Assembly Instructions MP-T Interrupt Timer

Introduction

The MP-T Interrupt Timer is a 5 1/4" x 3 1/2" double sided, plated thru hole circuit board implemented with the 5009 programmable counter/divider and 6820 peripheral interface adaptor integrated circuits. The board provides software selectable interrupts of 1 usec, 10 usec, 100 usec, 1 msec, 10 msec, 20 msec, 100 msec, 1 sec, 10 sec, 100 sec, 1 min, 10 min or 1 hour. Since only half of the 6820 peripheral interface adaptor is used for the interrupt timer the other half has been fully buffered to provide a general purpose eight bit input port along with one buffered "data read" input line and one buffered "data accepted" output line for complete handshake control. The interface is completely software programmable by the user with interrupt control as well as polarity control of the input port handshake lines. Power for the board is supplied by a +5 volt regulator with a current consumption of approximately 0.3 A. Approximately 15 ma. is drawn from the -12 VDC interface power buss to supply minus voltage to the 5009 integrated circuit.

Before using this board in your system, the control registers of the interface must be configured for proper operation of the board. Complete details for configuring the control registers for the interrupt timer portion of the board are contained later in this instruction set. Details for configuring the control registers on the input side of the interface are contained in the Hardware and Programming sections of the System Documentation Notebook.

When the SWTPC 6800 Computer System is being assembled, work on only one board at a time. Each of the system's boards and their associated parts must not be intermixed to avoid confusion during assembly. The MOS integrated circuits supplied with this kit are susceptible to static electricity damage and for this reason have been packed with their leads impressed onto a special conductive foam or possibly wrapped in a conductive foil. In either case, do not remove the protective material until specifically told to do so later in the instructions.

The MP-T Interrupt Timer is an option board and need not be assembled nor should be installed onto the mother board until the entire computer system has been checked out and is known to be working properly.

PC Board Assembly

NOTE: Since all of the holes on the PC board have been plated thru, it is only necessary to solder the components from the bottom side of the board. The plating provides the electrical connection from the "BOTTOM" to the "TOP" foil of each hole. Unless otherwise noted it is important that none of the connections be soldered until all of the components of each group have been installed on the board. This makes it much easier to interchange components if a mistake is made during assembly. Be sure to use a low wattage iron (not a gun) with a small tip. Do not use acid core solder or any type of paste flux. We will

not guarantee or repair any kit on which either product has been used. Use only the solder supplied with the kit or a 60/40 alloy resin core equivalent. Remember all of the connections are soldered on the bottom side of the board only. The plated-thru holes provide the electrical connection to the top foil.

( ) Before installing any parts on the circuit board, check both sides of the board over carefully for incomplete etching and foil "bridges" or "breaks". It is unlikely that you will find any but should there be one especially on the "TOP" side of the board it will be very hard to locate and correct after all of the components have been installed on the board.

( ) Starting from one end of the circuit board install each of the three, 10 pin Molex female edge connectors along the lower edge of board. These connectors must be inserted from the "TOP" side of the board and must be pressed down firmly against the circuit board so that each pin extends completely into the holes on the circuit board. Not being careful here will cause the board to either wobble and/or be crooked when plugging it onto the mother board. It is suggested that you solder only the two end pins of each of the three connectors until all have been installed at which time if everything looks straight and rigid you should solder the as yet unsoldered pins.

( ) Following the procedure outlined above, attach the one remaining 12 pin Molex female edge connector along the upper edge of the board. Solder.

( ) Insert the small nylon indexing plugs into both the upper and lower edge connector pins indicated by the small triangular arrows on the "BOTTOM" side of the circuit board. This prevents the board and I/O connector from being accidently plugged on incorrectly.

( ) Attach capacitors C1 thru C3 to the board. As with all other components unless noted, use the parts list and component layout drawing to locate each part and install from the "TOP" side of the board bending the leads along the "BOTTOM" side of the board and trimming so that 1/16" to 1/8" of wire remains. Solder.

( ) Install all of the resistors on the circuit board. Solder.

( ) Install the transistor and diode. These components must be oriented to match the component layout drawing. Solder.

( ) Install integrated circuit IC2 on the circuit board. This component must be oriented so its metal face is facing the circuit board as is secured to the circuit board with a #4- 40 x 1/4" screw, lockwasher and nut. A heatsink is not used. The three leads of the integrated circuit must be bent down into each of their respective holds. Solder.

( ) Install integrated circuits IC4 and IC5 on the circuit board. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuits should replacement ever be necessary. The semi-circle notch or dot on the end of the package is used for orientation purposes and must match with the outlines shown on the component layout drawing for each of the IC's.

