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5 Minutes or 5 Hours?

sorting techniques compared

Time Required to Sort N Items (seconds)

N	*Ripple*	*Modified*	*Bubble*	*S-M*
50	61	43	33	9
100	245	173	130	21
150	552	390	290	36
300	-	-	1224	85

Number of Swaps of Entries

N	*Ripple*	*Modified*	*Bubble*	*S-M*
50	1225	1225	1225	105
100	4950	4950	4950	260
150	11175	11175	11175	425
300	-	-	44850	1000

Number of Entry Comparisons

N	*Ripple*	*Modified*	*Bubble*	*S-M*
50	2450	1225	1225	263
100	9900	4950	4950	668
150	22350	11175	11175	1187
300	-	-	44850	2812

Table 1.

In an attempt to help justify the purchase of a floppy-disk system, I decided to put the computer to some practical use. It seems that not everyone considers piloting the Enterprise and destroying Klingons as a useful function worthy of another kilobuck investment. Using the system to keep track of household expenses seemed to be a good place to start. The Do-All program by Randy Miller (*Kilobaud*, August 1977) provided an ideal program.

After the program was loaded, a list of about a hundred items was entered for my demonstration of the practical advantages of a home computer. Everyone gathered for the show, and the program was run. A command was given to sort the list of data alphabetically. Everyone stared at the printer waiting for the output from this electronic marvel. Nothing happened.

Taking advantage of the pause and the presence of a captive audience, I discussed the advantages of adding a disk to the wonderful computer. At the end of my rather lengthy discussion there was still nothing on the printer. As time wore on, I began to consider the possibilities: hardware problems, software problems or simply another example of Murphy's Law. I felt there must be something wrong. After all, the Enterprise could move across the entire galaxy in only seconds, so alphabetizing this list could not take that long. Trying to remain cool, I suggested that we leave the computer and come back when it was done.

Much to my suprise, thirty minutes later the sorting was

```
5 REM --- RIPPLE SORT ---
6 REM --- SET UP ARRAY ---
10 N=150
20 DIM D(N)
30 J=N
40 FOR I=1 TO N
50 D(I)=J
60 J=J-1
70 NEXT
80 PRINT "*"
90 REM --- START OF SORT ---
100 M=N
105 C=0
110 FOR I=1 TO M-1
120 CM=CM+1
130 IF D(I)<=D(I+1) THEN 160
135 SW=SW+1
140 T=D(I):D(I)=D(I+1):D(I+1)=T
150 C=1
160 NEXT I
170 IF C=1 THEN 105
300 REM --- PRINT RESULTS ---
310 PRINT "SWITCHES =";SW
320 PRINT "COMPARISONS =";CM
330 PRINT "SIZE -";N
OK
```

Program A.

```
5 REM --- MODIFIED RIPPLE SORT ---
6 REM --- SET UP ARRAY ---
10 N=150
20 DIM D(N)
30 J=N
40 FOR I=1 TO N
50 D(I)=J
60 J=J-1
70 NEXT
80 PRINT "*"
90 REM --- START OF SORT ---
100 M=N
110 C=0
112 M=M-1
115 IF M=0 THEN 300
120 FOR I=1 TO M
125 CM=CM+1
130 IF D(I)<=D(I+1) THEN 160
135 SW=SW+1
140 T=D(I):D(I)=D(I+1):D(I+1)=T
150 C=1
160 NEXT I
170 IF C=1 THEN 110
300 REM --- PRINT RESULTS ---
310 PRINT "SWITCHES =";SW
320 PRINT "COMPARISONS =";CM
330 PRINT "SIZE -";N
OK
```

Program B.

complete. The printout revealed that the list had been sorted exactly as requested. What could have caused the delay? Perhaps my 8080 was slow. The benchmark programs in the basic timing comparisons article (*Kilobaud*, June 1977) were run and revealed that my computer ran a little faster than the one used for the article.

Since the program ran properly and the computer was up to speed, the solution to the problem must be in the sorting technique used in the program. An article on sorting routines by Andrew J. Rerko (*Kilobaud*, April 1977) was consulted and some test programs (Programs A, B and C) were run using the Ripple, Modified Ripple and Bubble routines described in the article.

The test programs consisted of setting up an array of N numbers in reverse order and using each of the sorting routines to sort them. The program execution times as well as number of comparisons and the number of element switches were recorded. The results are shown in Table 1. The results of this test revealed two things: The bubble sort was a little faster than the others, and sorting takes a lot of time. Sorting a simple table of 100 numbers took almost three minutes. No wonder the Do-All program took so long.

None of the common sorting methods described in Mr. Rerko's article would speed up a sorting program significantly. The solution to the problem, if any, would lie in an uncommon sorting routine. An article by John P. Grillo (*Creative Computing*, November 1976) discusses a technique called the Shell-Metzner Sort. This method offered significant speed advantages when sorting large amounts of data. A flowchart of the Shell-Metzner Sort is shown in Fig. 1. The article stated that a projected sort of 10,000,000 items would take 93 years using a bubble sort. Using the S-M technique, sorting the same data would require only 2.5 days. But would it help when sorting small amounts of data?

The benchmark sorting program was run using the S-M method and is shown in Program D. When sorting 150 items, the S-M sort was over eight times faster than the bubble sort and over 15 times faster than a ripple sort. The bubble sort required over 20 minutes to

```
5 REM --- BUBBLE SORT ---
6 REM --- SET UP ARRAY ---
10 N=150
20 DIM D(N)
30 J=N
40 FOR I=1 TO N
50 D(I)=J
60 J=J-1
70 NEXT
80 PRINT "*"
90 REM --- START OF SORT ---
100 M=N
110 FOR I=1 TO M-1
120 FOR J=I+1 TO M
125 CM=CM+1
130 IF D(I)<=D(J) THEN 170
135 SW=SW+1
140 T=D(I):D(I)=D(J):D(J)=T
170 NEXT J
180 NEXT I
300 REM --- PRINT RESULTS ---
310 PRINT "SWITCHES =";SW
320 PRINT "COMPARISONS =";CM
330 PRINT "SIZE -";N
OK
```

Program C.

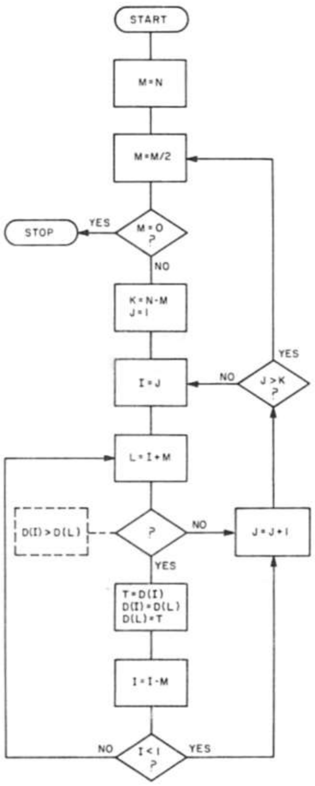


Fig. 1. Shell-Metzner Sort.

sort 300 items. The S-M method required only 85 seconds to sort the same list. The speed advantage of the S-M sort increases dramatically with the size of the list, but it seemed to speed sorts of even small lists.

The next step was to incorporate the S-M sort technique into the Do-All program and try it out. A random list of 100 entries was prepared and sorted by the standard program. Almost 45 minutes were required to sort this list. The Do-All program was then modified to use the S-M sort. Sorting the same list of 100 entries now required less than nine minutes. To modify the Do-All program, remove lines 4050-4115, 4150-4280, 9220-9340 and replace with the new lines shown in Progam E.

The only disadvantage I have found with the S-M technique so far is that it does require slightly more code, and it uses five index variables rather than only one or two as other sorting methods. Following the example benchmark program, it should be possible to use the S-M technique in other sorting programs.

Notes on Programs

All programs were run on an 8080 system with a 2 MHz clock and zero wait states. Mits 8K BASIC (Version 3.2) was used. Variable CM was used to total the number of comparisons between table entries. The variable SW was used to total the number of switches between table entries. ■

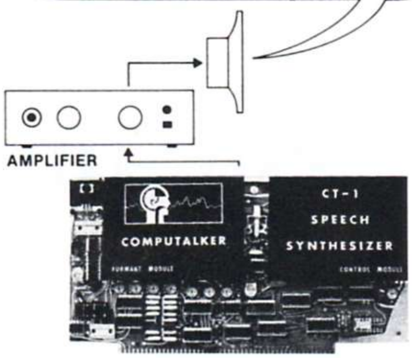
```
5 REM --- SHELL METZNER SORT ---
6 REM --- SET UP ARRAY ---
10 N=300
20 DIM D(N)
30 J=N
40 FOR I=1 TO N
50 D(I)=J
60 J=J-1
70 NEXT
80 PRINT "*"
90 REM --- START OF SORT ---
100 M=N
110 M=INT(M/2)
120 IF M=0 THEN 300
130 J=1 : K=N-M
140 I=J
150 L=I+M
155 CM=CM+1
160 IF D(I)<D(L) THEN 210
170 T=D(I): D(I)=D(L): D(L)=T
175 SW=SW+1
180 I=I-M
190 IF I<1 THEN 210
200 GOTO 150
210 J=J+1
220 IF J>K THEN 110
230 GOTO 140
300 REM --- PRINT RESULTS ---
310 PRINT "SWITCHES =":SW
320 PRINT "COMPARISONS =";CM
330 PRINT "SIZE -";N
OK
```

Program D.

```
LIST 4050

4050 M=P
4055 M=INT(M/2)
4060 IF M=0 THEN 1140
4065 J=1 : K=(P-1)-M
4070 I=J
4075 L=I+M
4080 IF N(T,I)<=N(T,L) THEN 4105
4085 GOSUB 9210
4090 I=I-M
4095 IF I<1 THEN 4105
4100 GOTO 4075
4105 J=J+1
4110 IF J>K THEN 4055
4115 GOTO 4070
BREAK
OK
LIST 4150

4150 M=P
4160 M=INT(M/2)
4170 IF M=0 THEN 1140
4180 J=1 : K=(P-1)-M
4190 I=J
4200 L=I+M
4210 IF A$(T,I)<=A$(T,L) THEN 4260
4220 GOSUB 9210
4230 I=I-M
4240 IF I<1 THEN 4260
4250 GOTO 4200
4260 J=J+1
4270 IF J>K THEN 4160
4280 GOTO 4190
BREAK
OK
LIST 9220

9220 X1=N(1,L)
9230 X2=N(2,L)
9240 B1$=A$(1,L)
9250 B2$=A$(2,L)
9260 FOR Z=1 TO 2
9270 N(Z,L)=N(Z,I)
9280 A$(Z,L)=A$(Z,I)
9290 NEXT
9300 N(1,I)=X1
9310 N(2,I)=X2
9320 A$(1,I)=B1$
9330 A$(2,I)=B2$
9340 RETURN
BREAK
OK
```

Program E.

COMPUTALKER



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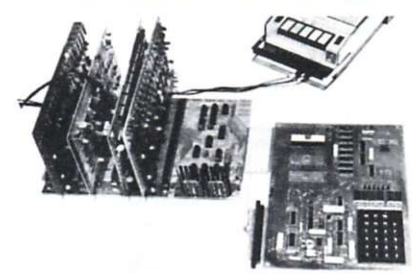

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When I first learned to program I was taught how to sign on to a computer system using a teletypewriter, type in a program and obtain the results at the terminal almost immediately. Other users around me, each working on his own program, were using similar type terminals. It appeared that each user had the entire computer to himself! This amazed and perplexed me. How could a computer run all the terminals and keep track of everybody—all at the same time? I conceded that the system was too complex to analyze (or perhaps it was sheer magic). Eventually I began to understand what went on by fighting my way through books on operating systems. I hope that future computer users will be spared a similar experience.

Last year, I purchased an M6800 system from SWTP. After programming on it for a while, I decided to investigate the possibility of implementing time-sharing on my system. It turns out to be simpler than you might think.

In this article, I will attempt to explain exactly why one would want to set up time-sharing and how it is done (for an M6800 system). I'll also try to explain some other programming considerations.

What is Time-sharing?

Time-sharing is accomplished by switching rapidly between many users. That means each user is allowed, in turn, a short duration of central processing unit (CPU) or microprocessing unit (MPU) time. This is called a time slice. For example, if the time slice were 50 milliseconds, then each user would use the processor for 50 milliseconds. If the switching is fast enough, the computer operation from each user's point of view will appear continuous.

Why Time-sharing?

The computer in a large system may cost several million dollars. Obviously, buying one computer for each user is extremely impractical. Sharing the computer among many users is a more effective way to utilize the system.

Another reason for time-sharing is because a computer's input/output (I/O) devices are much slower than the processor. If a terminal is outputting characters at 30 cps, there is sufficient time between characters for other work. Thus, with time-sharing, literally two, three or more times as much work can be accomplished than by a single user.

Most of the reasons given for using time-sharing would also apply to a microcomputer system (perhaps on a smaller scale). One possible argument against its use in microprocessors would be that they're too slow. However, for programs that do a lot of input and output and use little processor time (most games and business-type programs fall into this category), I see no reason why time-sharing cannot be implemented.

Using Interrupts

Proper use of interrupts comes first in implementing time-sharing. The ideas presented here are essentially the same, whether you have a small or large system.

An interrupt is basically a hardware mechanism that makes the microprocessor stop what it is doing and jump to another program (often known as a service routine). Sometimes it is possible to mask off an interrupt. If this happens, then the interrupt is ignored (or held pending until some later time).

Let's look briefly at the interrupt mechanisms on the SWTP system (which uses MIKBUG). There is a line marked IRQ (for interrupt request). If this line is temporarily gounded and the mask bit is a zero, an interrupt will occur. The system will then jump to the address contained in storage locations $A000 and $A001. One nice thing about the M6800 microprocessor is that when interrupted it stores everything (i.e., the condition code, B, A, X and program counter registers) on the stack. This means that little effort is required to remember where each program is when it was stopped. With other processors, you would typically have to store all registers away, which may take many instructions. One danger of this is that if another interrupt occurs before all registers are stored away, some register contents may be lost. The M6800 processor saves everything in one swoop.

