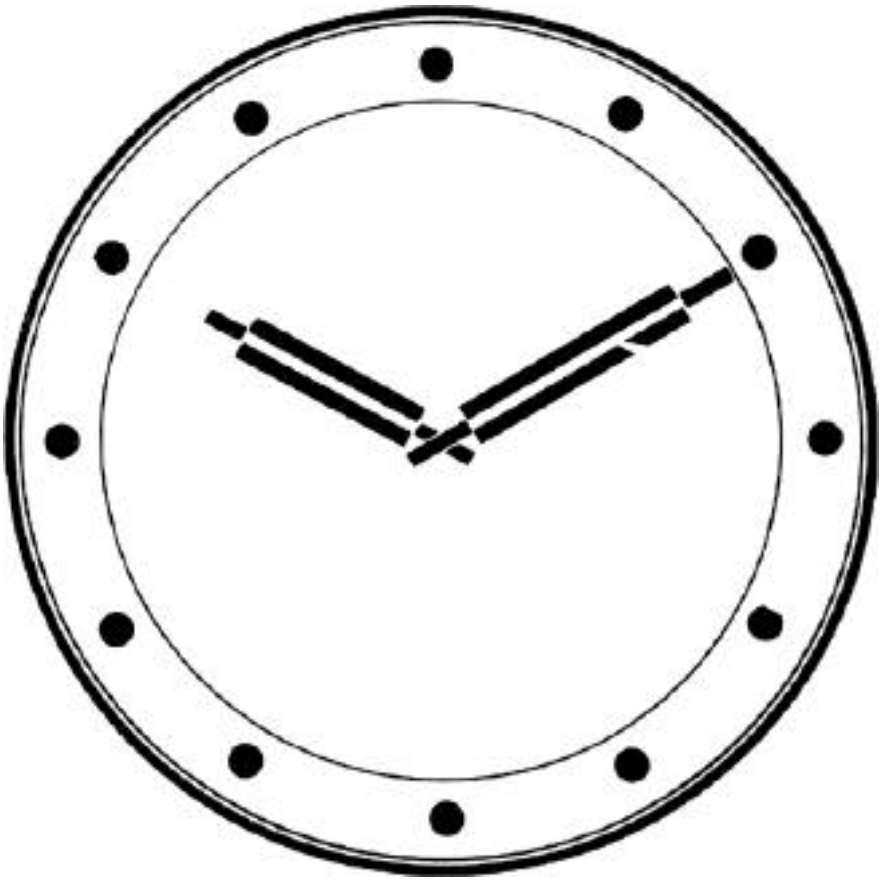
TIME II
CLOCK CARD



CONGRATULATIONS

You now own APPLIED ENGINEERING’S TIME II real time clock! APPLIED ENGINEERING is a leading manufacturer of Apple peripherals. Because of the time and care taken in the design and manufacture of your clock-, we are sure that you will enjoy the use of it for many years to come.

The authors have taken due care in preparing this manual and the programs in it. In no event shall the authors or publishers be liable for incidental or consequential damages in connection with or arising Out of the furnishing, performance or use of any of the programs herein.

If you have not already done so, please take a few minutes to complete and mail your OWNER/WARRANTY REGISTRATION CARD. This registration card will register your TIME II with the factory and include you in the list of TIME II owners. If you don’t send us this card, you will not receive any newsletters and information frequently mailed to TIME II owners. So please mail the completed card.

INSTALLING TIME II IN YOUR APPLE

The Time II real time clock simply plugs into a connector inside your Apple. Care must be exercised however, so follow these instructions exactly.

I) TURN OFF THE APPLE'S POWER SWITCH: This is very important to prevent damaging the computer as well as your Time II.

2) Remove the cover from the Apple. This is done by pulling up on the cover at the rear edge (the edge farthest from the keyboard) until the two corner fasteners pop apart. Then slide the cover backward until it comes free.