( ) Attach crystal XTAL1 to the circuit board. It should be oriented so its length lies flat across the circuit board as shown in the outline on the component layout drawing. If the crystal has long thin wire leads, they may be bent down 90 degrees at the base of the crystal so they fit into the two holes provided for the crystal on the circuit board. If the crystal has short heavy wire leads, solder onto and at a 90 degree angle, the crystal's leads some heavy buss wire. The buss wire with the crystal attached may then be inserted into the board. Solder. You may solder a piece of wire to the opposite end of the crystal's can and run the other end of the wire thru the hole provided in the circuit board. This will keep the crystal from moving around after it is mounted.

( ) Attach trimmer capacitor C4 to the circuit board as shown in the component layout drawing. The capacitor hooks onto the top edge of the circuit board so that it may be adjusted with the circuit board in place. The fingers of the trimmer are soldered to the solder tabs along the top edge of the top side of the circuit board. Make sure the capacitor is firmly in place before soldering.

( ) Unless you plan to use the board in a special situation where you will be using the non-maskable interrupt (NMI), you will want to run a pair of jumpers between point TIM and IRQ and point INP and IRQ on the board. This allows you to use the conventional interrupt, request line (IRQ) when it is selected in your program. These jumpers are not shown in place on the component layout drawing.

NOTE: MOS integrated circuits are susceptible to damage by static electricity. Although some degree of protection is provided internally within the integrated circuits, their cost demands the utmost in care. Before opening and/or installing any MOS integrated circuits you should ground your body and all metallic tools coming into contact with the leads, thru a 1 M ohm 1/4 watt resistor (supplied with the kit). The ground must be an "earth" ground such as a water pipe, and not the circuit board ground. As for the connection to your body, attach a clip lead to your watch or metal ID bracelet. Make absolutely sure you have the 1 Meg ohm resistor connected between you and the "earth" ground, otherwise you will be creating a dangerous shock hazard. Avoid touching the leads of the integrated circuits any more than necessary when installing them, even if you are grounded. On those MOS IC's being soldered in place, the tip of the soldering iron should be grounded as well (separately from your body ground) either with or without a 1 Meg ohm resistor. Most soldering irons having a three prong line cord plug already have a grounded tip. Static electricity should be an important consideration in cold, dry environments. It is less of a problem when it is warm and humid.

( ) Install MOS integrated circuits IC1 and IC3 following the precautions given in the preceding section. As they are installed, make sure they are down firmly against the board before soldering all of their leads. Do not bend the leads on the back side of the board. Doing so makes it very difficult to remove the integrated circuit should replacement ever be necessary. The "dot" or "notch" on the end of the package is used for orientation purposes and must match with that shown on the component layout drawing for the IC. Solder.

( ) Working from the "TOP" side of the circuit board, fill in all of the feed-thru's with molten solder. The feed-thru's are those unused holes on the board whose internal plating connects the "TOP" and "BOTTOM" circuit connections. Filling these feed-thru's with molten solder guarantees the integrity of the connections and increases the current handling capability.

( ) Now that all of the components have been installed on the board, double check to make sure all have been installed correctly in their proper location.

( ) Check very carefully to make sure that all connections have been soldered. It is very easy to miss some connections when soldering which can really cause some hard to find problems later during checkout. Also look for solder "bridges" and "cold" solder joints which are another common problem.

Since the MP-T circuit board now contains MOS devices, it is susceptible to damage from severe static electrical sources. One should avoid handling the board any more than necessary and when you must, avoid touching or allowing anything to come into contact with any of the conductors on the board.

Input Connector Wiring

The input connection may be made to the board thru a 12 pin connector along the top edge of the board. The function of each of the input pins is as follows:

C1 is the "handshake" control input. It is electrically the same as the CA1 input on IC1, the PIA integrated circuit. The line is buffer protected and represents one TTL load.

C2 is the "handshake" control output. It is the line buffered output of the CA2 pin on IC1, the PIA integrated circuit. It is TTL compatible and is capable of sourcing 5.2 Ma. and sinking 32 Ma. of current.

GND is the common line for all input connections and is electrically connected to the computer system's ground buss.

IØ-17 are the eight non-inverting data input lines. Each is buffered and represents one standard TTL load. The buffered lines feed pins PAØ thru PA7 respectively on IC1, the PIA integrated circuit.

Attaching the Input Connector to the Interface

The male input connector which attaches to the interface is simply a row of twelve pins supported by a nylon base. The longer side of the male connector plugs onto the interface board edge connector while the cable wires going to the peripheral device are soldered onto the shorter side of the connector. The cable which goes back to the peripheral should, if at all possible, be a multi-conductor cable (not supplied with the kit) with a minimum of twelve separate conductors.

When preparing to attach the cable to the connector, first strip back 2" of the cable's outer insulation. While positioning the cable in line with the male connector's nylon support strip allowing the wires to extend just beyond the last pin on the strip, attach and solder each of the appropriate wires oriented so the C1 pin is connected to the shortest wire on the cable. It is very easy to melt the body of the nylon connectors which will loosen the pins, so be very careful and use a heat-sink on each pin between the solder point and connector body where possible. After attaching all of the cable wires bend the connector around the cable a full 180 degrees and secure with two wire ties (supplied with the kit). Now cut off the indexing pin on the male connector. To minimize noise and ringing, keep the cable length between the interface and peripheral as short as possible.

