A4))
3700  FOR A6 = F1 TO 5 -  LEN ( STR$
      (D2(F3,A4))):BUFF$ = BUFF$ +
      " ": NEXT
3710  NEXT
3720  PRINT D$;"PR#1": PRINT BUFF
      $: PRINT D$;"PR#0"
3730  REM
3740 CP = F3:PN = TM
3750  VTAB 21: CALL    950
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3740 CD = I3:FN = TM
3750  VTAB 21: CALL - 950
3770  RETURN
3800  HOME : VTAB 3: PRINT "STOPP
      ED"
3810  FOR A = I1 TO I2:CU(A) = 0:
      CD(A) = 0: NEXT A
3820  FOR XX = 1 TO 400: NEXT XX
3840  GOTO 9020
3900 CE = I1
3910  IF  PEEK ( - 16287) > 127 THEN
      CE = I3
3920  RETURN
4000  HOME : VTAB 3
4010  PRINT "WAITING FOR RUN BUTT
      ON"
4020  VTAB 10
4030  PRINT "TO RETURN TO MAIN ME
      NU WITHOUT"
4040  VTAB 12
4050  PRINT "STARTING RUN PRESS R
      ETURN": VTAB 23
4060  GOSUB 3900: IF CE = I3 THEN
      818
4070 A3 =  PEEK (  16384): POKE
       - 16368,0
4080  IF A3 > 127 THEN  GOTO 3800

4090  GOTO 4060
4350  REM
4351 A5 = I3
4352  FOR A6 = 1 TO 8
4355  ON A6 GOSUB 4440,4450,4460,
      4470,4480,4490,4500,4510
4357 A8 =  I1
4360  FOR A7 = I1 TO I2
4370  IF A9(11,A7) = I3 THEN  GOTO
      4410
4372 A8 = A8 + I1
4380  PRINT D9(A6,A7);
4400  PRINT  SPC( 5 -  LEN ( STR$
      (D9(A6,A7))))
4410  NEXT
4420  PRINT F$
4425  NEXT
4431  PRINT :SR = I1: GOSUB 3417:
      SR = I3: PRINT
4432  VTAB 20
4436  RETURN
4440  PRINT "SP     ";: RETURN
4450  PRINT "P      ";: RETURN
4460  PRINT "I      ";: RETURN
4470  PRINT "IO     ";: RETURN
4480  PRINT "LIMIT ";: RETURN
4490  PRINT "SLOPE ";: RETURN
4500  PRINT "CAL A ";: RETURN
4510  PRINT "CAL B ";: RETURN
4550  VTAB 4: PRINT  SPC( 75);
4560  VTAB 4: RETURN
4600  HOME
4610  PRINT "STORE PLACES ALL OF
      THE INITIALIZATION"
4620  PRINT : PRINT "VALUES OF AL
      L OF THE CURRENTLY SELECTED"

4630  PRINT : PRINT "PARAMETERS O
      N TAPE"
4640  PRINT : PRINT : PRINT
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41 TAPE"
4640  PRINT : PRINT : PRINT
4650  PRINT "RECALL RETRIEVES THE
      INITIALIZATION"
4660  PRINT : PRINT "VALUES AT TH
     E CURRENT TAPE POSITION"
4670  PRINT : PRINT : PRINT
4673  PRINT "0 = RETURN TO MAIN M
     ENU"
4677  PRINT
4680  PRINT "1 = STORE (RECORDER
     IN RECORD MODE)"
4690  PRINT
4700  PRINT "2 = RECALL (RECORDER
      IN PLAY MODE)"
4710  PRINT : INPUT AB
4720  IF AB = K1 THEN  GOSUB 4800

4730  IF AB = 2 THEN  GOSUB 4850
4740  IF AB = K3 THEN 22250
4750  IF AB <  > 0 AND AB <  > K1
      AND AB <  > 2 THEN  GOTO 46
     00
4760  RETURN
4800  STORE A%: RETURN
4850  RECALL A%: GOSUB 4250: RETURN