3) Inside the Apple, across the rear of the main circuit board, there is a row of eight long narrow sockets called "slots". You can plug your Time II into any slot except slot 0. Slot 7 is the preferred slot. Insert the 'fingers" of the circuit .board into the slot you want. The fingers will enter the slot with some friction, and will seat firmly.

4) Replace the Apple's cover by sliding the front edge into place, then press down on the two rear corners until they pop into place.

5) Now turn on your Apple and continue.

HOW TO READ SECONDS FOR SLOT -7-*

Let’s start with a simple program.

1Ø HOME	clear screen
2Ø A = 49394	A = Slot 7 input port address
3Ø B = 49393	B = Slot 7 output port address
4Ø POKE B,16	Set bold line high (This is done so that one number doesn’t change while we’re reading another number. Actually, it isn’t even necessary here, but this practice will develop good programming habits for later on.)
5Ø POKE A,32	Set unit seconds address (see programming table)
6Ø VTAB (12)	Move cursor
7Ø PRINT PEEK (A)	Print data from input port (seconds—units)
8Ø POKE 9,Ø	Set bold line low (this will let the clock continue counting by putting a 9 in the output port)
9Ø GOTO 4Ø	Do it all again

* You can use this program in any slot by subtracting 16 from A and B for each slot back from 7 you go. For example, in slot 5 use A — 40378; B = 49377

Program For Any Slot

ADD these lines to your read seconds program.

```
5   HOME
1Ø  INPUT “WHAT SLOT IS THE CLOCK IN” ;S
```

```
2Ø A = 49282 + (S+16)

3Ø B = 49281 + (S*16)
```

Now run your new program. This program is said to be portable because it is NOT slot independent.

Now lets take a look at a program that will set the hours, minutes and seconds as well as display them.

```
1Ø   HONE
2Ø   INPUT “WHAT SLOT IS THE CLOCK IN?”; S
3Ø   A = 49282 + (8*16)
4Ø   B = 49281 + (S+16)
5Ø   PRINT “HIT D TO DISPLAY TINE”
6Ø   PRINT “HIT S TO SET TIME”
7Ø   INPUT A$
8Ø   IF A$=”D” GOTO 13O
9Ø   lF A$=“S” GOTO 500
1ØØ  PRINT
11Ø  PRINT “YOU HIT THE WRONG KEY”   PRINT
12Ø  GOTO 80
13Ø  POKE B,16         Set hold line high
14Ø  POKE A,32         Set seconds units address
15Ø  SU = PEEK (A)     Make SU=Data in register
                       defined by the address
                       above (32)
16Ø  POKE A,33         Set seconds tens address
17Ø ST = PEEK (A)      Make STData in register
                       defined by the address
                       above (33)
18Ø POKE A,34  Set minutes units address
```

```
190 MU = PEEK (A)                          Hake MU=Data in register
                                           defined by the address
                                           above (34)

200 POKE A35                               Set minutes tens address

210 MT = PEEK (A)                          Hake MT=Data in register
                                           defined by the address
                                           above (35)

220 POKE A,36                              Set hours units address

230 HU = PEEK (A)                          MAKE HU=Data in register
                                           defined by the address
                                           above (36)

240 POKE A,37                              Set hours tens address

250 HT = PEEK (A)                          Make HT=Data in register
                                           defined by the address
                                           above (37)

260  VTAB (1)                              Move Cursor

270  PRINT HT;HU;" :";MT;MU;":" ;ST;SU     Print time

280  PRINT

290  PRINT "HIT ANY KEY TO END"

300  IF PEEK (-16384)>127 THEN             Has key been hit?
     GOTO 350

310  POKE -16368,0                         Reset hit key check

320  PRINT

330  POKE B,0                              Lower hold line

340  GOTO 130                              Do it all again

350  POKE B,0                              Lower hold line

360  END                                   End

500  POKE B,16                             Set hold line high

510  INPUT "HOUR TENS" HT                  Input hours tens

520  POKE A,5                              Write register to address
                                           input part
```

```
530  POKE B,HT + 16                    Write the data plus 16
                                       to data output port
                                       (you need the 16 to keep
                                       the hold line high)

540  POKE A,5 +- 16                    Write register plus 16 to
                                       address input port (this
                                       raises the write line)

550 POKE A,5                           Write register to input
                                       port (this lowers the write
                                       line)

560  INPUT “HOUR UNITS”;HU

570  POKE A,4

580  POKE B,HU + 16

590  POKE A,4 + 16

600  POKE A,4

610  INPUT ‘MINUTE TENS” ;MT

620  POKE A, 3

630  POKE B,MT + 16

640  POKE A,3 + 16

650  POKE A,3

660  INPUT ‘MINUTE UNITS’;HU

670  POKE A,2

680  POKE B,MU + 16

690  POKE A.2 + 16

700  POKE A,2

710  POKE B,Ø                          Set hold line low

720  HOME

730  GOTO l3Ø                          Go print time just set
```