Using the Interrupt Timer

The Oscillator/Divider integrated circuit is connected to the B side of the peripheral interface adaptor. The divider's output is connected to the CB1 control line while it's programmable inputs are connected to the PIA's B side outputs. Before using the interrupt timer you will have to configure B side of the PIA for the desired interrupt timing interval. Use the table below to select the desired value:

PIA A data word	Timing-Interval
ØØ	1 usec
Ø1	10 usec
Ø2	100 usec
Ø3	1 msec
Ø4	10 msec
Ø5	100 msec
Ø6	1 sec
Ø7	10 sec
Ø8	100 sec
Ø9	1 min
ØA	1 hour
ØB	10 min
ØC	no output
ØD	no output
ØE	20 msec
ØF	no output

Outputting a 8Ø will reset the oscillator/divider so the count will stop, and everything will be prepared for an interval measurement. This will allow the computer to be used as a programmable stopwatch if desired.

When you are configuring the data direction registers for the board, the A side of the PIA should be set for all inputs while the B side should be set for all outputs.

You also have to configure the control register of the PIA so the CB1 line will respond to the negative going edge of the oscillator/divider circuit. Of course if you do not wish to use interrupt timer portion of the board, then you do not need to configure the B control register unless it has been configured for interrupts since the RESET button last was depressed.

Address Assignments

Four address assignments have been allocated for each interface port; they are as follows:

PORTØ	8ØØØ to 8ØØ3
PORT1	8ØØ4 to 8ØØ7 (Serial control interface only)
PORT2	8ØØ8 to 8ØØB
PORT3	800C to 800F
PORT4	8Ø1Ø to 8Ø13
PORT5	8Ø14 to 8Ø17
PORT6	8Ø18 to 8Ø1B
PORT7	8Ø1C to 8Ø1F

The actual addresses to be used in your programs for the interface(s) is determined by the interface position (port #) onto which the board is plugged.

Within each block of four addresses the lowest is used for Peripheral Register A and Data Direction Register A. The second sequential address is used for Control Register A. The third sequential address is used for Peripheral Register B and Data Direction Register B. The last sequential address is used for Control Register B. Complete details on these registers and their functions are contained in the Hardware section of the System Documentation Notebook and will not be repeated here.

Important Note

If the interrupt timer portion of the board does not appear to work, try adjusting trimmer capacitor C4. These capacitors are often shipped with the adjusting screw loose which makes their capacity too low for the oscillator to function.

Calibration

Although the interrupt timer is extremely accurate, the actual oscillator frequency can be changed several cycles per second by adjusting trimmer capacitor C4. You will of course need an accurate timebase to make this adjustment and in almost all cases, it is not necessary anyway. The oscillator's actual count output may be seen on pin 10 of IC3.

How It Works

The Interrupt Timer board interfaces a crystal controlled programmable oscillator/divider chip, IC3, to the computer system thru 6820 peripheral interface adaptor integrated circuit, IC2. Since the oscillator chip uses only one half of the PIA, the other half has been set up as a buffered eight bit input with handshake just like half of a standard MP-L parallel interface board. IC4 and IC5 are the buffers for the input lines. +5 volt power for the board is provided by voltage regulator integrated circuit IC2.

Using Maskable Interrupts (IRQ) on the SWTPC 6800 Computer System

Throughout the 6800 documentation you will find information telling you that the starting address of the maskable interrupt service routine must be stored in memory locations FFF8 and FFF9 which do not even exist in the SWTPC Computer System. The SWTPC 6800 vectors to memory locations E1F8 and E1F9 in the Mikbug^{R} ROM which in turn loads the program counter with the data stored in addresses AØØØ and AØØ1 of the scratchpad RAM on the MP-A board. This means that you must load the starting address of your interrupt service routine into these addresses before you service an interrupt.

Don't forget to always put a NOP instruction before every Clear Interrupt Mask (CLI) instruction in your program.