4900  REM
4905  VTAB 23: PRINT D$;"INE4": INPUT
     "";TI$: PRINT D$;"IN£0"
4910 TM =  VAL ( MID$ (TI$,10,2))

4912  IF TM <  > PQ THEN MC = MC +
     1:PQ = TM
4913  IF XP = K3 THEN 980
4914  IF XM = K3 THEN 4930
4915  IF TM - PN < K3 THEN PN = P
     N - 60
4920  IF TM - PN >  = CBP THEN  GOSUB
     3650
4925  GOTO 980
4930 CP = CP + K1
4935  IF CP >  = CBP THEN  GOSUB
     3650
4940  GOTO 980
4950  PR£ 4: IN£ 4
4953  VTAB 22: INPUT "";TI$
4955 T =  VAL ( MID$ (TI$,13,2))
4960  IF T = K3 AND TN = 59 THEN
     TN =  - K1
4970  IF T = TN THEN 4953
4980 TN = T
4992  IN£ 0: PR£ 0: CALL 1002
4995  VTAB K1: HTAB K1: CALL  - 8
     68: PRINT A: RETURN
5350  REM
5355  HOME : PRINT "PRINTER"
5357  VTAB 6
5360  PRINT "      0 = NO": PRINT

5370  PRINT "      1 = PRINTER OFF
     ": PRINT
5380  PRINT "      2 = ALTER PRINT
      INTERVAL": PRINT
5390  PRINT "      3 = TERMINATE A
      CHANNEL": PRINT
5395  PRINT "      4 = REPRINT INI
     TIALIZATION VALUES": PRINT
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5395  PRINT "     4 = REPRINT INI
      TIALIZATION VALUES": PRINT
5397  PRINT "     5 = RE INITIALI
      ZE PRINTER HEADINGS": PRINT

5400  VTAB 3: INPUT "DO YOU WISH
      TO MAKE ALTERATIONS ? ";SR
5410  IF SR = 3 THEN 22250
5412  VTAB 3: CALL     868: VTAB 2
      3
5415  ON SR GOTO 5420,5430,5440,5
      500,5650
5420 XP = 3: GOTO 22250
5430 XM = 1: INPUT "NEW PRINTER
      INTERVAL (MINS)    ";CBP: IF
      CBP = 3 THEN  VTAB 23: CALL
       - 958: INPUT "NEW PRINT INT
      ERVAL (CYCLES)   ";CBP:XM = 3
5435  GOTO 5450
5440  INPUT "STOP PRINTING CHANNE
      L NO. ? ";SR:A9(11, INT (SR)
      ) = 3: VTAB 23: CALL  - 958
      : VTAB 3: INPUT "ANY FURTHER
       ALTERATIONS ? ";SR: GOTO 54
      10
5450  HOME : PRINT D$:"PR#1": PRINT
      : PRINT "PRINT INTERVAL  ";C
      BP;: IF XM = 1 THEN  PRINT
      " MINS"
5460  IF XM = 3 THEN  PRINT " CY
      CLES"
5470  PRINT :SR = 1: GOSUB 3417:
       PRINT  CHR$ (10): PR# 0: CALL
      1002: GOTO 22250
5500 A9(11,3) = A9(11,1): HOME
      : PRINT D$;"PR#1": GOTO 3417

5560  PRINT : INPUT "CYCLE IDENTI
      FICATION ? ";CI$: RETURN
5600  PRINT D$;"IN#4": INPUT "";T
      I$: PRINT D$;"IN#0"
5605  PRINT "DATE "; LEFT$ (TI$,5
      ): PRINT
5610  PRINT "CYCLE ID : ";CI$: PRINT

5620  PRINT "PRINT INTERVAL : ";C
      BP;: IF XM = 1 THEN  PRINT
      " MINS"
5625  IF XM = 3 THEN  PRINT " CY
      CLES"
5627  IF BB = 13 THEN  PRINT  CHR$
      (15)
5630  PRINT : RETURN
5650  GOSUB 3155: GOTO 5500
9000  IF  PEEK (222) = 77 THEN  CALL
      768
9010  IF  PEEK (222) = 16 THEN  VTAB
      20: FLASH : PRINT "DISK ERRO
      R";: NORMAL : CALL     868: VTAB
      1: GOTO 20545
9020  FOR A = 1 TO 4: POKE D2(A),
      3: NEXT
9030  GOTO 22250
10050  GOSUB 3900: IF CF = 1 THEN
      23400
10700  IF E2 = 10 THEN  GOSUB 109
      00
```