Let’s try a different technique in our next program.

Type in Program #4

```
1Ø   HOME
2Ø   DIM TIME (6)
3Ø   INPUT “WHAT SLOT IS THE CLOCK
     IN?”;S
4Ø   HOME
5Ø   A = 49292 + (S*16)
6Ø   B = 49281 + (S*16)
7Ø   POKE B16                              Set hold line high
8Ø   N = Ø
9Ø   FOR C 37 to 32 STEP —1
1ØØ  POKE A,C                              Read time
11Ø  TIME (N) = PEEK (A)
12Ø  N = N + 1
13Ø  NEXT C
14Ø  D = TIME (Ø)
15Ø  IF D>7 THEN A$ —
16Ø  IF TIME (Ø)>7 THEN TIME (Ø) =         12 or 24 hour format
     TIME (Ø) — 8                          AM or PM
165  IF D<8 AND TIME (Ø)<4 THEN
     A$ = "A.M."
17Ø  IF 0<8 AND TIME (Ø)>3 THEN
     A$ = "P.M."
18Ø  IF TIME (Ø)>3 THEN TIME (Ø)-
     TIME (Ø) — 4
19Ø  VTAB (1)
2ØØ  PRINT THE TIME IS” ;TIME(Ø)
;TIME:(1):":":TIME(2);TIML(3)              Print time
;":":TIME($);TIME(%);":"A$
```

```
21Ø   PRINT
22Ø   PRINT
23Ø   PRINT
24Ø   IF PEEK (-16384)>127 THEN          Has key been hit
      GOTO 35Ø
25Ø   POKE -16368,9                     Reset key check
26Ø   PRINT
27Ø   POKE B,9                          Set hold low
28Ø   GOTO 70
39Ø   POKE B,9                          Set hold low
36Ø   END
```

Check your typing and RUN it.
Your screen should look like this:
THE TIME IS HH:MM:SS:AM or PH
Don’t be concerned if AM or PM isn’t right, because as of yet you have had no way to set them.

The preceding program was quite a bit different from program #3 due mostly to the use of ARRAYS. If you are not familiar with ARRAYS, have a look at pages 108-111 in your APPLESOFT TUTORIAL.

Notice how bits 4 and 8 were set to Ø before it is read at line 16Ø and l8Ø. If this were not done, the HOUR TENS number would be wrong.

DATA NAME	REG	+16	+32	DATA BITS			
				1	2	4	8
Seconds Units	0	16	32	*	*	*	*
Secoxida Tens	1	17	33	*	*	*	
Minutes Units	2	18	34	*	*	*	
Minutes Tens	3	19	3h	*	*	*	
Hours Units	4	20	36	*	*	*	*
Hours Tens (AM/PM)	5	21	37		*	Ta	Tb
Day of Week	6	22	38	*	*	*	
Date Units	7	23	39	*	*	*	
Date Tens (Leap Yr)	S	24	40	*	*		
Month UnIts	9	25	41	*	*	*	*
Month Tens	10	26	42	*			
Year Units	11	27	43	*	*	*	*
Tea Tens	12	28.	44	*	*	*	*
Interupt**	15	31	47	*	*	*	*