Incidentally, you may, if desired, use the nonmaskable interrupt NMI instead of IRQ. The interrupt address would then be stored at locations $A006 and $A007. I prefer, however, to use an interrupt that is maskable.

Software

Program A actually implements time-sharing. The comments should aid you in understanding how the program works. It starts at address BEGIN. Also, some hardware must be set up so that an IRQ interrupt is generated at regular intervals (this is explained later). Each time an interrupt is generated, one program is stopped and the next one in line is started. For example, if program 1 is currently executing and we are time-sharing three programs, then four interrupts will result in program 2 being executed (1 then 2 then 3 then 1 then 2). With Program A, you may time-share up to 15 different programs.

The part of the program that actually does the time-sharing (the service routine) is statements 69 to 83. Statements 1 to 64 merely initialize various parameters. The initialization routine basically works thus—initially each program is assigned a stack pointer. The stack-pointer addresses differ by 16 bytes. That is, program 1 has a stack-pointer value of END + 16, program 2 has a value of END + 32, etc. These values are stored at addresses STACK1, STACK2, etc.

The initialization routine also clears the condition-code register and stores the starting address of each program at the appropriate position in each stack. When the RTI instruction is executed, the processor fetches all registers (program counter included in the fetch) from the stack and starts (or resumes) a program at the appropriate address.

The purpose of clearing the condition code in the stack for each program is that when the RTI instruction is executed, the interrupt mask bit will not become set (which would lock up the system). For example, if the stack pointer were at $0F00, we would clear address $0F01 and store the starting address at address $0F06. An RTI instruction would then load the condition-code register with $00 and the program counter with the number at address $0F06. Initially, we don't care what the other register contents are.

The service routine performs a very simple function. It stops the current program from executing and runs the next program in line; it accomplishes this by storing away the current stack pointer and loading the next one. When the RTI instruction is executed, we do not return exactly where we left off (that is, resume execution of the same program) as is normally done. Instead, we go to the next program. This occurs because the stack pointer has been changed.

You will also observe that in the service routine, I purposely store data where instructions are. This is a trick I use to make the service routine execute quickly, although in general this is not good practice. I do have another version of the service routine that does not do this; however, it is slightly longer.

For a simple demonstration of time-sharing, Program B may be used. This program assumes that you have a serial interface port (which uses an ACIA) at the correct baud rate at address $8008. You will also have to have a terminal plugged in at this address. We will call this terminal 2. Terminal 1 will be at the control interface. If you run the Program B starting

Program A. Time-share program.

```
STMT  ADDR   CODE        STATEMENT
  1   0E00                          ORG       $0E00
  2   0E00               STRING     EQU       $E07E
  3   0E00               IN2HEX     EQU       $E055
  4   0E00               INHEX      EQU       $E0AA
  5   0E00               CR         EQU       $0D
  6   0E00               LF         EQU       $0A
  7   0E00               EOT        EQU       $04
  8   0E00   CE   0E92   BEGIN      LDX       #SERVCE
  9   0E03   FF   A000              STX       $A000      INITIALIZE INTERRUPT REQUEST POINTER
 10   0E06   CE   0E61              LDX       #MES1
 11   0E09   BD   E07E              JSR       STRING     PRINT '#PROGRAMS='
 12   0E0C   BD   E0AA              JSR       INHEX      GET NUMBER OF PROGRAMS TO BE TIME SHARED
 13   0E0F   B7   0EB2              STA   A   NUMBER
 14   0E12   16                     TAB
 15   0E13   CE   0EB3              LDX       #STACK1
 16   0E16   FF   0E5D              STX       TEMP0
 17   0E19   CE   0EE1              LDX       #END+16    X-REG NOW POINTS TO THE BEGINNING
 18   0E1C   FF   0E5F              STX       TEMP       OF THE STACK AREA
 19   0E1F   FE   0E5D   A1         LDX       TEMP0      LOAD ADDRESS OF STACK I
 20   0E22   FF   0E2E              STX       ST0+1
 21   0E25   08                     INX
 22   0E26   08                     INX
 23   0E27   FF   0E5D              STX       TEMP0      STORE ADDRESS OF STACK I+1
 24   0E2A   FE   0E5F              LDX       TEMP
 25   0E2D   FF   FFFF   ST0        STX       $FFFF      INITIALIZE STACK I
 26   0E30   6F   01                CLR       1,X        CLEAR CONDITION CODE REGISTER I
 27   0E32   86   06                LDA   A   #6
 28   0E34   8D   22                BSR       ADD
 29   0E36   FF   0E4A              STX       ST+1       THE X-REG NOW POINTS TO THE ADDRESS WHERE THE
 30   0E39   86   0A                LDA   A   #10        STARTING ADDRESS OF PROGRAM I STARTS
 31   0E3B   8D   1B                BSR       ADD
 32   0E3D   FF   0E5F              STX       TEMP       THE ADDRESS OF THE NEXT STACK WILL BE 16
 33   0E40   CE   0E73              LDX       #MES2      BYTES AWAY FROM THE CURRENT STACK
 34   0E43   BD   E07E              JSR       STRING     PRING 'START='
 35   0E46   BD   0E7C              JSR       INPUTX     INPUT STARTING ADDRESS
 36   0E49   FF   FFFF   ST         STX       $FFFF      INITIALIZE PROGRAM COUNTER I
 37   0E4C   5A                     DEC   B
 38   0E4D   26   D0                BNE       A1
```

```
0E4F  86    01              LDA  A  #1          BEGIN RUNNING PROGRAM#1
0E51  B7    0EB1            STA  A  STATUS
0E54  BE    0EB3            LDS     STACK1
0E57  3B                    RTI
0E58  08          ADD       INX                 THIS SUBROUTINE INCREASES THE X-REG
0E59  4A                    DEC  A              BY THE VALUE IN THE A-REG
0E5A  26    FC              BNE     ADD
0E5C  39                    RTS
0E5D              TEMP0     RMB     2
0E5F              TEMP      RMB     2
0E61  0D0A        MES1      FCB     CR,LF
0E63  2350                  FCC     /#PROGRAMS(1-F)?/
      524F
      4752
      414D
      5328
      312D
      4629
      3F
0E72  04                    FCB     EOT
0E73  0D0A        MES2      FCB     CR,LF
0E75  5354                  FCC     /START=/
      4152
      543D
0E7B  04                    FCB     EOT
0E7C  36          INPUTX    PSH  A              SUBROUTINE TO INPUT THE X-REG
0E7D  37                    PSH  B
0E7E  BD    E055            JSR     IN2HEX
0E81  B7    0E90            STA  A  DATA
0E84  BD    E055            JSR     IN2HEX
0E87  B7    0E91            STA  A  DATA+1
0E8A  FE    0E90            LDX     DATA
0E8D  33                    PUL  B
0E8E  32                    PUL  A
0E8F  39                    RTS
0E90              DATA      RMB     2
                  *
                  *THE PURPOSE OF THIS SERVICE ROUTINE IS TO
                  *STOP PROGRAM I AND BEGIN RUNNING PROGRAM I+1
0E92  CE    0EB1  SERVICE   LDX     #STACK1-2
0E95  B6    0EB1            LDA  A  STATUS      DETERMINE THE PROGRAM CURRENTLY EXECUTING
0E98  48                    ASL  A
0E99  B7    0E9D            STA  A  ST1+1
0E9C  AF    00    ST1       STS     X           SAVE THE STACK POINTER AT THE APPROPRIATE
0E9E  47                    ASR  A              ADDRESS(STACK1,STACK2,. . .,STACKF)
0E9F  4C                    INC  A              BEGIN TO EXECUTE THE NEXT PROGRAM
0EA0  B1    0EB2            CMP  A  NUMBER      CHECK FOR WRAP AROUND
0EA3  2F    02              BLE     L3
0EA5  86    01              LDA  A  #1          IF WRAP AROUND EXISTS EXECUTE PROGRAM#1
0EA7  B7    0EB1  L3        STA  A  STATUS      INDICATE THAT THE NEXT PROGRAM IS EXECUTING
0EAA  48                    ASL  A
0EAB  B7    0EAF            STA  A  ST2+1
0EAE  AE    00    ST2       LDS     X           LOAD THE APPROPRIATE STACK POINTER
0EB0  3B                    RTI                 BEGIN ACTUAL EXECUTION
0EB1              STATUS    RMB     1           CURRENT PROGRAM IN EXECUTION(1 TO F)
0EB2              NUMBER    RMB     1           TOTAL NUMBER OR PROGRAMS TO BE TIME SHARED
0EB3              STACK1    RMB     2           STACK POINTER FOR PROGRAM#1
0EB5              STACK2    RMB     2           STACK POINTER FOR PROGRAM#2
0EB7              STACK3    RMB     2           . . . ETC . . .
0EB9              STACK4    RMB     2
0EBB              STACK5    RMB     2
0EBD              STACK6    RMB     2
0EBF              STACK7    RMB     2
0EC1              STACK8    RMB     2
0EC3              STACK9    RMB     2
0EC5              STACKA    RMB     2
0EC7              STACKB    RMB     2
0EC9              STACKC    RMB     2
0ECB              STACKD    RMB     2
0ECD              STACKE    RMB     2
0ECF              STACKF    RMB     2
                  *
0ED1              END       EQU     *
                  *
A048                        ORG     $A048
A048  0E00                  FDB     BEGIN
```

SYMBOL	VALUE	DEFN	REFERENCES	
STRING	E07E	2	11	34

at address $0000, a series of zeros should be printed out on terminal 2. Starting at address $0008 will result in a printout of all ones.

We will now time-share both parts of this program. For this part, first press the reset button. This will set the mask bit to a one. Now set the interrupt rate to a very slow value, say once every ten seconds if possible. (We'll discuss the hardware to accomplish this in a moment.) Now run Program A, starting at address BEGIN ($0E00). You will then be required to type in the number of programs you want (this is a single hex number from 1 to F) to time-share, followed by their respective starting addresses. The data is entered as follows:

```
#PROGRAMS(1-F)?2
START=0000
START=0008
```

After having done the above, you should see the printout at terminal 2 alternate between strings of zeros and strings of ones. If you slowly increase the interrupt rate you will notice that the respective strings become shorter and shorter.

If you do not have a second terminal, you may unplug the terminal from the control interface in each of the above steps and plug it into the other port after having typed a G. Be very careful when doing this; you should avoid the practice in general.

Perhaps you have wondered why I used another I/O port and not MIKBUG directly. MIKBUG outputs a character by software, bit by bit. If you were to interrupt the output routine, the output bits would not appear at the proper time. That is, you cannot output part of a character now and the other part later. This problem does not occur with an ACIA because a character is output by a single store instruction.

Hardware

As stated previously, interrupts must be generated at regular intervals. An interrupt should be generated by a pulse that grounds the IRQ line for a very short duration before returning to a high state. This is because the IRQ line must return to its high state before the service routine has completed its job. If this is not done, then another interrupt will occur immediately after the service is completed, causing some programs to be skipped in execution. A pulse duration of 50 microseconds works quite well. An interrupt will not occur inside the service routine because the mask bit will be set at that time. If, however, you decide to use NMI instead, your pulse must be much narrower (e.g., 10 microseconds). Otherwise, the service routine may keep interrupting itself, which can lead to difficulties!

If you have a signal generator that can generate a pulse, so much the better. I also understand that SWTP now has available an interrupt timer board. In place of these alternatives, you may use the circuit shown in Fig. 1. There are no doubt other circuits that will work as well. Resistors R1 and

IN2HEX	E055	3	57	59	
INHEX	E0AA	4	12		
CR	000D	5	49	52	
LF	000A	6	49	52	
EOT	0004	7	51	54	
BEGIN	0E00	8	105		
A1	0E1F	19	38		
ST0	0E2D	25	20		
ST	0E49	36	29		
ADD	0E58	43	28	31	45
TEMP0	0E5D	47	16	19	23
TEMP	0E5F	48	18	24	32
MES1	0E61	49	10		
MES2	0E73	52	33		
INPUTX	0E7C	55	35		
DATA	0E90	65	58	60	61
SERVCE	0E92	69	8		
ST1	0E9C	73	72		
L3	0EA7	79	77		
ST2	0EAE	82	81		
STATUS	0EB1	84	40	70	79
NUMBER	0EB2	85	13	76	
STACK1	0EB3	86	15	41	69
STACK2	0EB5	87			
STACK3	0EB7	88			
STACK4	0EB9	89			
STACK5	0EBB	90			
STACK6	0EBD	91			
STACK7	0EBF	92			
STACK8	0EC1	93			
STACK9	0EC3	94			
STACKA	0EC5	95			
STACKB	0EC7	96			
STACKC	0EC9	97			
STACKD	0ECB	98			
STACKE	0ECD	99			
STACKF	0ECF	100			
END	0ED1	102	17		

STMT	ADDR	CODE		STATEMENT			
1	0000	8D	0E	PRGRM1	BSR		SETUP
2	0002	86	30	LOOP1	LDA	A	#'0
3	0004	8D	18		BSR		OUTPUT
4	0006	20	FA		BRA		LOOP1
5	0008	8D	06	PRGRM2	BSR		SETUP
6	000A	86	31	LOOP2	LDA	A	#'1
7	000C	8D	10		BSR		OUTPUT
8	000E	20	FA		BRA		LOOP2
9	0010	FE	001C	SETUP	LDX		ACIA
10	0013	86	13		LDA	A	#$13
11	0015	A7	00		STA	A	0,X
12	0017	86	11		LDA	A	#$11
13	0019	A7	00		STA	A	0,X
14	001B	39			RTS		
15	001C	8008		ACIA	FDB		$8008
16	001E	DE	1C	OUTPUT	LDX		ACIA
17	0020	C6	02	T1	LDA	B	#$02
18	0022	E4	00		AND	B	0,X
19	0024	27	FA		BEQ		T1
20	0026	A7	01		STA	A	1,X
21	0028	39			RTS		

SYMBOL	VALUE	DEFN	REFERENCES	
PRGM1	0000	1		
LOOP1	0002	2	4	
PRGRM2	0008	5		
LOOP2	000A	6	8	
SETUP	0010	9	1	5
ACIA	001C	15	9	16
OUTPUT	001E	16	3	7
T1	0020	17	19	

Program B. Test program.