```
10700  IF E2 = 10 THEN GOSUB 109
       00
10710  IF E4 = F1 THEN E3 = F3
10720 E3 = E3 + F1:E4 = F3
10730  IF TM - PD < E3 THEN PD =
       PD - 60
10740  IF TM - PD >= E1 THEN E4
       = F1:E2 = E2 + F1:PD = TM
10750  GOTO 830
10900  PRINT D$;"APPEND";EDISC$
10910  PRINT D$;"WRITE";EDISC$
10920  FOR A1 = F3 TO F8
10925  IF A9(10,A1) = F3 THEN 107
       60
10930  FOR A2 = F1 TO 10
10940  PRINT E8(A1,A2)
10950  NEXT A2
10960  NEXT A1
10970  PRINT D$;"CLOSE";EDISC$
10980 E2 = F3
10990  RETURN
11000  IF A9(10,A) = F3 THEN 1102
       0
11005 E9(A) = E9(A) + D9(E3,A)
11010  IF E4 = F1 THEN E8(A,E2) =
       E9(A) / E3:E9(A) = F3
11020  IF A = 8 THEN 10700
11030  GOTO 830
11050  IF MC > F6(A) THEN 11065
11055  IF F6(A) = F5(A) THEN 1106
       5
11060 A9(12,A) = F7(A) + (MC - F5
       (A)) * F3(A): RETURN
11065  IF E9(2,F2(A) + F1,A) = F3
       THEN 11080
11070  IF MC > E9(F1,F2(A) + F1,A
       ) THEN 11090
11080 A9(12,A) = F8(A): RETURN
11090 F2(A) = F2(A) + F1
11100 F5(A) = E9(F1,F2(A),A)
11110 F6(A) = E9(3,F2(A),A)
11120 F7(A) = E9(F7,F2(A),A)
11130 F8(A) = E9(4,F2(A),A)
11133  IF F5(A) = F6(A) THEN 1105
       0
11135 F3(A) = (F8(A) - F7(A)) / (
       F6(A) - F5(A))
11140  GOTO 11050
20050  GOSUB 20250: HOME : PRINT
       "TIME ";TI$
20060  PRINT : PRINT "DO YOU WISH
       TO MAKE ALTERATIONS"
20070  PRINT : PRINT : PRINT "0 =
       NO"
20080  PRINT : PRINT "1 = CHANGE
       MONTH"
20090  PRINT : PRINT "2 = CHANGE
       DAY"
20100  PRINT : PRINT "3 = CHANGE
       HOUR"
20110  PRINT : PRINT "4 = CHANGE
       MINUTE"
20120  VTAB 3: HTAB 23: INPUT "
       ";S
20130  IF S * (S - 1) * (S - 2) *
       (S - 3) * (S - 4) <> 0 THEN
       VTAB 3: CALL -868: GOTO 2
       0120
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      VTAB 3: CALL    868: GOTO 2
      0170
20140 IF S = 0 THEN 22250
20150 VTAB 3: CALL    868: VTAB
      22
20160 ON S GOSUB 20200,20270,202
      60,20290
20170 VTAB 22: GOSUB 20350: VTAB
      22: CALL    - 950: VTAB 1: HTAB
      6: PRINT TI$: VTAB 3: INPUT
      "ANY FURTHER ALTERATIONS ? "
      ;S: GOTO 20130
20200 INPUT "ENTER CORRECT MONTH
      (1 12) ";A$: IF  VAL (A$) >
      12 THEN 20200
20210 GOSUB 20400: IF A1 = 1000 THEN
      20200
20220 POKE BASE + 1,57: POKE BAS
      E,A1: POKE BASE + 1,58: POKE
      BASE,A2: RETURN
20230 INPUT "ENTER CORRECT DAY (
      1-31) ";A$: IF  VAL (A$) > 3
      1 THEN 20230
20240 GOSUB 20400: IF A1 = 1000 THEN
      20230
20250 POKE BASE + 1,55: POKE BAS
      E,A1: POKE BASE + 1,56: POKE
      BASE,A2: RETURN
20260 INPUT "ENTER CORRECT HOUR
      (1 24) ";A$: IF  VAL (A$) >
      24 THEN 20260
20270 GOSUB 20400: IF A1 = 1000 THEN
      20260
20280 A2 = A2 + 8: POKE BASE + 1,
      52: POKE BASE,A1: POKE BASE +
      1,53: POKE BASE,A2: RETURN
20290 INPUT "ENTER CORRECT MINUT
      E (0-59) ";A$: IF  VAL (A$)
      59 THEN 20290
20300 GOSUB 20400: IF A1 = 1000 THEN
      20290
20310 POKE BASE + 1,50: POKE BAS
      E,A1: POKE BASE + 1,51: POKE
      BASE,A2: RETURN
20350 D$ = "": PRINT D$;"IN£4": INPUT
      TI$: PRINT D$;"IN£0":TI$ = LEFT$
      (TI$,11): RETURN
20400 A1 =  LEN (A$)
20410  IF A1 = 1 THEN A2 = 0:A1 =
       VAL (A$): RETURN
20420  IF A1 = 2 THEN A2 =  VAL (
       LEFT$ (A$,1)):A1 =  VAL ( RIGHT$
      (A$,1)): RETURN
20470 A1 = 1000:A2 = 1000: RETURN