Precautions When Using Maskable Interrupts (IRQ) on the SWTPC 6800 Computer System

When using the 6800 Computer System with an interrupt generating device fed to the computer thru one of the programmable interface IC's on the interface card buss, care must be exercised in programming such that the interrupt mask bit is set (I=1) when interrupts are not desired. When either a power up RESET or manual RESET is generated, the I bit within the 6800 chip itself is set and the processor jumps into the Mikbug^{R} control program where it awaits single character commands from the operator. If an interrupt is generated by one of the interface boards during this time, the interrupt is remembered but not serviced until the I bit is cleared (I=0). When the operator finally types in a G for "Go to User Program", the 6800 executes a Return from Interrupt instruction (RTI) where it picks up the contents of the 1) condition code register, 2) B accumulator, 3) A accumulator, 4) index register and 5) program counter. This data is stored sequentially in memory locations AØ43 thru AØ49. The fact that the processor uses a RTI instruction at the beginning of each program has nothing to do with interrupts. It is just the most convenient way of getting accumulator, index register and program counter data into the internal registers of the 6800 chip itself. Since most programs initialize the values of the accumulators and index register within the program, the only data that generally must be entered is the value of the program counter. When the 6800 picks up the contents of the condition code register, it replaces the set interrupt mask bit with the new value contained in bit 4 of memory location AØ43. If this new bit happens to be a zero, and as mentioned earlier; an interrupt was generated by an interface board while the interrupt mask bit was set, then the 6800 will try to execute an interrupt service routine before it makes it to the first instruction of your program.

Fortunately 6820 PIA integrated circuits like those used on the MP-L and MP-T boards are internally reset when a 6800 buss RESET is generated and will not generate interrupts. This means that 6820 type interfaces should not cause this type of problem. Serial type 6850's however are internally reset on power up only. Once they are configured for interrupt operation, they will remain so until reconfigured or until they are powered down. This potential problem can best be eliminated by using Mikbug's memory change feature to write a 1Ø in memory location AØ43 before the program is started. This guarantees that the interrupt mask bit will be set until it is cleared by the user in his program or until the system is again RESET with the front panel button. Once into the user program, the 6800's stack

is decremented from AØ49 any time there is an interrupt, push or subroutine execution. If the stack is decremented down to the AØ43 address or if any data is ever stored in AØ43 then you can no longer count on bit 4 of the address being set. This means that if you exit your program with the RESET button, you will probably want to rewrite a 1Ø in memory location AØ43.

Another programming convenience is to put a Load Stack Pointer (LDS) with AØ42 instruction at the beginning of your program so that decrementing the stack will not change the contents of address AØ43. This same instruction will also protect the program counter address data in locations AØ48 and AØ49.

If you are not using any 6850 (MP-S) interfaces with enabled interrupts, on your system, then you shouldn't have to worry about getting an interrupt while you are in the Mikbug® control program. There still is the opportunity for the interrupt bit to be cleared (I=0) when the 6800's register data is picked up from memory location AØ43 after typing in the G for "Go to User Program". If this may cause a program in your program, then make the first instruction in your program a Set Interrupt Mask (SEI).

Another condition to be aware of is that when the processor services an interrupt, the I bit, which must be a zero for the processor to respond to the interrupt in the first place, is pushed onto the stack. The I bit within the 6800 however is set to a one to prevent further interrupts from restarting the service routine. At the end of the interrupt service routine, the Return from Interrupt (RTI) instruction pulls the cleared interrupt mask bit from the stack. If an interrupt occurred during the interrupt service routine, the processor will immediately jump back to the beginning of the service routine since the mask bit has now been cleared, and the 6800 responds to prior interrupt requests. If this creates a problem in your program, append the following code to the end of your interrupt service routine:

```
PUL A  - pulls condition codes from stack
ORA A #10-sets bit 4
PSH A  - push condition codes back on the stack
RTI    - return from interrupt
```

The computer will not respond to interrupts until the Clear Interrupt Mask (CLI) instruction is seen.

Parts List - MP-T Interrupt Timer Board

Resistors

___	R1	10M ohm 1/4 watt resistor
___	R2	6.8M ohm 1/4 watt resistor
___	R3	3.3M ohm 1/4 watt resistor
___	R4	220 ohm 1/2 watt resistor
___	R5	2.2K ohm 1/4 watt resistor
___	R6	10K ohm 1/4 watt resistor

Capacitors

___	C1	0.1 mfd disk capacitor
___	C2	4.7 pfd disk capacitor
___	C3	0.1 mfd film capacitor
___	C4	4-40 pfd trimmer capacitor