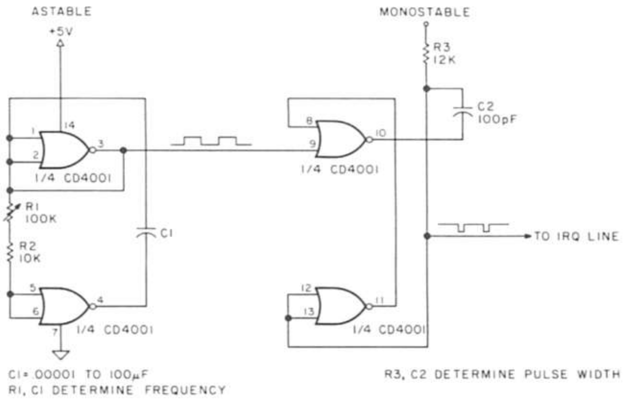

Fig. 1. Interrupt-oscillator circuit.

C1 may be changed to vary the interrupt rate.

The question of how often we generate an interrupt now arises. Suppose we were to generate an interrupt once every ten seconds. If each user were printing out data, the printing would be done in spurts. Another problem would be that a user might type in data while another program was being run, resulting in input being lost. If we increased the interrupt rate fast enough, the output would appear smooth and continuous. Also it would be impossible for a person to type so fast that some data might be lost. So, it would seem that the faster we generate interrupts, the better.

The problem, however, is that the service routine takes a fixed amount of time to perform its duties. As we increase the rate of interrupting, the percentage of time the microprocessor is in the service routine increases. It is possible to generate interrupts so fast that 99 percent of the time is spent in the service routine, meaning that only one percent of the processing time actually performs useful work. Therefore, we should try to choose an optimal interrupt rate. I find that 100 interrupts per second works well. You should experiment to determine what works best for you. You could also determine the optimal rate mathematically; this would require that you examine matters in more detail.

Programming Considerations

Suppose you are time-sharing two or more programs at the same time. If these programs are in different segments of memory, there are no problems. Often, however, it is desirable that programs be able to share the same subroutines; this is necessary for large programs.

For example, BASIC might take up approximately 8K bytes. If each of four users had his own copy of BASIC, we would need at least 32K! If all four users could use one copy of BASIC at the same time we would need only 8K, resulting in a tremendous saving in memory (of course, each user still needs his own area to store his program).

But wait a minute! You cannot take any subroutine and expect it to work on a time-shared basis. As a matter of fact, most subroutines would not work at all. A subroutine that is reentrant is needed. A reentrant subroutine is defined as one that may be employed by many users at the same time (i.e., on a time-shared BASIC). Let's go over some examples of reentrant and non-reentrant subroutines.

Let's say we wanted to write a subroutine that would add the contents of the A register to that of the B register and store the result in the B register. It is also desired that the A register not be modified when we return from this subroutine. The subroutine in Program C will accomplish this for a single user and will prove to be non-reentrant.

Suppose two users call this routine at about the same time, and the values of the A register for both users are $01 and $02, respectively, upon entry into the subroutine. User 1 enters the subroutine and executes the first three instructions before an interrupt occurs. Location TEMP will then contain a value of $01.

Let us now assume that after the interrupt, program 2 enters the subroutine and is interrupted after three instructions have been executed. Location TEMP now has a value of $02. After the interrupt, user 1 will resume execution and execute statement 4, a load instruction. The A register will now contain a value of $02. We will then return from the subroutine.

You will immediately notice that from user 1's point of view, the value of the A register has been changed from $01 to $02 upon leaving the subroutine. This was not intended. So, we have here an example of a subroutine that works for one user, but falls apart for two.

Now, let us write the same subroutine in a different way, as shown in Program D. This subroutine turns out to be reentrant. We'll assume the same sequence of events as in the previous example. User 1 will save $01 by pushing it onto its own stack. When user 2 enters the subroutine, it saves $02 on its own stack. The crucial point here is that each program has its own stack. Consequently, $01 and $02 are stored in different locations. When each program executes the PUL A instruction, it does so with respect to its own stack. This means that the proper values are restored. Two or more users can therefore use this subroutine at the same time!

Another example of reentrant programming can be found in the Motorola M6800 Programming Manual. For example, on pages 10-12 a reentrant 16-bit multiplication subroutine is depicted. The key technique here is that everything is first pushed onto the stack. The TSX (Transfer Stack Pointer to Index) is then executed. All instructions that follow are executed in the indexed mode. This is equivalent to the work area being in the stack. Nowhere in the program is there a label designating a storage location.

```
STMT ADDR    CODE          STATEMENT
  1  0000    B7    0009    ADD     STA   A    TEMP    SAVE A-REGISTER
  2  0003    1B                    ABA
  3  0004    16                    TAB
  4  0005    B6    0009            LDA   A    TEMP    RESTORE A-REGISTER
  5  0008    39                    RTS
  6  0009                  TEMP    RMB        1

SYMBOL    VALUE    DEFN    REFERENCES
ADD       0000     1
TEMP      0009     6       1    4
```

Program C. A non-reentrant subroutine.

```
STMT  ADDR   CODE           STATEMENT
   1  0000   36             ADD     PSH   A         SAVE A-REGISTER
   2  0001   1B                     ABA
   3  0002   16                     TAB
   4  0003   32                     PUL   A         RESTORE A-REGISTER
   5  0004   39                     RTS

SYMBOL   VALUE   DEFN   REFERENCES
ADD      0000       1
```

Program D. A reentrant subroutine.

In general, writing reentrant subroutines may be easy or difficult, depending on the type of instruction set available. For example, if the M6800 microprocessor had a PSH X instruction, the task of reentrant programming would be greatly simplified. Other processors have defects of their own. Perhaps in the future someone will design a stack-oriented microprocessor. Reentrant programming may then become a trivial task. Incidentally, stack processors have other advantages than the one given.

You must be careful, though, that the stack pointer does not change too much from its initial value. At the start of execution, the stack pointers of all programs initially differ by 16. This will change slightly throughout the course of execution. For example, if we were in program 1, an interrupt might occur after we had jumped to a subroutine. This would cause the stack pointer to differ by 2 from its initial value. If we nested subroutines too deeply, say 8 or 9, we could change the stack pointer so much that we'd wipe out the stack of another program! This problem can be solved, however, by initially separating the stack pointers by more than 16.

Since the time-sharing routine uses the stack pointer for its own bookkeeping, you must be careful what you do with the stack pointer. A common technique is to use the stack pointer to point to a list of numbers. This will not work if the stack pointer is pointing to, say, the middle of a list of numbers. It won't work because on interrupt, the registers that are stored in the stack will destroy some numbers in the list. Jumping to a subroutine or doing PSHES and PULLS modify the stack pointer but are not harmful because the stack pointer is changed in a way that won't change valid data in the stack.

Remarks

In this article, I have tried to point out some of the essential points that must be understood in order to implement time-sharing. I hope I've taken some of the mystery out of it. ■

Cassette Recorder Disaster: Ground Loops

the problem, and a solution

Photo 1. Cable adapter made from standard parts.

Photo 2. The ungrounding adapter is inserted between the computer and the recorder in the EAR or AUX lines.

Dave Waterman
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Alpine CA 92001

Dave Lien
8662 Dent Dr.
San Diego CA 92119

The ordinary household cassette recorder was not designed with anything as exotic as digital data recording in mind. Computer experimenters pressed the recorder into this role. All things considered, the device works well. However, two problems immediately arise—low-level ground loops, which can badly degrade the system's reliability, and the lack of a convenient means of overriding the computer's control of the drive motor. We'll address the problems separately.

Why the Ho Hum

The standard cassette recorder was not designed to input audio (data or otherwise) via its AUX or MIC jack, and an instant later feed audio out through the EAR jack—with all jacks tied to a common external ground. Many recorders do not even have a common *internal* ground for these jacks and the REM motor control jack. Those that do usually have a relatively high-resistance ground. When this shaky ground system is tied to the computer's common ground by way of three separate shielded cables (DATA-in, DATA-out and REMOTE motor control), the ground loops created can completely destroy the reliability of the recording system.

A Way Around this Hummer

The standard way out of this ground-loop problem is to unplug either the DATA-in or DATA-out plug from the recorder, whichever is not in use. It usually works but is inconvenient, particularly for the half-way serious computer user who values his time. Fortunately, there are a couple of simple and inexpensive solutions (until more suitable recorders hit the market at the right price).

Photo 1 shows a simple cable adapter made from standard parts. It consists of a miniplug, minijack and a short (the shorter the better) piece of *unshielded* wire. This wire is soldered *only* to the "hot" (center) connectors of both plug and jack.

This ungrounding adapter is inserted between the computer and the recorder in the EAR line or the AUX line, as shown in Photo 2. Given the choice, it is better to use an unbroken shield to the AUX jack to assure a good-quality recording. A properly recorded tape can always be reloaded, but a bad tape cannot. Keep power supplies and other possible sources of interference away from this unshielded adapter. It works well.

The second ground-looping solution is a variation on the same theme, but it also solves the annoying problem of lack of convenient motor control. Two jacks, one miniature (to match

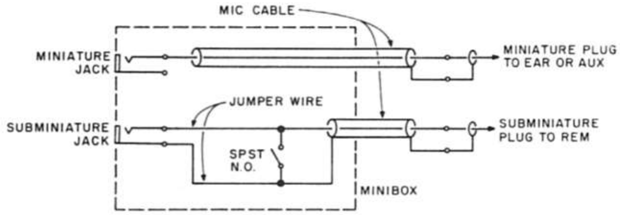

Fig. 1.

the EAR plug) and one subminiature (to match the REM motor plug), are mounted in a small plastic case. The one shown in Photo 3 was used to hold a burglar-alarm panic switch. A shielded cable is run from the EAR jack in the box to the EAR plug for the recorder. Note in Fig. 1 that the shielded part of the cable is not attached to break the ground loop. Another shielded cable is run from the REM jack to the REM plug for the recorder, but its ground integrity is maintained.

Similar switch boxes are equipped with an SPST normally closed switch. If this is the case with the one you select, replace the switch with a similar SPST switch with normally *open* contacts, as shown in Fig. 1. Unshielded jumper wires are then connected from the switch to the subminiature REM Jack-in-the-box (sorry about that!). Paralleling the REM line with the push-button switch allows us to turn on the motor.

We can always turn the recorder *off* with its normal STOP button. This arrangement allows us to turn the motor on for purposes of rewinding tape, advancing a cassette past the leader or going fast forward to find a certain spot on the tape.

Photo 4 shows this handy auxiliary control box installed with a Radio Shack TRS-80 computer system. It should work as well with any other.

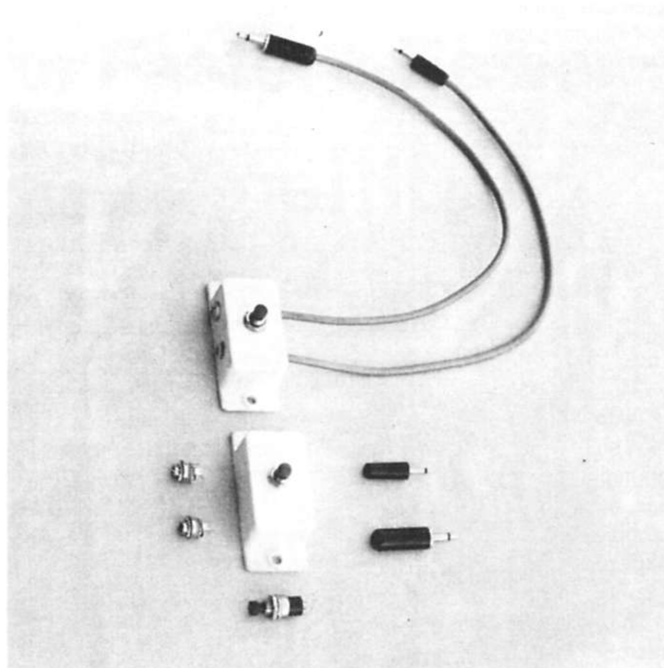

Photo 3. Small case with mounted jacks.

Success

Both of these solutions to nuisance problems work well, are inexpensive and require no special tools or skill. Give them a try, and see how much more you enjoy your computer.■

Photo 4. The control box installed with a TRS-80.

Glen Charnock
864 Palomar Way
Oxnard CA 93030

A Different Search Technique

don't just try it—benchmark it

Good things *can* come in small packages. This programming trick is so simple it can easily retrofit to existing programs; yet, it can substantially reduce the time needed to search a table.

The traditional method of searching a table is shown in Fig. 1. First, a loop index is initialized. Then a loop is executed, comparing the table element with the search argument and incrementing the loop index until either a match is found or the table is exhausted. When the loop is exited, the loop index points either to the location of the matching table element or, if no match was found, to the last table element plus one.

The new method dimensions one extra place at the end of the table for a "dummy" value. To search the table, first move the search value into this dummy location at the end of the table; then initialize the loop index and begin looping through the table. This time, however, only search for a match and increment the loop index within the loop. You don't need to test for the end of the table . . . if you haven't found a match by then, you will on the last table entry because you've already moved the search argument into this last entry. Thus, you save one comparison for each table entry searched (see Fig. 2).

Depending on the language and the way the computer implements subscripts, this trick can save as much as half the the time needed for the search. That's pretty good for such a small change!