20500 HOME : PRINT "DISK"
20510 VTAB 6: PRINT "0 = RETURN
      TO MAIN MENU"
20515 PRINT : PRINT "1 = STORE A
      LL PARAMETER VALUES"
20520 PRINT : PRINT "2 = RETRIEV
      E ALL PARAMETER VALUES"
20530 PRINT : PRINT "3 = LOG FUN
      CTION"
20540 PRINT : PRINT "4 = INSPECT
       FILES ON THIS DISK"
20543 PRINT : PRINT "5 = DELETE
      FILE ON THIS DISK"
```

```
20543 :PRINT-: PRINT "5 = DELETE
      FILE ON THIS DISK"
20545  VTAB 3: INPUT "SELECT REQU
      IREMENT ";EY
20550 EY =  INT (EY)
20560  IF EY = 0 THEN 22250
20565  IF EY = 3 THEN 23050
20570  IF EY = 4 THEN 20870
20575  IF EY = 5 THEN 20900
20580  IF (EY   F1) * (EY   F7)
       F3 THEN 20500
20590  VTAB 3: CALL    868
20600  IF EY = 2 THEN 20760
20610  VTAB 3: PRINT "PARAMETER S
      TORAGE"
20620  VTAB 20: INPUT "FILE NAME
      ? ";NAME$
20630  PRINT D$;"OPEN";NAME$
20640  PRINT D$;"WRITE";NAME$
20650  FOR B6 = F1 TO F2
20660  FOR B7 = 1 TO 13
20670  PRINT A9(B7,B6)
20680  NEXT
20690  NEXT
20700  FOR B6 = 1 TO 16
20710  PRINT EN$(B6): PRINT PREN$
      (B6)
20730  NEXT
20735  FOR B6 = F1 TO 8: FOR B7 =
      F1 TO F2: PRINT D9(B6,B7): NEXT
      : NEXT
20740  PRINT D$;"CLOSE";NAME$
20750  GOTO 22250
20760  VTAB 3: PRINT "PARAMETER R
      ETRIEVAL"
20770  VTAB 20: INPUT "FILE NAME
      ? ";NAME$
20780  PRINT D$;"OPEN";NAME$
20790  PRINT D$;"READ";NAME$
20800  FOR B6 = F1 TO F2
20810  FOR B7 = F1 TO 13
20820  INPUT "";A9(B7,B6)
20825  NEXT
20830  NEXT
20832  FOR B6 = 1 TO 16
20834  INPUT "";EN$(B6)
20836  INPUT "";PREN$(B6)
20838  NEXT
20839  FOR B6 = F1 TO 8: FOR B7 =
      F1 TO F2: INPUT "";D9(B6,B7)
      : NEXT : NEXT
20840  PRINT D$;"CLOSE";NAME$
20850  REM
20860  GOTO 22250
20870  HOME : PRINT D$;"CATALOG"
20880  PRINT : INPUT "PRESS RETUR
      N TO GO BACK TO DISK";EY$
20890  GOTO 20500
20900  VTAB 3: CALL    868: PRINT
      "DELETE FILE"
20910  VTAB 20: INPUT "FILE NAME
      ? ";NAME$
20920  PRINT D$;"DELETE";NAME$
20930  GOTO 20500
21000  REM
21105 FT$(1) = "SET POINT"
21110 FT$(2) = "P. BAND"
21115 FT$(3) = "I (RATE)"
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21110 FT$(2) = "F. BAND"
21115 FT$(3) = "I (RATE)"
21120 FT$(4) = "I (VALUE)"
21125 FT$(5) = "LIMIT"
21130 FT$(6) = "SLOPE"
21170  RETURN
21600  REM
21610  FOR A6 = 1 TO 2: FOR A7 =
       1 TO 12:D9(A6,A7) =  FN R4(
       A9(A6,A7)): NEXT : NEXT
21620  RETURN
21650  VTAB 3: PRINT "PARAMETER V
       AL  S.F. ";: INVERSE : PRINT
       "PARAMETER VAL  S.F.": FOR A
        = 4 TO 21: HTAB 21: VTAB A:
        PRINT  SPC( 19): NEXT : NORMAL