Diodes and Transistors

___	D1*	10 volt zener diode
___	Q1*	TIS58 FET transistor

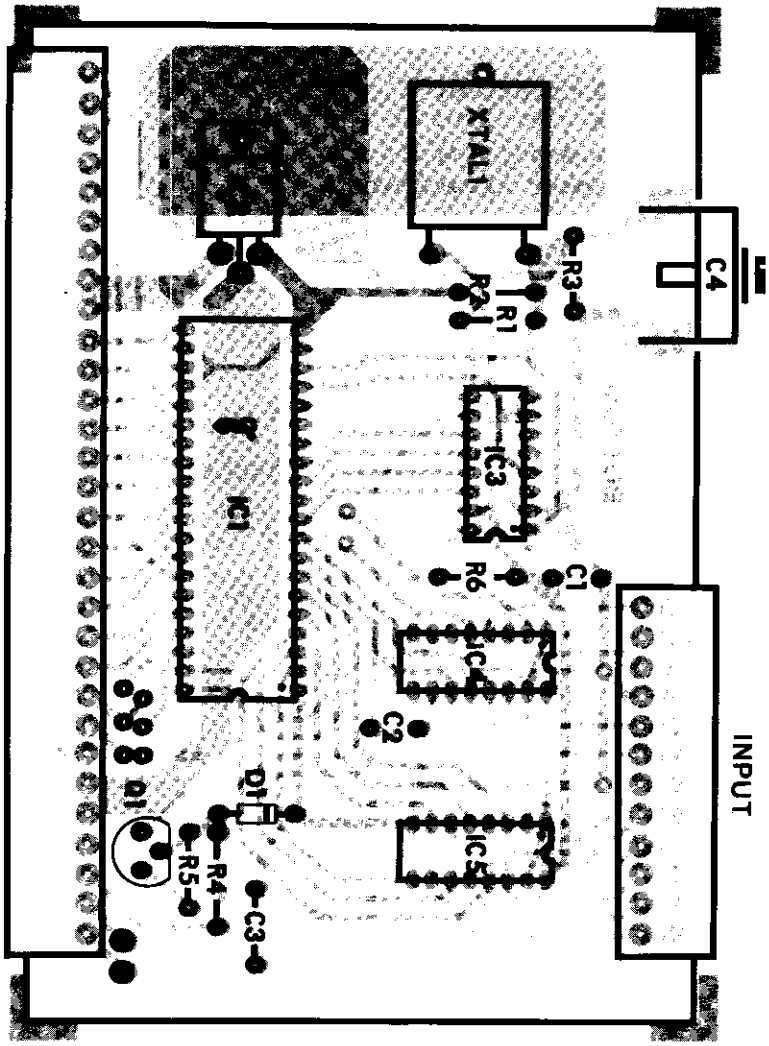
Integrated Circuits

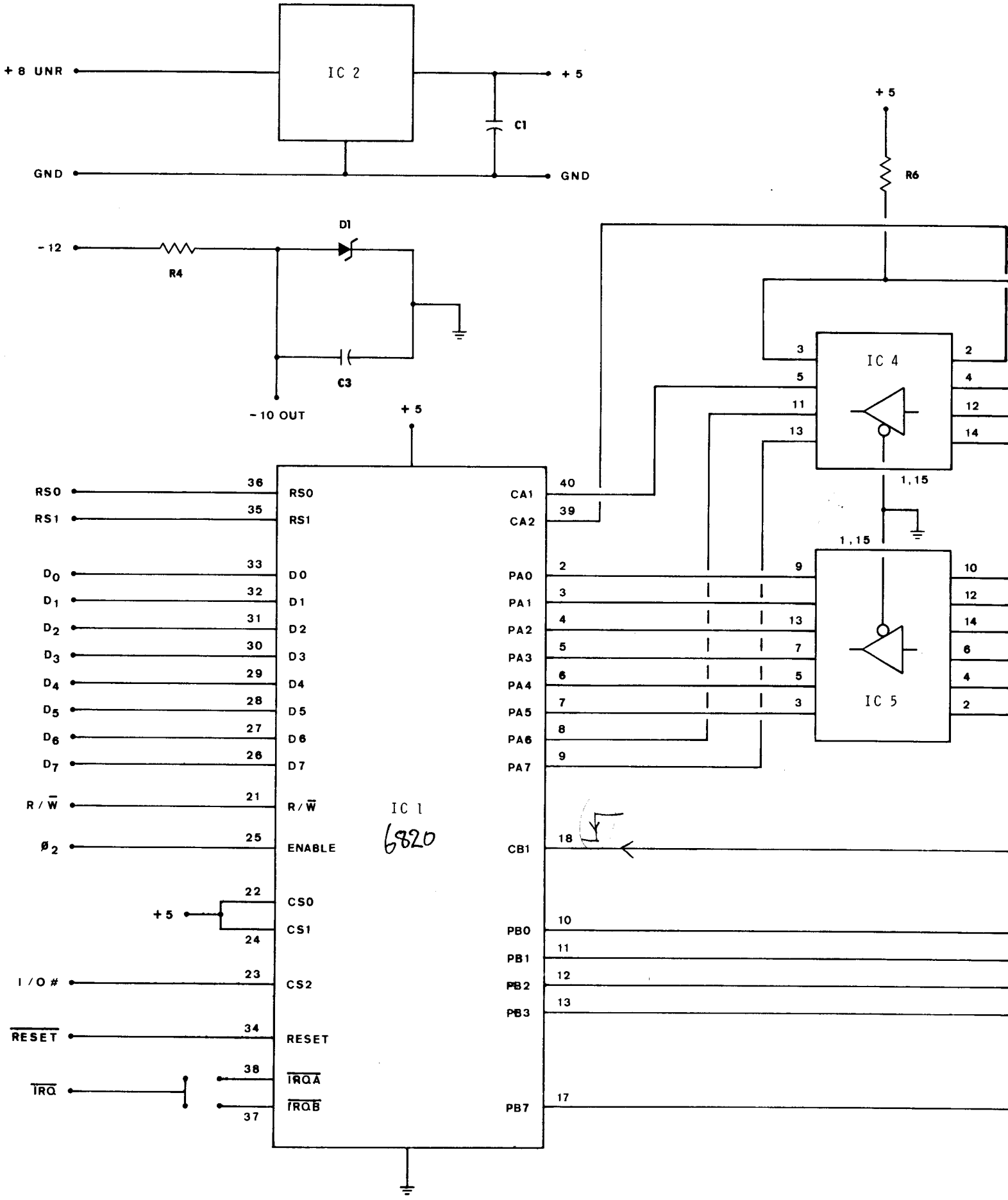
___	IC1*	6820 MOS peripheral Interface Adaptor
___	IC2*	7805 Voltage Regulator
___	IC3*	MK5009 MOS Osc./Divider
___	IC4*	DM8097 hex buffer
___	IC5*	DM8097 hex buffer