I learned this programming trick from the advertising brochure of Software Consulting Services of Allentown PA. Further details may be found in *The Art of Computer Programming*, Vol. 3, "Sorting and Searching," by Donald E. Knuth. ■

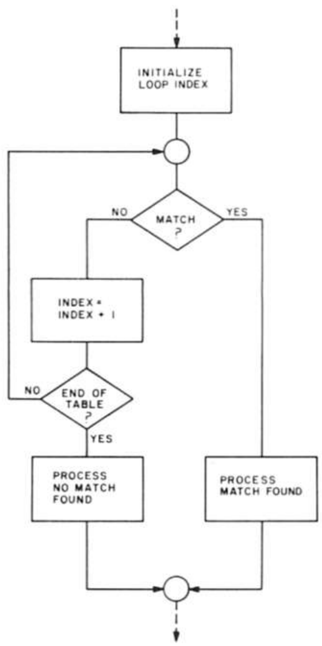

Fig. 1. Traditional table-searching method.

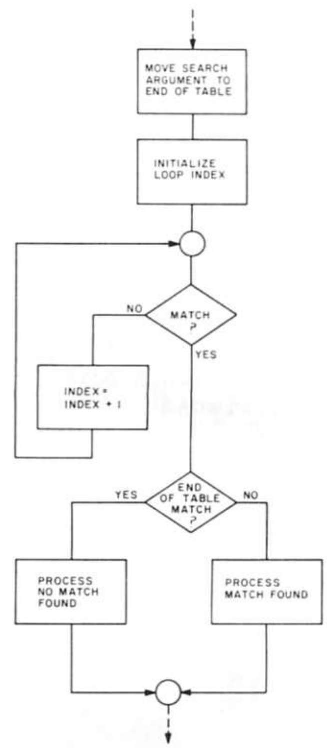

Fig. 2. A different search technique.

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Use Kilobaud Classified

Contest!

Another month has gone by, and the votes have been counted. The article winner for the wintry month of February is Dr. Mark Boyd, author of "Interfacing Tips" on page 72.

Choice-of-a-book-from-the-Book Nook winner is Larry Nelson of Marion IN.

To both Mark and Larry, we offer congratulations and best wishes.

And to all of our readers who are responding enthusiastically with their votes, we also offer congratulations, best wishes and good reading.

Keep voting!

NEW PRODUCTS

(from page 15)

passage. Kinged pieces are identified on the display and messages appear at the right of the board relating to each move.

Included with Video Checkers is a 9-page instruction book. The game's author has invited purchasers of the cassette to add enhancements to the program. Therefore, an entire program listing is included.

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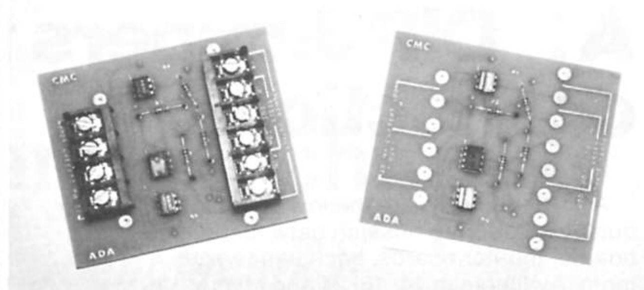

CmC's ADA.

ADA sells for $24.50 with drilled, plated-through solder pads for all connections, or for $29.50 with barrier strips and screw terminals.

CONNECTICUT microCOMPUTER, 150 Pocono Road, Brookfield, CT 06804.

This Is the Electric Pencil

The Electric Pencil is a character-oriented word-processing system. This means that text is entered as a continuous string of characters and manipulated as such, allowing the user freedom and ease in the movement and handling of text. Since lines are not delineated, any number of characters, words, lines or paragraphs may be inserted or deleted anywhere in the text. The typing of carriage returns as well as word hyphenation is not required since each line of text is formatted automatically. Whenever text is inserted or deleted, existing text is pushed down or pulled up in a wraparound fashion. Everything appears on the video display screen as it occurs, which eliminates any guesswork.

When text is printed, The Electric Pencil automatically inserts carriage returns where they are needed. Numerous combinations of line length, line spacing and page spacing allow for any form to be handled. Pages may be numbered as well as titled.

Minimum system hardware requirements: (Stock system —other versions available by special order) SOL-20/SOLOS (or equivalent: system w/ VDM-1 and CUTS cassette), 8K of memory starting at location 0000, Printer (TTY, Selectric, etc.), Video Display Monitor, Cassette recorder.

The Electric Pencil is available from stock at: Interactive Computers, 7646 1/2 Dashwood, Houston TX 77036.

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Features:	TH3216	TH6416
Display	32 characters by 16 lines 2 pages	64 characters by 16 lines scrolling
Characters	Upper case ASCII	Upper/lower case optional
Baud Rates	300-9600	110-9600
Controls	Read to/from memory	Scroll up or down
Price (kit)	$149.95	$189.95

Above prices include all IC sockets

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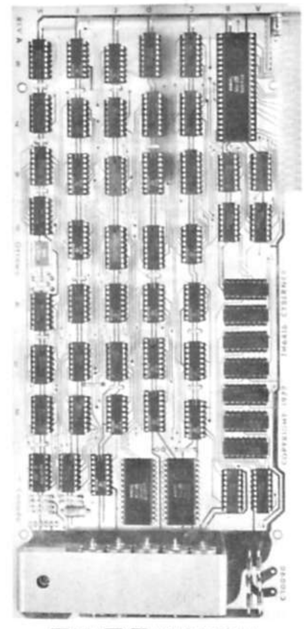
Video/RF Modulator, VD-1 . . . . 6.95
Lower case option (TH6416 only) 10.00
Assembled, tested units, add 60.00



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556	.75
566	1.49
567	1.49
324	1.49
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Atlanta GA

The 16th Annual Convention of the Association for Educational Data Systems will be held in Atlanta GA, May 15-19, 1978. For further information, contact: Dr. James E. Eisele, Office of Computing Activities, University of Georgia, Athens GA 30602.

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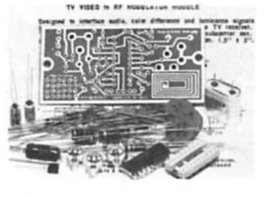

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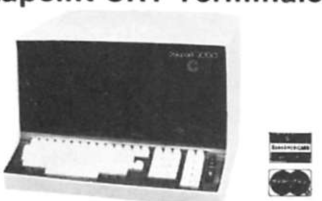

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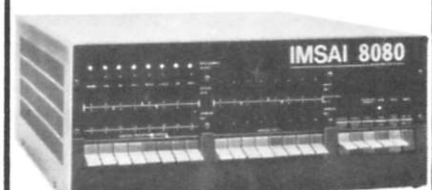

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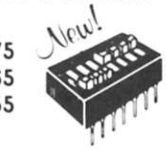

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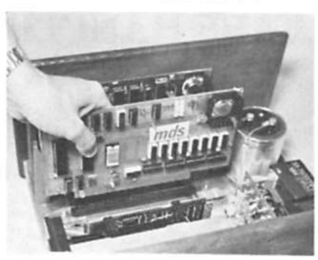

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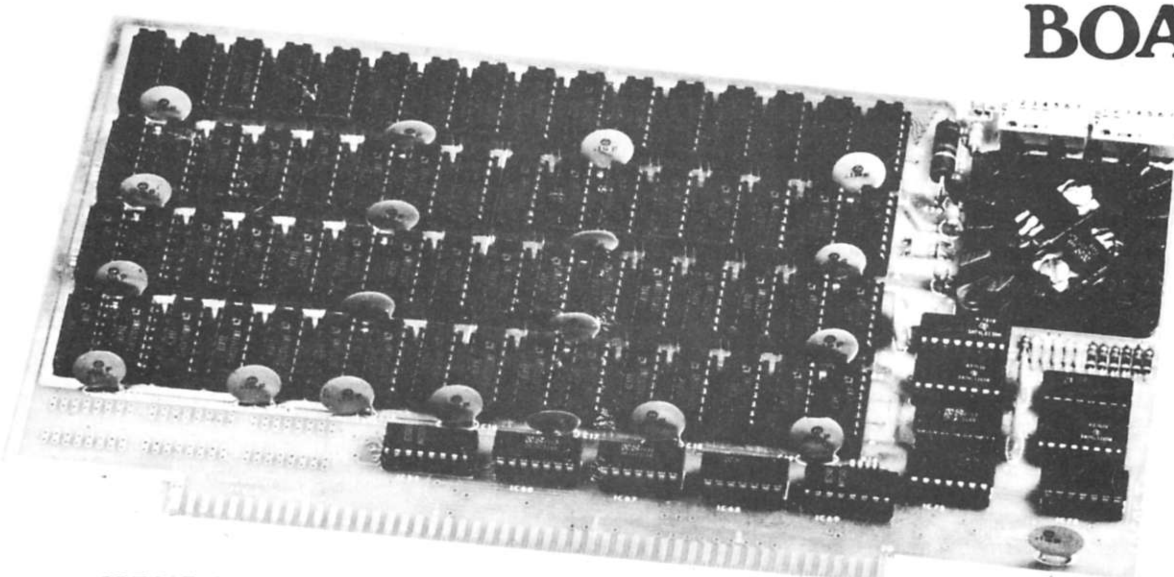

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PHONE: (___)______________ *Visa (BankAmericard) & Master Charge Accepted.*

S.D. COMPUTER PRODUCTS

AN EMPIRE IND. CO. — S2

P.O. BOX 28810K — DALLAS, TEXAS 75228

EXPANDABLE EPROM BOARD

16K OR 32K EPROM $49.95 W/OUT EPROM

Allows You to Use Either 2708's For 16K of Eprom or 2716's For 32K of Eprom.

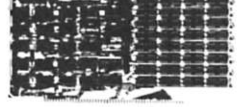
KIT FEATURES:

1. All Address Lines & Data Buffered
2. Quality Plated through P.C. Board Including Solder Mask and Silk Screen
3. Selectable Unit States
4. On Board Regulation Provided
5. All Sockets Provided W/Board

WE CAN SUPPLY 450As 2708's AT $11.95 WHEN PURCHASED WITH BOARD.

EXPANDORAM
THE ULTIMATE RAM BOARD
32K FOR $475.00

32K MODEL	
8K	$151.00
16K	259.00
24K	367.00
32K	475.00



64K MODEL	
16K	$281.00
32K	519.00
48K	757.00
64K	995.00

THE 32K VERSION USES THE MOSTEK MK4115 RAM AND HAS 8K BOUNDARIES AND PROTECTION & UTILIZES DIP SWITCHES. P. C. BOARD COMES WITH SOCKETS FOR 32K OPERATION

BUY A S100 COMPATIBLE RAM BOARD AND UPGRADE THE SAME BOARD TO A MAXIMUM OF 65K MEMORY IN STEPS OF EITHER 8K OR 16K AT YOUR OPTION BY MERELY PURCHASING MORE RAM CHIPS FROM SD COMPUTER PRODUCTS.

THE 64K VERSION USES THE MOSTEK MK4116 RAM AND HAS 16K BOUNDARIES AND PROTECTION & UTILIZES DIP SWITCHES. P. C. BOARD COMES WITH SOCKETS FOR 64K OPERATION

LOOK AT THE FEATURES WE HAVE BUILT INTO THE EXPANDORAM!

- MEMORY ACCESS TIME IS 375 ns
- MEMORY CYCLE TIME IS 500 ns
- POWER REQUIREMENTS ARE:
  8 VDC 400 MA DC
  18 VDC 400 MA DC
  —18 VDC 30 MA DC
- ON BOARD INVISIBLE REFRESH
- NO WAIT STATES REQUIRED
- NO CYCLE STEALING NEEDED
- ON BOARD REGULATION
- CONTROL, DATA & ADDRESS INPUTS UTILIZE LOW POWER SCHOTTKY DEVICES
- DESIGNED TO WORK WITH Z-80, 8080, 8085, CPU's

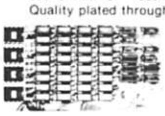
ADD $50.00 TO ABOVE PRICES FOR FULLY ASSEMBLED AND TESTED BOARDS

Low Cost Cassette Interface Kit
$19.95

Fea..ures: Play and record K.C. Standard 2400/1200 Hz tapes, 300 Baud, TTL I/O Compatible, Phase Lock Loop, Both 22 Pin Connector and 8 Pin Molex Connector. Comes partially assembled. Oscillator and phase lock .oop pre-tuned to K.C. Standard. Selector switch sends cassette data or auxiliary input data to microprocessor. LED indicates logic 1 level.

4K LOW POWER RAM KIT
The Whole Works - $79.95

Full Buffered - on board regulated - reduced power consumption utilizing low power 21L02-1 500ns RAMS - Sockets provided for all IC's. Quality plated through PC board.



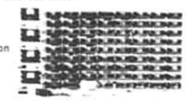
*Add $10.00 for 250ns RAM operation.

8K LOW POWER RAM
$159.95

FULLY ASSEMBLED AND TESTED. NOT A KIT.

Imsai — Altair — S-100 Buss compatible, uses low power static 21L02-500ns fully buffered on board regulated, quality plated through PC board, including solder mask. 8 pos. dip switches for address select.

*Add $30.00 for 250ns RAM operation



Z-80 CPU BOARD KIT
Complete Kit $139.

CHECK THE ADVANCED FEATURES OF OUR Z-80 CPU BOARD: Expanded set of 158 instructions, 8080A software capability, operation from a single 5VDC power supply; always stops on an M1 state, true sync generated on card (a real plus feature!), dynamic refresh and NMI available, either 2MHZ or 4MHZ operation, quality double sided plated through PC board; parts plus sockets provided for all IC's. *Add $10. extra for Z-80A chip which allows 4MHZ operation.

NEW FROM S.D.
"VERSAFLOPPY"™ KIT
THE VERSATILE FLOPPY DISK CONTROLLER

ONLY $149.00

FEATURES: IBM 3740 Soft Sectored Compatible. S-100 BUS Compatible for Z-80 or 8080. Controls up to 4 Drives (single or double sided). Directly controls the following drives:
1. Shugart SA400/450 Mini Floppy
2. Shugart SA800/850 Standard Floppy.
3. PERSCI 70 and 277.
4. MFE 700/750.
5. CDC 9404/9406.