21655 A9(10,13) = A9(10,11)
21655  HTAB 1
21660  FOR A = 11 TO 8
21670  IF A9(10,A) = 13 THEN 2169
       0
21680  VTAB A * 2 + 4: PRINT EN$(
       A)
21690  NEXT
21695  INVERSE
21700  FOR A = 9 TO 12
21710  IF A9(10,A) = 13 THEN 2173
       0
21720  VTAB A + A   12: HTAB 21: PRINT
       EN$(A)
21730  NEXT
21735  NORMAL
21740  GOTO 820
22000  ONERR  GOTO 9000
22010  DEF  FN R4(X) =  VAL ( LEFT$
       ( STR$ (X),4))
22030  HOME : VTAB 3: PRINT "ELEC
       TROLUX MICROCOMPUTER CONTROL
       LED": PRINT : PRINT : PRINT
        SPC( 12)"FERMENTATION"
22040  GOSUB 21000
22050  FOR N = 0 TO 9: READ DA: POKE
       (768 + N),DA: NEXT
22060  DATA 104,160,104,166,223,1
       54,72,152,72,96
22145  DIM D9(4,11,16): DIM D2(16
       ): DIM D3(16): DIM D5(16): DIM
       D6(16): DIM D7(16): DIM D8(1
       6)
22150  DIM EN$(16): DIM CU(16): DIM
       CD(16): DIM D9(12,16): DIM T
       (16): DIM D4(16)
22155  DIM E8(16,10): DIM E9(16)
22160  DIM VL(16): DIM PRC(16): DIM
       PREN$(16): DIM VL$(16): DIM
       A9(14,16): DIM OY(16)
22170 I1 = 1:I2 = 16:I3 = 0:I4 =
       768:I5 = 808:I6 = 224:I7 = 2
       :I8 = 15:I9 = 14:I0 = 7:IA =
       10:IB = 12:IC = 13:ID = 3:IE
        = 4:IF = 5
22180 BASE =    16256 + (16 * 4)
22185 AI =    16224
22187 DI =    15616:HC =    16176
       : POKE HC,0: POKE DI + 3,255
       : POKE DI + 2,255: POKE DI +
       17,255: POKE DI + 18,255: POKE
```

```
:POKE DI + 3,255: POKE DI +
19,255: POKE DI + 18,255: POKE
HC,15
22180 B2(1) = DI + 1:B2(3) = DI:B
2(2) = DI + 17:B2(4) = DI +
16
22190 D$ = "":F$ = ""
22250  HOME : PRINT "SELECT REQUI
REMENT": PRINT
22260  PRINT "0 = RUN": PRINT
22270  FOR A = 1 TO 8: IF A9(10,A
) = 1 THEN  INVERSE
22285  IF A = F3 THEN  NORMAL
22290  HTAB 2: PRINT A;: NORMAL :
PRINT " = "EN$(A): PRINT : NEXT