Miscellaneous

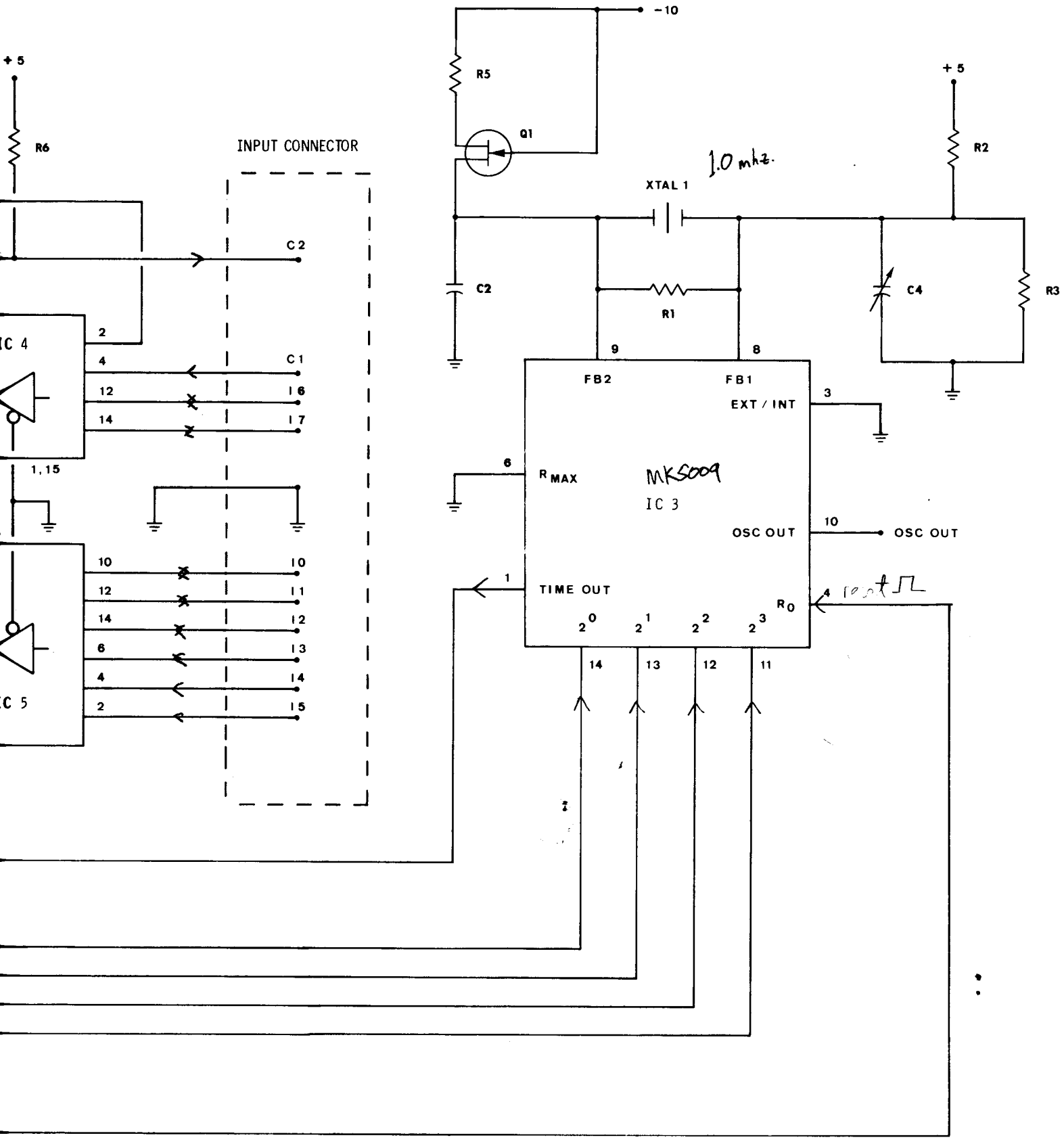
___	XTAL1	1.0MHz crystal

Note: All components flagged with a * must be oriented as shown in the component layout drawing