34 Pin Connector for Mini Floppy. 50 Pin Connector for Standard Floppy. Operates with modified CP/M operating system and C-Basic Compiler. The new "Versafloppy" from S.D. Computer Products provides complete control for many of the available Floppy Disk Drives, Both Mini and Full Size. FD1771B-1 Single Density Controller Chip, Listings for Control Software are included in price.

FD 1771B-1 CHIP ALONE $39.95

S. D. SALES NEW
EXPANDABLE EPROM BOARD

16K OR 32K EPROM $49.95 W/OUT EPROM

Allows You to Use Either 2708's For 16K of Eprom or 2716's For 32K of Eprom.

KIT FEATURES:

1. All Address Lines & Data Buffered
2. Quality Plated through P.C. Board Including Solder Mask and Silk Screen
3. Selectable Unit States
4. On Board Regulation Provided
5. All Sockets Provided W/Board

WE CAN SUPPLY 450As 2708's AT $11.95 WHEN PURCHASED WITH BOARD.

INTRODUCING THE SBC-100
(The Z-80 Based, S-100 Single Board Computer)

$349.00

FEATURES:

- No Front Panel Needed
- Z-80 CPU (2 or 4 MHZ)
- 1K RAM
- 4 ROM/PROM Sockets for 4K/8K of Memory
- SYNCHRONOUS/ASYNCHRONOUS Serial I/O with RS-232 and Current Loop Interface and Software
- Programmable Baud Rate
- Parallel Input Port
- Parallel Output Port
- 4 Channel Timer/Counter
- 4 Vectored Interrupts

O. E. M. SPECIAL

ASK ABOUT SPECIAL O.E.M. DISCOUNTS ON THE S.D. "COMPATIBLE SET."

SBC-100 — SINGLE BOARD COMPUTER	$349.00
VERSAFLOPPY™ — FLOPPY DISK CONTROLLER	$149.00
EXPANDORAM — 32K RAM	$475.00

EACH KIT IF PURCHASED SEPARATELY TOTAL $973.00

ORDER ALL 3 KITS TOGETHER FOR

$899.00

This Powerful Threesome Operates Together to Form A Complete Computer for Your System.

Z-80 Programming Manual — IN DEPTH DETAIL OF THE Z-80 CPU MICRO-COMPUTER — S. D. SALES SPECIAL **$9.95**

RAMS

21L02 - 500NS	8/11.50
21L02 - 250NS	8/15.95
2114 — 4K	14.95
1101A — 256	8/$4.00
1103 — 1K	35
MK 4115 - 8K	15.45
74S 200 - 256	3.95

CPU's

Z—80 includes manual	29.95
Z—80A includes manual	34.95
8080A CPU 8 BIT	11.95
8008 CPU 8 BIT	6.95

PROMS

1702A - 1K - 1.5us	3.95 or 10/35.
2708 - 8K - 450ns	14.95
5204 - 4K	7.95
82S129 — 1K	2.50
2708U 8K signetics 650ns	9.95

COUNTER CHIPS

MK50397 6 Digit elapsed timer	8.95
MK50250 Alarm clock	4.99
MK50380 Alarm chip	2.95
MK50395 6 digit up/dn. count.	12.95
MK5002 4 digit counter	8.95
MK5021-Cal. chip sq. root	2.50

S.D. NOW HAS SOFTWARE FOR IT'S CUSTOMERS

CP/M® DISK OPERATING SYSTEM . . . $99.95

CP/M is a powerful disk operating system which has become an industry standard. It is compatible with several disk based FORTRAN and BASICS. This package includes a CP/M diskette (mini or full size) adapted for S.D.'s SBC-100/VERSAFLOPPY EXPANDORAM board set. Complete documentation is included. (® CP/M is a registered trademark of Digital Research Corp., Pacific Grove, CA.

Z-80® DISK BASED ASSEMBLER $69.95

Runs on ANY CP/M based disk system. Assembles the official Zilog-Mostek Mnemonics. Contains extensive set of pseudo-ops. Available on mini or full size diskette.

VERSAFLOPPY™ CONTROL FIRMWARE . . . $24.95

Provides control for VERSAFLOPPY and boots up CP/M. This runs on Z-80, 8080 or 8085 based computers. Available in 2708 or 2758 prom.

SD MONITOR $49.95

Powerful monitor for SBC-100 single board computers. Includes all VERSAFLOPPY control firmware. Comes in 2716 prom. Available in 4-6 weeks.

VERSAFLOPPY DIAGNOSTIC PROGRAM . . . $24.95

Provides routines which are helpful in checking out a disk based system. Available in 2708 or 2758 prom.

MICROPROCESSOR CHIPS

8212 - I/O port	3.50
8214 — P.I.C.	12.95
8216 — Non Invert Bus	4.95
8224 — Clock Gen.	4.95
8226 — Invert Bus	3.95
PIO for Z—80	14.95
CTC for Z—80	14.95
8228 Sys. Controller	8.20
8251 Prog. comm. interfact.	10.95
8255 prog. prep. interface	13.50
8820 Dual Line Recr	1.75
8830 Dual Line Dr.	1.75
2513 Char. Gen.	7.50
8838 Quad Bus. Recvr.	2.00
74LS138N — 1/8 decoder	.99
8T97-Hex Tri-State Buffer	1.25
1488/1489 RS232	1.50
TR 1602B Uart	3.95
TR 1853 Uart	8.50
FD 1771B-1	39.95

CMOS

4001	19	4029	99
4002	19	4042	69
4011	19	4047	1.50
4013	32	4049	35
4016	32	4069	23
4017	95	4071	19
4020	97	4076	97
4022	97	14518	1.10
4024	75	14528	85
4027	39	14529	85

SUPER FLOPPY SPECIAL

S. D. SALES' VERSAFLOPPY S-100 CONTROLLER BOARD PLUS SHUGART SA 400 FLOPPY DISK DRIVE INCLUDING CABLE FOR ONLY

$449.00

CALL IN YOUR BANKAMERICARD (VISA) OR MASTER CHARGE ORDER IN ON OUR CONTINENTAL TOLL FREE WATTS LINE:

1—800—527—3460

Texas Residents Call Collect:

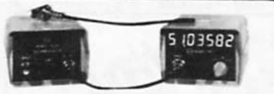
214/271—0022

DEALER INQUIRIES INVITED!

(All prices subject to change without prior notice.)

NO COD's. TEXAS RESIDENTS ADD 5% SALES TAX. ADD 5% OF ORDER FOR POSTAGE & HANDLING. ORDERS UNDER $10. ADD 75c HANDLING.FOREIGN ORDERS — U. S. FUNDS ONLY!

MS-15 MINISCOPE $289.00 NLS



SC-5 With Rechargeable Batteries & Charger Unit **$89**

FM-7 With Rechargeable Batteries & Charger Unit **$195**

Features Include: • By using the new NLS SC-5 Prescaler, the range of the FM-7 Frequency Meter, which is 10 Hz to 60 MHz, may be extended to 512 MHz (the upper VHF & UHF frequency bands). • The FM-7 utilizes an LED readout, providing 7-digit resolution. • The FM-7 can be calibrated to an accuracy of 0.00001%. • The SC-5 is accurate to one part per million. • Each unit has 30 millivolts sensitivity, is battery powered and has a charger unit included. • Dimensions of each are 1.9" H x 2.7" W x 3.9" D. • The units may be obtained separately or as a "Frequency Duo." • Parts & Labor guaranteed 1 year.

Tilt stand option .... $ 3.50
Leather case $16.00

MS-15 MINISCOPE $289

With Rechargeable Batteries & Charger Unit

- 15 megahertz bandwidth.
- External and internal trigger.
- Time base — .1 microsec. to 0.5 Sec/div - 21 settings. ± 3%.
- Battery or line operation.
- Automatic & line sync modes.
- Power consumption < 15 watts.
- Vertical Gain — .01 to 50 V/div - 12 settings ± 3%.
- Viewing area 1.1" x 1.35".
- Case size 2.7"H x 6.4"W x 7.5"D, 3 pounds.
- Parts & labor guaranteed 1 year
- 10 to 1, 10 meg probe $24.50
- Leather carrying case $30.00

PROBE 1¢ with the purchase of SCOPE and the MENTION of this MAGAZINE

NEW VOLKSMETERS!

With LCD Display—
Excellent Readability in Direct Sunlight!

1% LM-300 Full three digits $99.50*

0.5% LM-350 3½ digits $125.00*

FEATURES

- Measures DC volts, AC volts, ohms and current.
- Automatic polarity, decimal and overload indication.
- No zero adjustment and no full scale ohms adjust.
- Large LCD display for easy reading without interpolation.
- Size: 1.9" H x 2.7" W x 4.0" D.
- Parts and labor guaranteed for one year.

SPECIFICATIONS

MODE	RANGE	ACCURACY LM-300	ACCURACY LM-350	RESOLUTION	INPUT RESISTANCE	TEST CURRENT
VOLTS DC*	1 / 10 / 100 / 1000	±1% Reading†	±0.5% Reading†	1 mV / 10 mV / 100 mV / 1 V	10 MΩ	
VOLTS AC*	1 / 10 / 100 / 1000	±2% Reading† 50-400 Hz	±1.7% Reading† 50-400 Hz	1 mV / 10 mV / 100 mV / 1 V	10 MΩ, 20 pF	
KILOHMS**	1 / 10 / 100 / 1000 / 10000	±1% Reading†	±0.5% Reading†	1 Ω / 10 Ω / 100 Ω / 1 kΩ / 10 kΩ		1 mA / 100 µA / 10 µA / 1 µA / 100 nA
CURRENT	1 mA / 10 mA / 100 mA / 1 A	±2% Reading†	±2% Reading†	1 µA / 10 µA / 100 µA / 1 mA	1 kΩ / 100 Ω / 10 Ω / 1 Ω	

* 1000 vdc or peak ac maximum any range. †±2 Digits
**Test Voltage (Ohms) 1 vdc Full Scale - LM-300; 2 vdc Full Scale - LM-350
\# LM-350 has 100% over-range - full scale readings are 1.999, 19.99, etc.

Tilt Stand Option, add	$3.50
Leather Case	$16.00
3AA NiCad Batts. & Charger	$12.00

Standard AA-size batteries provide up to 20 hours of operation.
Rechargeable NiCad batteries and charger unit available as optional equipment.
*Batteries not included.

LEDU MG 10A List $72.00

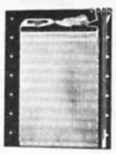
Perfectly balanced, fluorescent lighting with precision magnifier lens. For prof'l, techn'l & hobbist. Has die cast protective shade, inst. start 3 diopter lens. 42" reach.

$44.95 with T-9 fluorescent lamp (required) $49.95
colors: Gray or Black Chocolate Brown
2 choices please

$44.95 SPECIAL

8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS — Vector

- Kit includes 12 tantalum capacitors for +5, +12, —12 buses and insulated mounting spacers.
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads.
- Solder mask with solder windows on etched circuits to avoid accidental short circuits.
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R681-2, or mounts 10 receptacles plus interconnections to smaller mother board for expansion.
- Includes etched circuits and instructions for option of active, pull-up, or floating terminations.
- Large buses: +5V and GND (10 AMPS), ± 12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10°C rise.
- Fits in Vector-pak enclosures.
- Fits in IMSAI 8080 microcomputer as expander board.



Price: $29.50

Vector Plugboards

8800V

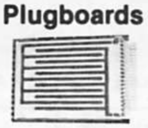
Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

1-4	5-9	10-24
$19.95	$17.95	$15.96

8801-1

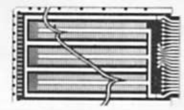
Same as 8800V except plain; less power buses & heat sink.

1-4	5-9	10-24
$14.95	$13.46	$11.96



3682 9.6" x 4.5" $10.97
3682-2 6.5" x 4.5" $9.81

Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



3677 9.6" x 4.5" **$10.90**
3677-2 6.5" x 4.5" **$9.74**

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

3662 6.5" x 4.5" **$7.65**
3662-2 9.6" x 4.5" **$11.45**

P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156

R644 P.C. recepticle 22/44 cont. .156 ctrs. pierced solder eyelets tails gold $3.45
R644-3 P.C. recepticle 22/44 cont. .156 ctrs. Wire Wrap tails gold $4.49

S-100 Bus P.C. Edge Connectors

R681 DIP solder tails on .140" spaced rows for ALTAIR mother boards. Fits .042" dia. holes, gold $7.35
R681-1 .025" sq., 3 wrap lengths posts (.62 long) on .250 spaced rows, gold $5.00
R681-2 .025" sq., 1 wrap length posts (.22 long) on .250 spaced rows for wrapping or DIP solder for IMSAI mother boards, gold $5.85
R681-3 pierced solder eyelet tails, gold $7.35

1/16 Vector BOARD

.042 dia holes on 0.1 spacing for IC's

Phenolic

PART NO.	SIZE	PRICE
64P44-062XXP	4.5 x 6.5"	$ 1.49
169P44-062XXP	4.5 x 17"	$ 3.51

Epoxy Glass

PART NO.	SIZE	PRICE
64P44-062	4.5 x 6.5"	$ 1.70
84P44-062	4.5 x 8.5"	$ 2.10
169P44-062	4.5 x 17"	$ 4.30
169P84-062	8.5 x 17"	$ 6.39

SLIT-N-WRAP

Wraps insulated wire on .025" square posts
FOUR TIMES FASTER
than regular manual wrap-post tools

P180 with two 100' spools of 28 ga. wire **$24.50**

P160-4T includes charger, wire **$75.00**

"Daisy-chain" runs
Reliable and easy to use
Manual or power operation

Vector

NO PRE-STRIPPING*
NO PRE-CUTTING*
SPOOL-FED WIRE*

*The spooled wire passes through the tool past a slitting edge next to the wrap post. A narrow longitudinal cut is made in the insulation where it presses the square post corner; the bared copper is indented by the sharp edge (7 turns = 28 contacts)
insulation is slit where wrapped but not between terminal posts when led straight out of the tool

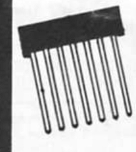
SLIT-N-WRAP WIRE $2.75 Package
NO. 28 GAGE INSULATED WIRE, 100' SPOOLS
W28-2-A Pkg. 3 Green W28-2-C Pkg. 3 Clear
W28-2-B Pkg. 3 Red W28-2-D Pkg. 3 Blue

2708 8K 450 ns EPROM FACTORY PRIME

1-9	$12.00
10-24	$11.50

25+ Call for Price

14 & 16 PIN 3 LEVEL WIRE WRAP SOCKETS



14-T3 100 for $30.00
16-T3 100 for $30.00
50 of ea. for $32.00

ACE • All-Circuit Evaluator — for fast, solderless, plug-in circuit building and testing

Model 236

10% OFF SALE

Just plug in any components with leads to .032" dia. Interconnect with solid wire up to 20 ga. Assembled models too!