Seconds units & tens are reset to zero irrespective of input data when a write instruction is executed

Ta = Ø for AM, 1 for PM
Tb = Ø for 12 hour format, T for 24 hr.format

Tc = Ø for 28 days in month 2, 1 for 29 days In month 2 ***

* Bits Used

** Interupts are only active during a read operation and hold line set low. (1Ø24 HZ interrupt is not hold state dependent

*** If Te Previously set to “1", upon completion of month 2 (February) day 29, Tc will automatically be reset to “Ø"

12 OR 24 HOUR FORMAT, AM OR PM

To start off with, if you select the 24 hour format you need not be concerned with AM & PM.

Let's look at the part of our programming chart concerned with 12 and 24 hour format and A.M., P.M.

DATA NAME	REG	+16	+32	DATA BITS
				1 2 4 8
HOURS TENS	5	21	37	* *

If Bit 4 is high, then it is P.M.

If Bit 4 is low, then it is A.M.

If Bit 8 is high. then 24 hour format
If Bit 8 is low, then 12 hour format

LEAP YEAR?

Looking at the part of our programming chart concerned with leap year:

DATA NAME	REG	+16	+32	DATA BITS
				1 2 4 8
HOURS TENS	8	24	40	* *

If Bit 4 is high, (1) then there are 29 days in month 2 (February)
If Bit 4 is low, (Ø) then there are 28 days in month 2 (February)

Upon completion of month 2, day 29, bit 4 will be reset low (Ø)

+-30 SECOND ADJUST

TIME II clock-calendar has the ability to adjust the seconds ± 30.

Try this program:

```
1Ø  B = 49393
2Ø  POKE B,32
3Ø  FOR DELAY = 1 to 25
4Ø  NEXT DELAY
5Ø  POKE B,O
6Ø  END
```

To predict what this program will do, let’s look at some examples.

If the time is 12:16:24 when the above program is run, the time will be at back 24 seconds. The clock will continue running from 12:16:00.

If the time is 12:16:31 when the above program is run, the time will be let ahead 29 seconds to 12:17:00.

Line 20 writes 32 to the date output port and sets the ±30 ADJUST line HIGH(1). Lines 3D and 40 give the necessary time delay for the clock chip to read it. (31.25 milliseconds minimum is required.) Line 50 resets the ±30 second line LOW (0) completing the SET routine.

If You wish, you can add this routine to the programs you already have.

In this program, we take advantage of most of the TIME II features. Enter it and experiment with it. When you have finished, be sure to save it on tape or d~sk.

```
1Ø   TEXT
2Ø   HOME
3Ø   INPUT “WHAT SLOT IS THE CLOCK
     IN?”; S
4Ø   PRINT
5Ø   A = 49282 + (S416)
6Ø B = 49281 + (S*16)
7Ø Dliii X(13)
8Ø DIII Y$(7)
9Ø DIM Z$(13)
1ØØ  DATA “SUNDAY “, “MONDAY",
     "TUESDAY “, “WEDNESDAY“,
     THURSDAY “, “FRIDAY“,
     "SATURDAY"
11Ø  DATA “SECOND UNITS”, “SEC
     OND TENS”, “MINUTE UNITS”
     ,“MINUTE TENS", “HOUR UNIT
     S”, “HOUR TENS”
12Ø DATA “DAY OF WEEK Ø = SUN,
     1 = MON, ETC.”, “DATE UNITS
     “,“DATE TENS’
13Ø  DATA “MONTH UNITS”, "MONTH
     TENS”, “YEAR UNITS", “YEAR
     TENS”
14Ø  DATA “SECONDS TENS”, “SECON
     D UNITS”
15Ø  FOR C = Ø TO 6
16Ø  READ Y$(C)
17Ø  NEXT C
18Ø  FOR D = Ø TO 12
19Ø  READ Z$(D)
2ØØ  NEXT 'D
```

What slot?