22300  VTAB 5
22310  FOR A = 9 TO 16: IF A9(10,
A) = 1 THEN  INVERSE
22320  HTAB 22: PRINT A;: NORMAL
: PRINT " = "EN$(A): PRINT :
NEXT
22350  VTAB 23: PRINT  SPC( 1)"20
= CLOCK"
22360  VTAB 21: HTAB 2: IF XP = 1
THEN  INVERSE
22370  PRINT "18";: NORMAL : PRINT
" = PRINTER" TAB( 22)"21 = D
ISK";
22380  VTAB 1: HTAB 20: INPUT " ?
";EX
22390  IF EX = 18 THEN 3150
22400  IF EX = 20 THEN 20050
22420  IF EX = 21 THEN 20500
22430  IF EX < 0 OR EX > 16 THEN
22250
22440 EX =  INT (EX)
22450  IF EN$(EX) = "" AND EX > 0
THEN  GOSUB 3050
22460  IF EX = 0 THEN  HOME : GOTO
22520
22470 A9(10,EX) = 1
22510  GOTO 22800
22520 B9 = 0: FOR B5 = 1 TO 15: IF
A9(10,B5) = 1 THEN B9 = B9 +
1
22530  NEXT B5: GOTO 805
22540  VTAB 23: PRINT D$;"IN#4": INPUT
T1$: PRINT D$;"IN#0"
22800  HOME :D9(4,EX) =  FN R4(A9
(4,EX))
22810  PRINT EN$(EX)
22820  VTAB 6: PRINT "0 = NO"
22830  PRINT
22850  VTAB 8: FOR A6 = 1 TO 4: PRINT
A6" = "FT$(A6) TAB( 15)"("D9
(A6,EX)")": PRINT : NEXT
22860  VTAB 8: HTAB 24: PRINT "5
= CALIBRATE"
22870  VTAB 10: HTAB 24
22880  PRINT "6 = CANCEL"
22890  VTAB 16: HTAB 24: PRINT "9
= TIME"
22895  VTAB 18: HTAB 24: PRINT "1
0 = DISPLAY"
22900  VTAB 14: HTAB 24: PRINT "8
= ALARM"
22910  VTAB 12: HTAB 24: PRINT "7
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```
= ALARM"
22910  VTAB 12: HTAB 24: PRINT "7
= RENAME"
22915  VTAB 3: INPUT "DO YOU WISH
TO MAKE ALTERATIONS ? ";S
22920  IF S = 0 THEN 22750
22930  VTAB 3: CALL - 868: VTAB
22
22940 S =  INT (S)
22950  IF S < 1 OR S > 12 THEN 2
2990
22960  PRINT "ENTER NEW "F1$(S)::
 INPUT " ? ";A9(S,EX): IF S =
1 THEN A9(12,EX) = A9(11,EX
)
22970 D9(S,EX) =  FN R4(A9(S,EX))
: VTAB 6 + 2 * S: HTAB 16: PRINT
 SPC( 7):: HTAB 16: PRINT D9
(S,EX)")"
22975  IF S = 1 THEN F4(EX) = 0
22980 N = EX: GOTO 23020
22990  IF S = 5 THEN  GOSUB 2700
23000  IF S = 6 THEN A9(10,EX) =
0:A9(11,EX) = 0:EN$(EX) =
"":CU(EX) = 0:CD(EX) = 0: GOTO
22250
23005  IF S = 9 THEN  GOSUB 23200

23007  IF S = 10 THEN 23800
23010  IF S = 7 THEN  GOSUB 3055:
VTAB 1: CALL - 868: PRINT
EN$(EX)
23020  VTAB 21: CALL  - 958: VTAB
3: INPUT "ANY FURTHER ALTERA
TIONS ? ";S: GOTO 22920
23030  REM
23040  GOTO 805
23050  HOME : PRINT "LOG FUNCTION
": VTAB 6: PRINT "0 = RETURN
": PRINT : PRINT "1 = LOG DA
TA": PRINT : PRINT "2 = CANC
EL"
23055  VTAB 3: INPUT "SELECT REQU
IREMENT ? ";A1:A1 =  INT (A1
)
23060  ON A1 + 1 GOTO 23080,2309
0,23150
23070  GOTO 23055
23080  GOTO 22250
23090  VTAB 3: CALL  - 868
23100  VTAB 20: INPUT "COLLATION
INTERVAL ? ";E1
23110  VTAB 22: INPUT "FILE NAME
? ";EDISC$
23120  VTAB 20: CALL  - 958
23125  PRINT D$;"OPEN";EDISC$: PRINT
D$"WRITE";EDISC$: PRINT E1: FOR
A1 = 0 TO 8: PRINT A9(10,A
1): NEXT A1: PRINT D$;"CLOSE
";EDISC$
23130 XDISC = 0
23140  GOTO 22250
23150 XDISC = 3: GOTO 22250
23200  REM
23205  HOME : PRINT EN$(EX)" TIME
PROFILING"
23210  PRINT : PRINT  SPC( 15)"FR
OM" SPC( 5)"TO"
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23210  PRINT : PRINT  SPC( 15)"FR
     OM" SPC( 5)"TO"
23220  FOR A = 1 TO 10
23225  PRINT "CHANGE ";A;: INVERSE