ACE Model No.	Tie Points	DIP Capacity	No. Buses	No. Posts	Board Size (inches)	Price Each
200-K (kit)	728	8 (16's)	2	2	4-9/16 x 5-9/16	$18.95
208 (assem.)	872	8 (16's)	8	2	4-9/16 x 5-9/16	28.95
201-K (kit)	1032	12 (14's)	2	2	16 x 7	24.95
212 (assem.)	1224	12 (14's)	8	2	4-9/16 x 7	34.95
218 (assem.)	1760	18 (14's)	10	2	6-1/2 x 7-1/8	46.95
227 (assem.)	2712	27 (14's)	28	4	8 x 9-1/4	59.95
236 (assem.)	3648	36 (14's)	36	4	10-1/4 x 9-1/4	79.95

Gold-anodized aluminum base/ground; non-corrosive nickel-silver terminals; 4 rubber feet.

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR

- For Auto, Home, Office
- Small in size (2x2½x½)
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE:
  LCD-101, portable model runs on self-contained batteries for better than a year.
  LCD-102, runs on 12 Volt system and is backlighted.
- LCD-101 or LCD-102 your choice .... $34.95 ea.
- Clear desk stand for $2.00

3 LEVEL GOLD WIRE WRAP SOCKETS

	1-24	25-49	50-99
8 pin	.47	.42	.37
10 pin	.45	.41	.37
14 pin	.39	.38	.37
16 pin	.43	.42	.40
18 pin	.75	.68	.62
22 pin	1.00	.97	.95
24 pin	1.00	.94	.75
28 pin	1.09	.98	.84
36 pin	1.59	1.45	1.30
40 pin	1.49	1.39	1.29

Vector MICRO-KLIP

for .042 dia. holes
(all boards on this page)
T42-1 pkg. 100 $ 1.50
T42-1 pkg. 1000 .... $11.00
P-149 hand installing tool .... $ 2.03

.8" LED ALARM CLOCK

12 hr. LED Alarm Clock uses 3½ digit .8" LED Display with AM/PM indicators and colons. Direct drive. PIN to PIN interface with **S1998A** I.C. Just add switches, AC Supply, Alarm. Display and I.C. only.

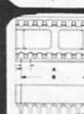
$7.95 or 2/$15.00

Price Breakthrough! $17.95

MA1003 CAR CLOCK

Bright Green Fluorescent Display Crystal Time Base Assembled, just add switches and 12 VDC.

SPECIAL



14CS2 100 for $14.00
16CS2 100 for $16.00
14 pin CS2 10 for $2.00
16 pin CS2 8 for $2.00

These low cost DIP sockets will accept both standard width plugs and chips.
For use with chips, the sockets offer a low profile height of only .125" above the board. These sockets are end stackable.

WRAP POST

for .042 dia. holes
(all boards on this page)
T-44 pkg. 100 .. $ 2.28
T-44 pkg. 1000 .... $14.00
A-13 hand installing tool .... $ 2.80

PRIORITY ONE ELECTRONICS

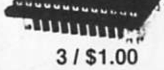
P21

10031W Woodley Ave. Sepulveda CA. 91343

Terms: VISA, MC, BAC, check, Money Order, C.O.D., U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00. Orders less than $75.00 include 10% shipping and handling; excess refunded. Just in case . . . please include your phone no. **"Sorry, no over the counter sales"** Good thru June 15, 1978

Send for our latest brochure. **phone orders welcome (213) 893-8202** OEM and Institutional inquiries invited.

24 PIN DIP PLUGS WITH COVERS



3 / $1.00
40 / $10.00

New!

16K E-PROM CARD

Uses 2708's!

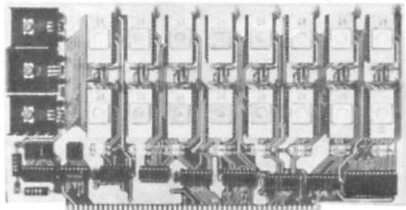
IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Double sided PC board with solder mask and silk screen and gold plated contact fingers.
2. Selectable wait states.
3. All address lines & data lines buffered!
4. All sockets included.
5. On card regulators.

KIT INCLUDES ALL PARTS AND SOCKETS (except 2708's). Add $25. for assembled and tested.



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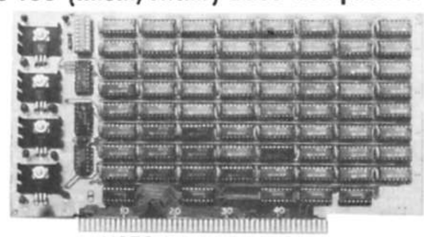

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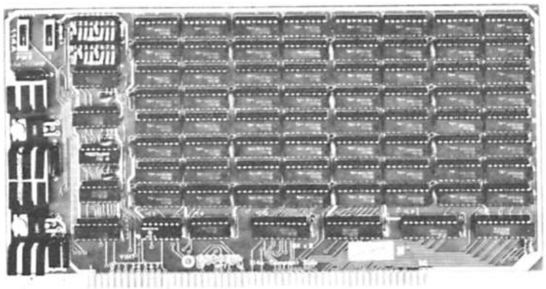

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S-100 Compatible 8K × 8 in a cost-effective package. Buffering on all lines, 0 wait states with the 8080, low power consumption, configured as two separate 4K blocks for addressing flexibility, handles DMA, memory protect with vector interrupt provision if you try to write into protected memory, fully socketed, gold-flashed edge fingers, solder masked and legended board . . . this is the board that doesn't cut any corners, but cuts the price instead.

(See the 1/77 issue of **Kilobaud** magazine for a product profile that tells just about everything you'd ever want to know about Econoram II . . . or send a self-addressed, stamped envelope to "Kilobaud Article" c/o our address and we'll send you a reprint. But if you **really** want to be convinced . . . talk to somebody who owns one!)

Kit form: $135.00 3 kits: $375.00 Assembled, tested: $155.00

SUPER MEMORY FOR A SUPER MACHINE: H8 COMPATIBLE ECONORAM VI™

Users of the S-100 buss have found out why our memories are their best value . . . now H8 owners can find out too. This 12K × 8 kit offers the same basic features as our ECONORAM series . . . static design, configuration as two blocks (one 8K and one 4K), switch selected protect, sockets for all ICs, full buffering on address and data lines . . . plus the required hardware and edge connector to mate mechanically with the H8. As a bonus, **all** sockets and bypass capacitors are pre-soldered to the circuit board so you can start right in on the fun part of building this high-quality memory.

Kit form: $235.00

ANNOUNCING . . . THE 16K ECONORAM IV™

We'll be ready to ship these soon, so we thought you'd like a sneak preview. The price? Under **$400**. The performance? All that you've come to expect from the Econoram line, along with impressively low power consumption and a couple of other tricks we have up our sleeve. If you've been waiting for a 16K board, you'll be happy you waited for us.

SOME WORDS ABOUT STATIC MEMORIES

When it comes to memory, we're pretty partial to static technology. Although more costly than dynamic devices, static memories are free of critical refresh and timing needs — which is one reason why DMA works so well with our memory boards. When we send an Econoram out into the world, we not only want it to work right with whatever system you have (Altair, IMSAI, Cromemco, Parasitic, Polymorphic, etc.); we want it to keep working for you. Static memories are proven, time-tested, and reliable . . . that's why we like them so much.

ACTIVE TERMINATOR BOARD

The active termination circuitry in our motherboard kits minimizes the ringing, crosstalk, overshoot, scrambled data, and noise problems that can occur with unterminated lines. But even if you don't have a Godbout motherboard, you can trick your computer into thinking you do by adding this useful peripheral. Simply plug into any S-100 machine, and gain the benefits of active circuitry. **#CK-017, $29.50.** Kit form only.

CPU POWER SUPPLY

Here is an economical supply for small computer systems or digital bench work. Delivers 5V @ 4A with crowbar overvoltage protection (accidents can happen . . . and you shouldn't have to replace all your TTL if one does!). Also gives +12V @ ½A and −12V @ ½A, along with an adjustable negative bias supply (−5 to −10V @ 10 mA). All in all, you can't beat the price or the performance. **#CK-014, $50.00.** Kit form only.

DB-25 RS-232 SUBMINI-D CONNECTORS

Male plug, **#CK-1004, $3.95;** female jack, **#CK-1005, $3.95;** plastic hood for male connector, **#CK-1006, $0.90.**

PLUG FROM BILL: There's more to life than computers . . . like music. Craig Anderton, noted author and designer of our Musikit products, has produced a cassette tape of original music that is distributed by our friends at PAIA Electronics (1020 W. Wilshire, Oklahoma City, OK 73116; $6.45 ppd). In addition to hearing our Musikits in action, you get to hear some really good modern music. We like it . . . you probably will too.

WE ALSO SPEAK DYNAMIC: ECONORAM III™

If you want a dynamic memory, might as well get one that works right. Econoram III is inexpensive, completely assembled and tested, and ready to plug into your S-100 machine. Low power, 0 wait states with 8080 CPU, configured as two 4K blocks, fully socketed.

$149.00, assembled and tested only.

EDGE CONNECTORS

There are edge connectors, and there are **Edge Connectors.** These are the kind where the pins don't fall out, thanks to the bifurcated contacts. (We use the same connectors with our motherboards.)

#CK-1001: 100 pin edge connector with gold plated 3 level wrap posts. Mates with Altair/IMSAI peripherals. **$5 each or 5/$22.**

#CK-1002: Same as above, but with soldertail pins on 0.25" centers. (Mates with IMSAI motherboard). **$5 each or 5/$22.**

#CK-1003: Same as above, but with soldertail pins on 0.14" centers. (Mates with Altair motherboard). **$6 each or 5/$27.50.**

10 SLOT MOTHERBOARD

Whether implemented as an add-on to existing systems that need more room, or as the nucleus of a stand-alone system, this S-100 compatible motherboard fits the needs of the budget-minded enthusiast. Our price includes **all** edge connectors, along with active termination circuitry that promotes accurate and reliable data transfer. Lots of bypass caps and extra heavy power line traces contribute to efficient operation. Heavy duty epoxy glass board, with a solder mask for easy soldering.

#CK-015, $90.00. Kit form only.

18 SLOT MOTHERBOARD

All the same features and advantages of the 10 slot version, including our active termination circuitry. Complete with 18 edge connectors.

#CK-016, $124.00. Kit form only.

DEALER NOTE

We'd like to thank the ever-growing number of dealers who are spreading the Econoram word to their customers . . . you will be happy to know that we have **doubled** the capacity of our Compukit™ division in order to continue handling the massive response. We're glad you like what we're doing . . . and we're going to keep on doing it!

TERMS: Please allow up to 5% for shipping; excess refunded. Californians add tax. COD orders accepted with street address for UPS. For VISA*/Mastercharge* orders call our 24 hour order desk at **(415) 562-0636.** Prices good through cover month of magazine.

FREE FLYER: These are just a few of the items we carry for the computer enthusiast. We also stock a broad line of semiconductors, passive components, and hobbyist items. We will gladly send you a flyer describing our products upon receipt of your name and address.

GODBOUT

G4

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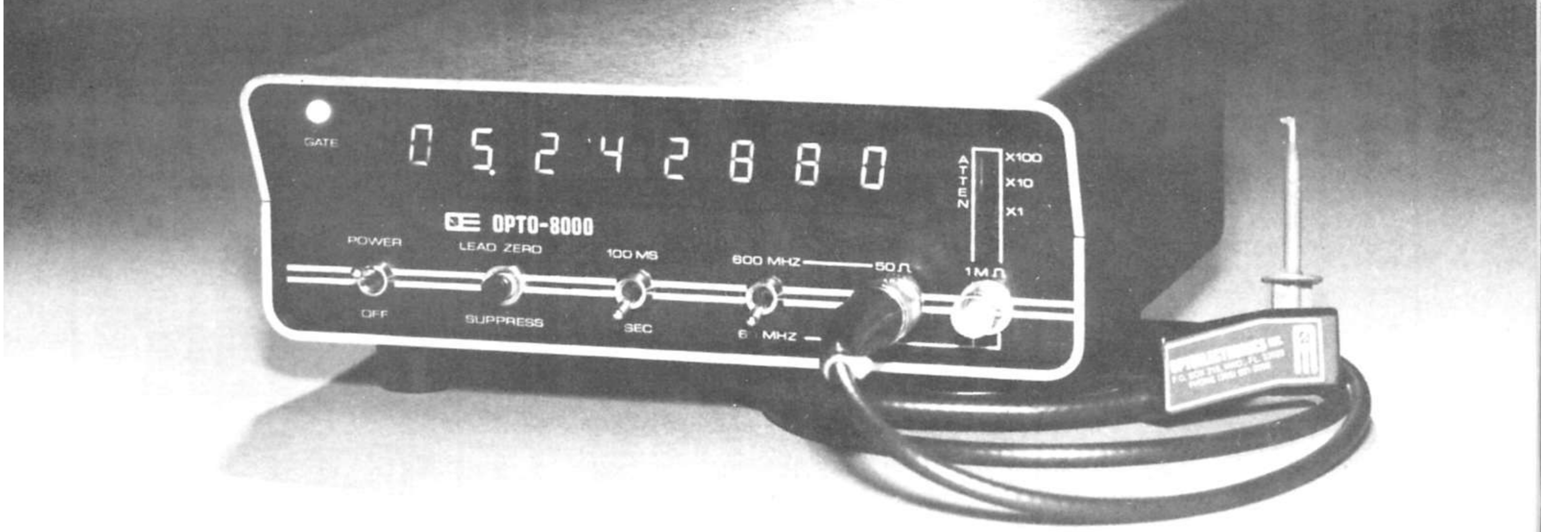
ask for us locally

600 MHZ. FREQUENCY COUNTER
±0.1 PPM TCXO

OPTO-8000.1



This new instrument has taken a giant step in front of the multitude of counters now available. The Opto-8000.1 boasts a combination of features and specifications not found in units costing several times its price. Accuracy of ±0.1 PPM or better — *Guaranteed* — with a factory-adjusted, sealed TCXO (Temperature Compensated Xtal Oscillator). **Even kits require no adjustment for guaranteed accuracy!** Built-in, selectable-step attenuator, rugged and attractive, black anodized aluminum case (.090" thick aluminum) with tilt bail. 50 Ohm and 1 Megohm inputs, both with amplifier circuits for super sensitivity and both diode/overload protected. Front panel includes "Lead Zero Blanking Control" and a gate period indicator LED. AC and DC power cords with plugs included.