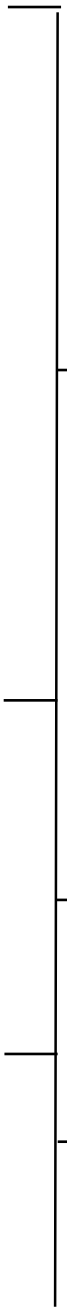
Dimension array X,Y,Z

Enter data

Load Y$ Array

Load Z$ Array

```
210   PRINT "TYPE D TO DISPLAY DAT
      E-TIME”
220   PRINT “TYPE S TO SET DATE-TI
      ME”
230   PRINT TYPE A TO ADJUST TIME
      +- 30 SEC.”
240   PRINT "TYPE E TO END PROGRAM
      "
250   INPUT Q$
260   PRINT
270   HOME                                  What Subroutine?
280   IF Q$ = “D” THEN GOTO 360
290   IF Q$ = “5” THEN GOTO  64O
300   IF Q$ = “A" THEN GOTO 1030
310   IF Q$ = “E” THEN END
320   PRINT
330   PRINT “YOU HIT THE WRONG KEY
      !"
340   PRINT
350   GOTO 210
360   I = Ø
370   POKE B,16
380   FOR E 44 to 32 STEP —1
390   POKE A,E                              Load date time
400   X(I) = PEEK (A)
410   1= I + 1
420   NEXT E
430   IF F>7 THEN P$ = " "
440   IF X(4)>3 THEN X(4) = X(4)
      -4                                    12 or 24 hour format
450 F = X(7)                                AM or PM
```



```
460  IF F>7 THEN P$ = ""

470  IF X(7)>7 THEN X(7) = X(7)
     —8

480  IF F<6 AND X(7)<4 THEN P
     $ = “AM”

490  IF F<8 AND X(7)>3 THEN P
     $= "PM"

500  IF X(7)>3 THEN X(7) = X(7)
     -4

510- VTAB (1)

520  PRINT "THE DATE IS “;X(2);X(
     3);"/";X(4);X(5);"/";X(0);X(
     1)

530  PRINT “TODAY IS “;Y$(X(6))

540  PRINT “THE TIME IS “;X(7);X(
     8);":";X(9);X(0);":"X(11);
     X(12) P$

550  PRINT

560  PRINT “HIT ANY KEY TO END”

570  IF PEEK (—16384)>L27 THEN
     GOTO 620

580  POKE -16368,0

590  PRINT

600  POKE B,0

610  GOTO 369

620  POKE B,W

630  END

640  G = 12

650  POKE B,16

660  FOR G = 12 to 0 STEP -1

670  PRINT Z$(G)
```

12 or 24 hour format
AM or PM

Print time

End program?

Set hold line low

Get new time

End program

Set date/time

```
680  INPUT N
690  X(G) = N
700  NEXT G
710  INPUT 'IS THIS A LEAP YEAR"
     ;Y$
720  IF Y$ = "Y" GOTO 780
730  IF Y$ = "N" GOTO 780
740  PRINT
750  PRINT "TYPE Y OR N PLEASE!"
760  PRINT
770  GOTO 710
780  INPUT "12 OR 24 HOUR FORMAT
     ";Y
790 IF Y = 24 THE$ X(5) = X(5) +
     8
800  IF Y = 12 GOTO 860

810  IF Y = 24 GOTO 940
820  PRINT
830  PRINT "TYPE 12 or 24 PLEASE!
840  PRINT
850  GOTO 780
860  INPUT "AM OR PM"
870  IF X$ = "PM" THEN X(5)= X(5
     )+4
880  IF X$ - "PH" THEN GOTO 940
890  IF X$ = "AM" THEN GOTO 940
900  PRINT
910 PRINT "TYPE AM OR PM PLEASE!
     "
```