23230  PRINT " TIME": TAB( 16): INT
     (F9(1,A,EX) / 60);":";F9(1,A,E
     X)  60 *  INT (F9(1,A,EX) /
     60): TAB( 25): INT (F9(3,A,E
     X) / 60);":";F9(3,A,EX)  60 *
      INT (F9(3,A,EX) / 60)
23235  NORMAL
23237  IF J1 = 1 THEN 23337
23240  PRINT "          VALUE"; TAB(
     16);F9(2,A,EX): TAB( 25);F9(
     4,A,EX)
23250  NEXT A
23260  INVERSE : PRINT "11 = SAVE
      PROFILE  12 = RECALL PROFIL
     E";: NORMAL
23270  VTAB 2: HTAB 1: INPUT "SEL
     ECT CHANGE (0 = NO CHANGE) "
     ;A1: VTAB 2: CALL  - 868:A =
      INT (A1): IF A1 > 12 OR A1 <
     0 THEN 23270
23280  IF A1 = 0 THEN 23370
23282  IF A = 11 THEN 23500
23285  IF A = 12 THEN 23650
23290  VTAB 2 * A + 2
23295  INVERSE
23300  HTAB 16: INPUT "";A2$: INVERSE

23310 F9(1,A,EX) = 60 *  VAL ( LEFT$
     (A2$,2)) +  VAL ( RIGHT$ (A2
     $,2))
23320  VTAB 2 * A + 2: HTAB 25: INPUT
     "";A2$
23330 F9(3,A,EX) = 60 *  VAL ( LEFT$
     (A2$,2)) +  VAL ( RIGHT$ (A2
     $,2))
23332  VTAB 2 * A + 2: CALL  - 86
     8
23333  NORMAL
23335 J1 = 1: GOTO 23225
23337 J1 = 0
23340  HTAB 16: INPUT "";F9(2,A,E
     X)
23350  VTAB 2 * A + 3: HTAB 25: INPUT
     "";F9(4,A,EX)
23360  GOTO 23270
23370 F5(EX) = F9(F1,J1,EX):F7(EX
     ) = F9(F2,F1,EX):F6(EX) = F9
     (3,F1,EX):F8(EX) = F9(4,F1,E
     X):F4(EX) = F1
23371  IF F6(EX) = F5(EX) THEN 23
     375
23372 F2(EX) = F1
23374 F3(EX) = (F8(EX)  F7(EX)) /
     (F6(EX)  F5(EX))
23390  GOTO 22800
23500  VTAB 2: CALL  - 958: PRINT

23510  PRINT "PROFILE STORAGE"
23520  PRINT : INPUT "FILE NAME ?
     ";FILE$
23530  PRINT D$;"OPEN"FILE$
23540  PRINT D$;"WRITE"FILE$
23550  FOR A1 = 1 TO 10
23560  FOR A = 1 TO 4
```

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23540  PRINT D$;"WRITE"FILE$
23550  FOR A1 = 1 TO 10
23560  FOR A = 1 TO 4
23570  PRINT F9(A,A1,EX)
23580  NEXT A
23590  NEXT A1
23600  PRINT D$;"CLOSE"FILE$
23610  GOTO 23200
23650  VTAB 2: CALL     958: PRINT

23660  PRINT "PROFILE RETRIEVAL"
23670  PRINT : INPUT "FILE NAME "
      ";FILE$
23680  PRINT D$;"OPEN";FILE$
23690  PRINT D$;"READ";FILE$
23700  FOR A1 = 1 TO 10
23710  FOR A = 1 TO 4
23720  INPUT "";F9(A,A1,EX)
23730  NEXT A
23740  NEXT A1
23750  PRINT D$;"CLOSE"FILE$
23760  GOTO 23200
23800  VTAB 7: CALL   - 860: PRINT
     "PRESS RETURN TO PROCEED": VTAB
     22: PRINT "VALUE"
23810  VTAB 22:N = EX: GOSUB 2200
     :T(EX) =  FN R4(V * A9(7,EX)
      + A9(0,EX)): VTAB 22: HTAB
     7: PRINT T(EX)"          "
23820 A3 =  PEEK ( - 16384): POKE
     - 16368,0
23830  IF A3 < 128 THEN 23810
23845  GOTO 23020
```

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