OPTOELECTRONICS, INC.
5821 NE 14 Avenue
Ft. Lauderdale, FL 33334
Phones: (305) 771-2050 771-2051
Phone orders accepted 6 days, until 7 p.m.

master charge
BANKAMERICARD

SPECIFICATIONS:
Time Base—TCXO ±0.1 PPM GUARANTEED!
Frequency Range—10 Hz to 600 MHz
Resolution—1 Hz to 60 MHz; 10 Hz to 600 MHz
Decimal Point—Automatic
All IC's socketed (kits and factory-wired)
Display—8 digit LED
Gate Times—1 second and 1/10 second
Selectable Input Attenuation—X1, X10, X100
Input Connectors Type —BNC
Approximate Size—3"h x 7½"w x 6½"d
Approximate Weight—2½ pounds
Cabinet—black anodized aluminum (.090" thickness)
Input Power—9-15 VDC, 115 VAC 50/60 Hz or internal batteries

OPTO-8000.1 Factory Wired	**$299.95**
OPTO-8000.1K Kit	**$249.95**

ACCESSORIES:
Battery-Pack Option—Internal Ni-Cad Batteries and charging unit **$19.95**

Probes:
- P-100—DC Probe, may also be used with scope **$13.95**
- P-101—LO-Pass Probe, very useful at audio frequencies **$16.95**
- P-102—High Impedence Probe, ideal general purpose usage **$16.95**

VHF RF Pick-Up Antenna-Rubber Duck w/BNC #Duck-4H **$12.50**
Right Angle BNC adapter #RA-BNC **$ 2.95**

FC-50 — Opto-8000 Conversion Kits:
Owners of FC-50 counters with #PSL-650 Prescaler can use this kit to convert their units to the Opto-8000 style case, including most of the features.

FC-50 — Opto-8000	**Kit $59.95**
*FC-50 — Opto-8000F	**Factory Update $99.95**
FC-50 — Opto-8000.1 (w/TCXO)	**Kit $109.95**
*FC-50 — Opto-8000.1F	**Factory Update $149.95**

*Units returned for factory update must be completely assembled and operational

TERMS: Orders to U.S. and Canada, add 5% to maximum of $10.00 per order for shipping, handling and insurance. To all other countries, add 10% of total order. Florida residents add 4% state tax. C.O.D. fee: $1.00. Personal checks must clear before merchandise is shipped.

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SN7414N	.70	SN7491N	.59	SN74176N	.79
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74LS28	.29	74LS96	.89	74LS193	.89
74LS30	.23	74LS107	.35	74LS194	.89
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MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6710	Common Anode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	4/$1	MAN 6730	Common Anode-red ±1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 52	Common Anode-green	.300	1.25	MAN 6750	Common Cathode-red ±1	.560	.99
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MAN 72	Common Anode-red	.300	.99	MAN 6780	Common Cathode-red	.560	.99
MAN 74	Common Cathode-red	.300	1.25	DL701	Common Anode-red ±1	.300	.99
MAN 81	Common Anode-yellow	.300	.99	DL702	Common Cathode-red	.300	1.25
MAN 82	Common Anode-yellow	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 84	Common Cathode-yellow	.300	.99	DL707	Common Anode-red	.300	.99
MAN 3620	Common Anode-orange	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3630	Common Anode-orange ±1	.300	.99	DL746	Common Anode-red ±1	.630	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 4610	Common Anode-orange	.300	.99	DL749	Common Cathode-red ±1	.630	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL750	Common Cathode-red	.600	1.49
MAN 4710	Common Anode-red ±1	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4730	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Anode	.350	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode (FND500)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6630	Common Anode-orange	.560	.99	5082-7300	4 x 7 Sgl. Digit-RHDP	.600	19.95
MAN 6640	Common Cathode-orange-D.D.	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6650	Common Cathode-orange ±1	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6660	Common Anode-orange	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013	2.15	CA3083	1.60
CA3023	2.56	CA3086	.85
CA3035	2.48	CA3089	3.75
CA3039	1.35	CA3091	3.50
CA3046	1.30	CA3102	2.95
CA3053	1.50	CA3123	2.15
CA3059	3.25	CA3130	1.39
CA3060	3.25	CA3140	1.25
CA3080	.85	CA3160	1.25
CA3081	2.00	CA3401	.49
CA3082	2.00	CA3600	1.75

EXAR

XR-2206KB Kit $19.95 — **XR-2206KA Kit $14.95**

WAVEFORM GENERATORS

XR-205	$8.40
XR-2206CP	5.50
XR-2207CP	3.85

STEREO DECODERS

XR-1310CP	$3.20
XR-1800P	3.20
XR-2567	2.99

MISCELLANEOUS

XR-2211CP	$6.70
XR-4136	2.00
XR-1468	3.85
XR-1488	1.95
XR-1489	1.95
XR-2208	5.20

TIMERS

XR-555CP	$.39
XR-320P	1.55
XR-556CP	.99
XR-2556CP	3.20
XR-2240CP	4.80

PHASE LOCKED LOOPS

XR-210	5.20
XR-215	6.60
XR-567CP	.99
XR-567CT	1.25

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	$.17	.16	.15	22 pin LP	$.37	.36	.35
14 pin LP	.20	.19	.18	24 pin LP	.38	.37	.36
16 pin LP	.22	.21	.20	28 pin LP	.45	.44	.43
18 pin LP	.29	.28	.27	36 pin LP	.60	.59	.58
20 pin LP	.34	.32	.30	40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

14 pin ST	$.27	.25	.24	28 pin ST	$.99	.90	.81
16 pin ST	.30	.27	.25	36 pin ST	1.39	1.26	1.15
18 pin ST	.35	.32	.30	40 pin ST	1.59	1.45	1.30
24 pin ST	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

8 pin SG	$.30	.27	.24	24 pin SG	$.70	.63	.57
14 pin SG	.35	.32	.29	28 pin SG	1.10	1.00	.90
16 pin SG	.38	.35	.32	36 pin SG	1.75	1.40	1.26
18 pin SG	.52	.47	.43	40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

8 pin WW	$.40	.38	.35	22 pin WW	.95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
14 pin WW	.39	.38	.37	28 pin WW	1.40	1.25	1.10
16 pin WW	.43	.42	.41	36 pin WW	1.59	1.45	1.30
18 pin WW	.75	.68	.62	40 pin WW	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	1/4 WATT 5% - 50 PCS.
ASST. 2	5 ea.	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	1/4 WATT 5% - 50 PCS.
ASST. 3	5 ea.	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	1/4 WATT 5% - 50 PCS.
ASST. 4	5 ea.	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	1/4 WATT 5% - 50 PCS.
ASST. 5	5 ea.	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	1/4 WATT 5% - 50 PCS.
ASST. 6	5 ea.	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	1/4 WATT 5% - 50 PCS.
ASST. 7	5 ea.	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	1/4 WATT 5% - 50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1978 Catalog
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WRAP • STRIP • UNWRAP
- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$12.95

WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP - $6.95

WIRE WRAP WIRE — 30 AWG
25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30
- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.95 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red **$1.98/spool**

Prime Stock Inventory Clearance STEWART WARNER Special Offer

P/N	10(min.)	100	1000	P/N	10(min.)	100	1000
SW7401	$1.20/lot	$9.00/lot	$80.00/lot	SW7482	$4.90/lot	44.00/lot	430.00/lot
SW7407	2.20	19.00	180.00	SW7483	3.50	31.00	300.00
SW7416	2.20	19.00	180.00	SW7486	2.20	19.00	180.00
SW7417	2.20	19.00	180.00	SW7491	3.50	31.00	300.00
SW7420	1.30	11.00	100.00	SW7494	3.50	31.00	300.00
SW7423	2.20	19.00	180.00	SW7495	3.50	31.00	300.00
SW7425	1.70	14.00	130.00	SW7496	3.50	31.00	300.00
SW7427	1.50	12.00	110.00	SW74100	6.90	66.00	650.00
SW7430	1.50	12.00	110.00	SW74104	2.20	19.00	180.00
SW7432	1.50	12.00	110.00	SW74105	2.20	19.00	180.00
SW7437	1.50	12.00	110.00	SW74107	2.20	19.00	180.00
SW7438	1.50	12.00	110.00	SW74121	2.20	19.00	180.00
SW7440	1.20	9.00	80.00	SW74123	2.50	22.00	200.00
SW7443	3.50	31.00	300.00	SW74145	5.50	51.00	500.00
SW7444	3.50	31.00	300.00	SW74150	6.90	66.00	650.00
SW7445	3.50	31.00	300.00	SW74151	3.50	31.00	300.00
SW7446	4.00	36.00	350.00	SW74153	4.00	36.00	350.00
SW7450	1.20	9.00	80.00	SW74156	4.00	36.00	350.00
SW7453	1.20	9.00	80.00	SW74180	4.50	41.00	400.00
SW7454	1.20	9.00	80.00	SW74181	9.90	96.00	950.00
SW7460	1.20	9.00	80.00	SW74182	4.50	41.00	400.00
SW7472	2.20	19.00	180.00	SW9601	2.50	22.00	200.00
SW7475	3.50	31.00	300.00	SW9602	4.90	44.00	430.00
SW7480	2.90	26.00	250.00				

Pre-tubed • No mixing or combining prices

TV GAME CHIP SET — $7.95

Includes AY-3-8500-1 Chip and 2.010 mhz crystal
(2.010 crystal — $.99 ea/AY-3-8500-1 Chip — $7.50 ea.)

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	.28	1N4734	5.6	1w	.28
1N5234	6.2	500m	.28	1N4735	6.2	1w	.28
1N5235	6.8	500m	.28	1N4736	6.8	1w	.28
1N5236	7.5	500m	.28	1N4738	8.2	1w	.28
1N456	25	40m	6/1.00	1N4742	12	1w	.28
1N458	150	7m	6/1.00	1N4744	15	1w	.28
1N485A	180	10m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.50
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 200V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

MPS A05	.30			PN4250	4/$1.00
MPS A06	5/$1.00			2N4400	4/$1.00
2N918	4/$1.00			2N4401	4/$1.00
2N2219A	3/$1.00	2N3638	5/$1.00	2N4402	4/$1.00
2N2221	4/$1.00	2N3702	5/$1.00	2N4403	4/$1.00
2N2222A	5/$1.00	2N3704	5/$1.00	2N4409	5/$1.00
2N2369	5/$1.00	2N3705	5/$1.00	2N5086	4/$1.00
2N2369A	4/$1.00	2N3706	5/$1.00	2N5087	4/$1.00
2N2484	4/$1.00	2N3707	5/$1.00	2N5088	4/$1.00
2N2906A	4/$1.00	2N3711	5/$1.00	2N5089	4/$1.00
2N2907A	5/$1.00	2N3724	$.65	2N5129	5/$1.00
2N2925	5/$1.00	2N3725	$1.00	2N5138	5/$1.00
2N3035	2/$1.00	2N3772	$2.25	2N5139	5/$1.00
2N3055	$.89	2N3903	5/$1.00	2N5209	5/$1.00
MJE2955	$1.25	2N3904	4/$1.00	2N5210	5/$1.00
MJE3055	$1.00	2N3905	5/$1.00	2N5432	$2.00
2N3392	5/$1.00	2N3906	4/$1.00	2N5449	3/$1.00
2N3398	5/$1.00	2N4013	3/$1.00	2N5951	5/$1.00
PN3567	3/$1.00	2N4014	3/$1.00	C106B1SCR	2/$1.00
PN3568	4/$1.00	2N4123	4/$1.00	40409	$1.75
PN3569	4/$1.00	PN4249	4/$1.00	40410	$1.75

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

SOCKET JUMPERS

Mates with two rows of .025" sq. or dia. posts on patterns of .100" centers and shielded receptacles. Probe access holes in back. Choice of 6" or 18" length.

Part No.	No. of Contacts	Length	Price
924003-18R	26	18"	$ 5.38 ea.
924003-06R	26	6"	4.78 ea.
924005-18R	40	18"	8.27 ea.
924005-06R	40	6"	7.33 ea.
924006-18R	50	18"	10.31 ea.
924006-06R	50	6"	9.15 ea.

JUMPER HEADERS

Solder to PC boards for instant plug-in access via socket-connector jumpers. .025" sq. posts. Choice of straight or right angle.

Part No.	No. of Posts	Angle	Price
923863-R	26	straight	$1.28 ea.
923873-R	26	right angle	1.52 ea.
923865-R	40	straight	1.94 ea.
923875-R	40	right angle	2.30 ea.
923866-R	50	straight	2.36 ea.
923876-R	50	right angle	2.82 ea.

INTRA-CONNECTOR

Provides both straight and right angle functions. Mates with standard .10" x .10" dual row connectors (i.e. 3m, Ainsley, etc.) Permits quick testing of inaccessible lines.