Set date/time

```
920  PRINT
930  GOTO 860
940  FOR H = 12 TO 0 STEP -1
950  N = X(H)
960  GOSUB 1020
970  NEXT H                                  Set date/time
980  POKE B,9
990  PRINT
1000 HOME
1010 GOTO 360
1020 POKE A,H: POKE B,N +16: POKE
     A,H + 16: A,N: RETURN
1030 POKE B,32
1040 FOR J = 1 TO 25
1050 NEXT J                                  ±30 second adjust
1060 POKE B,0
1070 GOTO 360
```

Let's review what we've learned so far:

1) Each digit has its own address.

2) Set hold line high when reading data.

3) Add 32 to register when reading it.

4) Set hold line low after reading data.

5) The 12 and 24 hour & AM/P.M. bits must be set low when READING the DATE TENS DATA.

7) The DAY of WEEK is a number from Ø to 6.

8) Write 32 to data output port to set ± 30 Second adjust 111GB.

9) Write 0 to data output port to reset ± 30 second adjust.

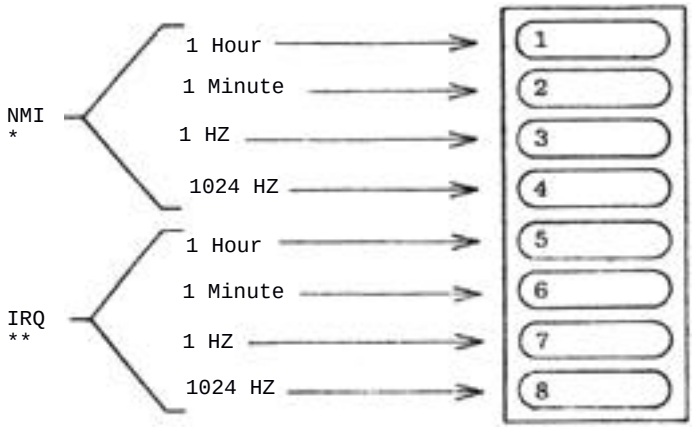
10) When setting the time: a) SET HOLD LINE hig~h (see line 500 in program #3) b) write the register of the DATA you want to the address input port (see line 520 in Program #3) c) write DATA +16 to output port (see line 530) d) write register +16 to address input port (see line 550). Repeat parts b, c, d and e until all registers are loaded. Set HOLD line LOW (see line 710 in program #3)

TIME II INTERRUPTS

There are 4 interrupts lines, running at 1024 HZ, 1 HZ, 1 Minute and 1 Hour. These interrupt lines are driven low (Ø) when a read is done on address 15. Any of the four signals can be switched to either NMI (nonsaskable interrupt) or IRQ (interrupt request). In fact, it is possible to set one interrupt to NMI and another to IRQ!

The interrupt lines are driven by open collector HAND GATES and are driven low for 122.1 aS (except the 1024 HZ signal which has a 50% duty cycle).

Refer to the below drawing to set the INTERRUPTS.



*NMI Non-maskable interrupt. When this line is pulledlow (Ø) the Apple begins an interrupt cycle and jumps to an interrupt handling routine at location $3FB.

**IRQ Interrupt request. When this line is pulled low (Ø) the Apple begins an interrupt cycle ONLY if the 6502’s (interrupt disable) flag is not set. If so, the 6502 will jump to the interrupt

handling routine whose address is stored in locations $3FE and $3FF.

TIME BASE CALIBRATION

Your TIME II has a quartz crystal time base which oscillates at 32,768 HZ (2^{15}). This frequency can be adjusted up or down approximately 2 HZ by the trimmer capacitor which is next to the dip switches at the rear of the board. Your TIME II was calibrated at the factory to 32,768.0 HZ ± .0002%.