XTAL1
C4
R3
R2
R1
IC3
IC1
R6
C1
IC4
C2
D1
Q1
IC5
R4
R5
C3
INPUT



SCHEMATIC / MP-T INTERRUPT


+5
R6
INPUT CONNECTOR
C2
IC 4
2
4
C1
12
I6
14
I7
1,15
10
I0
12
I1
14
I2
6
I3
4
I4
2
I5
IC 5
-10
R5
Q1
1.0 mhz.
XTAL 1
+5
R2
C2
R1
C4
R3
9
8
FB2
FB1
EXT / INT
3
6
R MAX
MK5009
IC 3
OSC OUT
10
OSC OUT
1
TIME OUT
4
reset
R0
2 0
2 1
2 2
2 3
14
13
12
11

Clock Program for the SWTPC 6800 Computer System with the MP-T Interrupt Timer Option INTCLK-1

This program accepts and displays hours, minutes and seconds in a 12 hour format on the computer system's control terminal. The program works by first allowing the operator to enter the correct time. The MP-T interrupt Timer board is configured for a one second maskable interrupt, and each time an interrupt is generated the program updates and displays the new time. The program uses the lower 256 words of memory and is meant to be loaded in three parts from tape or instruction by instruction using Mikbug^{R}.

The interface address to which the MP-T Interrupt Timer is attached must be loaded into addresses AØØ2 and AØØ3 using Mikbug^{R} before the program is initiated. The most significant byte goes into AØØ2. The starting addresses of the various interface ports are given below:

Port	Address in Hex
I/O #Ø	8ØØØ
I/O #1	8ØØ4 (reserved for control interface)
I/O #2	8ØØ8
I/O #3	8ØØC
I/O #4	8Ø1Ø
I/O #5	8Ø14
I/O #6	8Ø18
I/O #7	8Ø1C

In addition addresses AØØØ and AØØ1 must be loaded with the starting address of the interrupt service routine which is Ø13D.

The program counter addresses, AØ48 and AØ49, must also be set to Ø1ØØ before the program is initiated. The program may then be started as described in the "Go to User's Program" section of the Engineering Note 100 in the Operating System secion of your yellow notebook. Once initiated, the program may be stopped only by depressing the "RESET" button. The time may be re-entered and restarted by retyping a G for "Go to User Program".

When the program is initiated, it will print the following on the control terminal:

SWTPC 6800 COMPUTER SYSTEM TIME:

HH:MM.SS

It will then wait for you to enter the appropriate data. You must be very careful when entering the time because the program makes no checks on the entry to see that correct ASCII data is being entered. Type in the data exactly as it is formatted on the screen. If there is only one hour digit, enter a space for the first character. The colon and period must be entered just as shown on the screen. The program will start as soon as the last digit is entered. Example:

```
12:17.07
 1:35.00
```