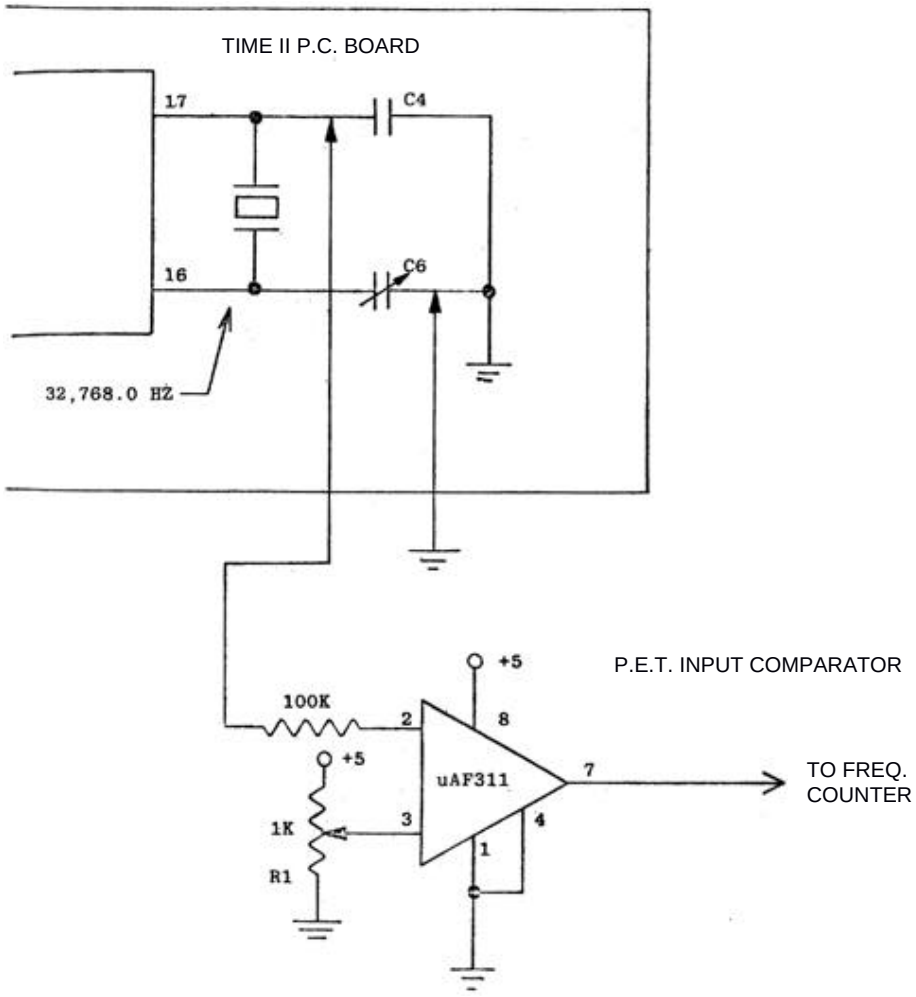
The manufacturer of the crystal specifies that the frequency may age .0005% or 5 parts per million in one year.

RECALIBRATING TIME BASE:
You can recalibrate the time base with a frequency counter; however, most frequency counters have a input capacitance that is too high and a input resistance that is too low. Check your owners manual. The input capacitance must be less than 2pF and input resistance should be greater than 50 M ohms. If it is not, you can make a simple circuit to buffer the signal before it goes into your frequency counter. (See page 21 for schematic.)

If the above discussion seems like a lot of work (and it is, however it is very unlikely that this will be required for several years). But since we developed this circuit, we wanted you to have access to it (it never hurts to over explain).

You can adjust the frequency by turning the trimmer capacitor C6 so that the clock matches a known time standard. REMEMBER, YOUR TIME II WAS CALIBRATED AT THE FACTORY SO DON'T TURN THE TRIMMER UNLESS YOU CAN DO YOUR OWN CALIBRATION.

BUFFER CIRCUIT FOR FREQUENCY COUNTER



ADJUST R1 FOR STABLE OUTPUT.