If you ever wish to reset the time, simply hit the RESET button and type in a G for "Go the User Program". The control terminal will display the time at which the RESET button was pressed. Simply overstrike the old time with the correct time. The program will resume as soon as the last digit is entered.

```
00010                          NAM     INTCLK
00020                          OPT     O
00030                          OPT     S
00040 0100                     ORG     $0100
00050 0100 0F                  SEI
00060 0101 8E A042             LDS     #$A042
00070 0104 CE 0020             LDX     #$0020
00080 0107 BD E07E             JSR     PDATA1
00090 010A CE 0060             LDX     #$0060
00100 010D BD E07E             JSR     PDATA1
00110 0110 CE 0061             LDX     #$0061
00120 0113 86 0D               LDA A   #$0D
00130 0115 BD E1D1             JSR     OUTEEE
00140 0118 BD E1AC LOOP1       JSR     INEEE
00150 011B A7 00               STA A   0,X
00160 011D 8C 0068             CPX     #$0068
00170 0120 27 03               BEQ     CONFIG
00180 0122 08                  INX
00190 0123 20 F3               BRA     LOOP1
00200 0125 FE A002 CONFIG      LDX     $A002
00210 0128 86 FF               LDA A   #$FF
00220 012A A7 02               STA A   2,X
00230 012C 86 3D               LDA A   #$3D
00240 012E A7 03               STA A   3,X
00250 0130 86 80               LDA A   #$80
00260 0132 A7 02               STA A   2,X
00270 0134 86 06               LDA A   #$06
00280 0136 A7 02               STA A   2,X
00290 0138 01                  NOP
00300 0139 0E                  CLI
00310 013A 01          LOOP2   NOP
00320 013B 20 FD               BRA     LOOP2
00330 013D FE A002 INTSER      LDX     $A002
00340 0140 A6 02               LDA A   2,X
00350 0142 CE 0060             LDX     #$0060
00360 0145 86 39               LDA A   #$39
00370 0147 C6 30               LDA B   #$30
00380 0149 A1 08               CMP A   8,X
00390 014B 27 04               BEQ     SKIP2
00400 014D 6C 08               INC     8,X
00410 014F 20 50               BRA     DISPLY
00420 0151 E7 08    SKIP2      STA B   8,X
00430 0153 86 35               LDA A   #$35
00440 0155 A1 07               CMP A   7,X
00450 0157 27 04               BEQ     SKIP3
00460 0159 6C 07               INC     7,X
00470 015B 20 44               BRA     DISPLY
00480 015D E7 07    SKIP3      STA B   7,X
00490 015F 86 39               LDA A   #$39
00500 0161 A1 05               CMP A   5,X
00510 0163 27 04               BEQ     SKIP4
00520 0165 6C 05               INC     5,X
00530 0167 20 38               BRA     DISPLY
00540 0169 E7 05    SKIP4      STA B   5,X
```

```
00550 016B 86 35          LDA A  #$35   "5"
00560 016D A1 04          CMP A  4,X
00570 016F 27 04          BEQ    SKIP5
00580 0171 6C 04          INC    4,X
00590 0173 20 2C          BRA    DISPLY
00600 0175 E7 04    SKIP5 STA B  4,X
00610 0177 86 32          LDA A  #$32   "2"
00620 0179 C6 39          LDA B  #$39   "9"
00630 017B A1 02          CMP A  2,X
00640 017D 27 08          BEQ    SKIP6
00650 017F E1 02          CMP B  2,X
00660 0181 27 16          BEQ    SKIP8
00670 0183 6C 02          INC    2,X
00680 0185 20 1A          BRA    DISPLY
00690 0187 86 31    SKIP6 LDA A  #$31   "1"
00700 0189 A1 01          CMP A  1,X
00710 018B 27 04          BEQ    SKIP7
00720 018D 6C 02          INC    2,X
00730 018F 20 10          BRA    DISPLY
00740 0191 A7 02    SKIP7 STA A  2,X
00750 0193 C6 20          LDA B  #$20
00760 0195 E7 01          STA B  1,X
00770 0197 20 08          BRA    DISPLY
00780 0199 86 30    SKIP8 LDA A  #$30   '0'
00790 019B C6 31          LDA B  #$31   '1'
00800 019D A7 02          STA A  2,X
00810 019F E7 01          STA B  1,X
00820 01A1 CE 0060 DISPLY LDX    #$0060
00830 01A4 BD E07E        JSR    PDATA1
00840 01A7 3B             RTI
00850 0020                ORG    $0020
00860 0020 10             FCB    $10,$16,$0D,$00,$00,$00
      0021 16
      0022 0D
      0023 00
      0024 00
      0025 00
00870 0026 53             FCC    /SWTPC 6800 COMPUTER SYSTEM TIME /
      0027 57
      0028 54
      0029 50
      002A 43
      002B 20
      002C 36
      002D 38
      002E 30
      002F 30
      0030 20
      0031 43
      0032 4F
      0033 4D
      0034 50
      0035 55
      0036 54
```

```
        0037 45
        0038 52
        0039 20
        003A 53
        003B 59
        003C 53
        003D 54
        003E 45
        003F 4D
        0040 20
        0041 54
        0042 49
        0043 4D
        0044 45
        0045 3A
00880   0046 0D             FCB     $0D, $0A, $00, $00, $00, $04
        0047 0A
        0048 00
        0049 00
        004A 00
        004B 04
00890   0060                ORG     $0060
00900   0060 0D             FCB     $0D
00910   0061 48             FCC     /HH: MM. SS  /
        0062 48
        0063 3A
        0064 4D
        0065 4D
        0066 2E
        0067 53
        0068 53
        0069 20
00920   006A 04             FCB     $04
00930   A048                ORG     $A048
00940   A048 0100           FDB     $0100
00950   A002                ORG     $A002
00960   A002 8010           FDB     $8010
00970   A000                ORG     $A000
00980   A000 013D           FDB     $013D
00990        E1AC   INEEE   EQU     $E1AC
01000        E07E   PDATA1  EQU     $E07E
01010        E1D1   OUTEEE  EQU     $E1D1
01020               END
LOOP1   0118
CONFIG  0125
LOOP2   013A
INTSER  013D
SKIP2   0151
SKIP3   015D
SKIP4   0169
SKIP5   0175
SKIP6   0187
SKIP7   0191
SKIP8   0199
```

```
DISPLY 01A1
INEEE  E1AC
PDATA1 E07E
OUTEEE E1D1

TOTAL ERRORS 00000
```