Part No.: 922576-26 **No. of contacts:** 26 **Price** $6.90 ea.

INTRA-SWITCH

Permits instant line-by-line switching for diagnostic or QA testing. Switches actuated with pencil or probe tip. Mates with standard .10" x .10" dual-row connectors. Low profile design. Switch buttons recessed to eliminate accidental switching.

Part No.: IS-26 **No. of contacts:** 26 **Price** $13.80 ea.

CRYSTALS

THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33/U	$5.95
CY2A	2.000 MHz	HC33/U	$5.95
CY2.01	2.010 MHz	HC33/U	$ .99
CY3A	4.000 MHz	HC18/U	$4.95
CY7A	5.000 MHz	HC18/U	$4.95
CY12A	10.000 MHz	HC18/U	$4.95
CY14A	14.31818 MHz	HC18U	$4.95
CY19A	18.000 MHz	HC18/U	$4.95
CY22A	20.000 MHz	HC18/U	$4.95
CY30B	32.000 MHz	HC18/U	$4.95

CONNECTORS

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out

Bifurcated Contacts — Fits .054 to .070 P.C. Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100A (.100 Spacing)	PINS (Wire Wrap)	$6.95

25 PIN-D SUBMINATURE (RS232)

DB25P	PLUG	$3.25
DB25S	SOCKET	$4.95
DB51226-1	COVER FOR 25S/25P	$1.75

LOTS OF POTS

Untested ⅜" square Spectrol Trimpots
Single-turn Printed Circuit Potentiometers

GB134	3 ea. of: 10-20-25-50, 100-200-250-500 ohm	= 24 pcs.	$2.95
GB135	3 ea. of: 1K-2K-2.5K-5K, 10K-20K-25K-50K	= 24 pcs.	$2.95
GB136	3 ea. of: 100K-200K-250K-500K, 1Meg-2Meg-2.5Meg-5Meg	= 24 pcs.	$2.95

(Values subject to substitution within each group.)

'EXTRA SAVINGS' Buy all 3 (GB134, 135 & 136) for only $7.49

SWITCHES

¼" mounting holes

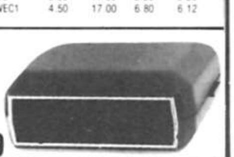
					1-9	10+
TOGGLE (sub-miniature)	JMT121	SPDT	on-off-on		$1.95	$1.43
	JMT123	SPDT	on-none-on		1.65	1.21
	JMT221	DPDT	on-off-on		2.55	1.87
	JMT223	DPDT	on-none-on		2.15	1.58
TOGGLE (Printed Circuit)	MPC121	SPDT	on-off-on		$2.05	$1.53
	MPC123	SPDT	on-none-on		1.75	1.31
	MPC221	DPDT	on-off-on		2.65	1.97
	MPC223	DPDT	on-none-on		2.25	1.68
PUSH BUTTON	PB123	SPDT	maintained		1.95	1.47
	PB126	SPDT	momentary		1.95	1.47
PUSH BUTTON Minature	MS102	DPST	momentary open		.35	.30
	MS103	SPST	momentary closed		.35	.30
DIPSWITCH SPST	206-4	8 pin dip	4 switch		1.75	1.65
	206-7	14 pin dip	7 switch		1.95	1.85
	206-8	16 pin dip	8 switch		2.25	2.15

1/16 VECTOR BOARD

0.1" Hole Spacing

	Part No.	P-Pattern L	W	Price 1-9	10 up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062WE	4.50	6.50	2.07	1.86
	84P44 062WE	4.50	8.50	2.56	2.31
	169P44 062WE	4.50	17.00	5.04	4.53
	169P84 062WE	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062WEC1	4.50	17.00	6.80	6.12

INSTRUMENT/CLOCK CASE



Injection molded unit.
Complete with red bezel.
4½" x 4" x 1-9/16"

$3.49

MICROPROCESSOR COMPONENTS

8080A	CPU	$10.95	Z80	CPU	$24.95
8212	8 Bit Input/Output	4.95	CDP1802	CPU	19.95
8214	Priority Interrupt Control	7.95	MC6800	8 Bit MPU	19.95
8216	Bi-Directional Bus Driver	4.95	MC6810AP1	128 x 8 Static RAM	5.95
8224	Clock Generator/Driver	5.95	MC6820	Periph. Interface Adapter	7.95
8228	System Controller Bus Driver	5.95	MC6830L8	1024 x 8 Bit ROM	14.95

CPU'S

8080A	Super 8008	$10.95
2650	8 Bit MPU	26.50
P8085	CPU	29.95

SR'S

2504	1024 Dynamic	$ 3.95
2518	Hex 32 BIT	4.95
2519	Hex 40 BIT	4.00
2522	Dual 132 Bit SSR	2.95
2524	512 Dynamic	.99
2525	1024 Dynamic	2.95
2527	Dual 256 BIT	2.95
2528	Dual 250 Bit Static	4.00
2529	Dual 512 BIT	4.00
2532	Quad 80 BIT	2.95
2533	1024 Static	2.95
3341	Fifo	6.95
74LS670	16 x 4 Reg	1.95

UART'S

AY-5-1013	30K Baud	$ 5.95

ROM'S

2513(2140)	Char. Gen.-upper case	$ 9.95
2513(3021)	Char. Gen.-lower case	9.95
2516	Char. Gen.	10.95
MM5230	2048 BIT (512 x 4 or 256 x 8)	1.95
MM5262	2K x 1 Dynamic RAM	3 for 1.00

RAM'S

1101	256 x 1	Static	$ 1.49
2101	256 x 4	Static	5.95
2102	1024 x 1	Static	1.75
2107/5280	4096 x 1	Dynamic	4.95
2111	256 x 4	Static	6.95
TMS4044-45NL	4K	Static	14.95
7489	16 x 4	Static	1.75
8101	256 x 4	Static	5.95
8111	256 x 4	Static	6.95
8599	16 x 4	Static	3.49
21L02/91L02	1024 x 1	Static	1.95
74200	256 x 1	Static	6.95
93421	256 x 1	Static	2.95
MK4116(UPD416)	4K	Dynamic 16 Pin	5.95
MK4027(UPD414)	16K	Dynamic 16 Pin	29.95

PROMS

1702A	2048	Famos	$ 5.95
5203	2048	Famos	14.95
82S23	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	5.00
74S287	1024	Static	7.95
3601	256 x 4	Fast	3.95
2708	8K	Eprom	10.95
2716 T.I.	16K	Eprom	29.95
2716 Intel	16K	Eprom	59.95
6301-1	1024	Tri-State Bipolar	3.49
6330-1	256	Open Collector Bipolar	2.95

SPECIAL REQUESTED ITEMS

FCM3817	$5.00	11C90	19.95	7205	19.95	9368	3.95
AY-3-8500-1	7.50	4N33	3.95	ICM7045	24.95	LD110/111	25.00/set
AY-5-9100	14.95	8T20	7.50	ICM7207	7.50	95H90	11.95
AY-5-9200	14.95	8T97	1.50	ICM7208	19.95	MC3061P	3.50
AY-5-9500	4.95	HD0165	7.95	ICM7209	7.50	MC4016 (74416)	7.50
AY-5-2376	14.95	MCM6571	13.50	MK50240	17.50	MC1408L7	4.95
9374	1.50	MCM6574	13.50	DS0026CH	3.75	MC1408L8	5.75
82S115	19.95	MCM6575	13.50	TIL308	10.50	74C922	9.95

CLOCK CHIPS

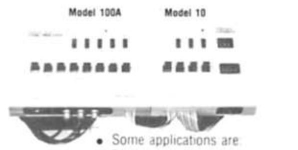
MM5309	$9.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5841	9.95
CT7001	5.95

PARATRONICS

Featured on February's Front Cover of Popular Electronics

Logic Analyzer Kit Model 100A

$229.00/kit



Model 100A Model 10

- Analyzes any type of digital system
- Checks data rates in excess of 8 million words per second
- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
- Displays 16 logic states up to 8 digits wide
- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

(Model 100A Manual - $4.95)

- Some applications are:
  - Troubleshooting microprocessor address, instruction, and data flow
  - Examine contents of ROMS
  - Tracing operation of control logic
  - Checking counter and shift register operation
  - Monitoring I/O sequences
  - Verifying proper system operations during testing

PARATRONICS TRIGGER EXPANDER - Model 10

Adds 16 additional bits. Provides digital delay and qualification of input clock and 24-bit trigger word. — Connects direct to Model 100A for integrated unit).

Model 10 Kit - $229.00
Baseplate — $9.95
Model 10 Manual — $4.95

B&K PRECISION 3½-Digit Portable DMM

- Overload Protected
- .3" high LED Display
- Battery or AC operation
- Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution
- Overrange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage - 0-1000V/ AC Voltage: 0-1000V
Freq. Response: 50-400 HZ
DC/AC Current: 0-100mA
Resistance: 0-10 meg ohm
Size: 6.4" x 4.4" x 2"

Model 2800 $99.95
Comes with test leads, operating manual and spare fuse

Accessories:

AC Adapter BC-28	$9.00
Rechargeable Batteries BP-26	20.00
Carrying Case LC-28	7.50

CSC 100 MHz 8-Digit Counter

- 20 Hz-100 MHz Range
- .6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.38" x 5.63"
- Four power souces, i.e. batteries, 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply

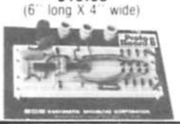
MAX-100 $134.95

ACCESSORIES FOR MAX 100:
Mobile Charger Eliminator use power from car battery — Model 100 — CLA $3.95
Charger/Eliminator use 110 V AC — Model 100 — CAI $9.95

CONTINENTAL SPECIALTIES

PROTO BOARD 6

$15.95
(6" long X 4" wide)



Other CS Proto Boards

PB100 - 4.5" x 6"	$ 19.95
PB101 - 5.8" x 4.5"	29.95
PB102 - 7" x 4.5"	39.95
PB103 - 9" x 6"	59.95
PB104 - 9.5" x 8"	79.95
PB203 - 9.75 x 6½ x 2¾	80.00
PB203A - 9.75 x 6½ x 2¾ (includes power supply)	129.95

PROTO CLIPS

14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

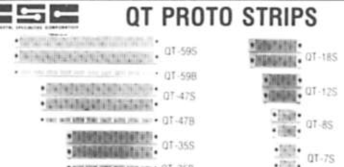
DESIGN MATES

DM1 - Circuit Designer $69.95
DM2 - Function Generator $74.95
DM3 - RC Bridge $74.95

LOGIC MONITOR

for DTL, HTL, TTL or CMOS Devices **$74.95**

CSC QT PROTO STRIPS



QT type	# holes	price
QT-59S	590	12.50
QT-59B	bus strip	2.50
QT-47S	470	10.00
QT-47B	bus strip	2.25
QT-35S	350	8.50
QT-35B	bus strip	2.00
QT-18S	180	4.75
QT-12S	120	3.75
QT-8S	80	3.25
QT-7S	70	3.00

Experimentor 300	$ 9.95
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J1

The Incredible "Pennywhistle 103"

$129.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character)
Receive Channel Frequencies	2025 Hz for space; 2225 Hz for mark
Transmit Channel Frequencies	Switch selectable: Low (normal) - 1070 space, 1270 mark. High - 025 space, 2225 mark.
Receive Sensitivity	-46 dbm acoustically coupled
Transmit Level	-15 dbm nominal. Adjustable from -6 dbm to -20 dbm
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase, 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

The Original the 3rd Hand

$9.95 each

- Leaves two hands free for working
- Clamps on edge of bench, table or work bench
- Position board on angle or flat position for soldering or clipping
- Sturdy, aluminum construction for hobbyist, manufacturer or school rooms

DIGITAL STOPWATCH

- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One: Times Single Event — Split & Taylor
- Size 4.5" x 2.15" x .90" (4½ ounces)
- Uses 3 Penlite Cells

Kit — $39.95
Assembled — $49.95
Heavy Duty Carry Case $5.95

Stop Watch Chip Only (7205) $19.95

IMC 3½ DIGIT DPM KIT

- New Bipolar Unit
- Auto Zeroing
- .5" LED
- Auto Polarity
- Low Power
- Single IC Unit

Model KB500 DPM Kit	$49.00
Model KB503 5V Power Kit	$17.50

JE700 CLOCK

12 or 24 Hour

The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout, and the MM5314 clock chip.

115 VAC *KIT ONLY* **$16.95**

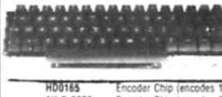
HEXADECIMAL ENCODER 19-KEY PAD

- 1 - 0
- ABCDEF
- Shift Key
- 2 Optional Keys

$10.95 each

New 63 KEY KEYBOARD

$29.95 IN STOCK



This keyboard features 63 unencoded SPST keys, unattached to any kind of P.C.B. A very solid molded plastic 13" x 4" base suits most applications.

HD0165	Encoder Chip (encodes 16 Keys)	$7.95 ea.
AY-5-2376	Encoder Chip (encodes 88 Keys)	$14.95 ea.

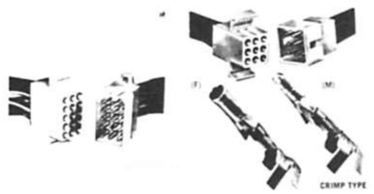
JE803 PROBE

The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols: (HI) - 1 (LOW) - 0 (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.

$9.95 Per Kit
printed circuit board

T²L 5V 1A Supply

This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only **JE225 $9.95 Per Kit**



NYLON CONNECTORS

Mfg by Molex

Complete Connectors Per Pkg.	Type No.	Class	Description	Price Ea. Pkg.
5	1625-1PRT	Min.(.062")	1 Circuit	$1.75
3	1625-2PRT	"	2 Circuit	1.90
3	1625-3PRT	"	3 Circuit	2.10
2	1625-4PRT	"	4 Circuit	2.10
2	1625-5PRT	"	5 Circuit	2.20
2	1625-6PRT	"	6 Circuit	2.35
1	1649-8PRT	"	8 Circuit	1.55
1	1625-9PRT	"	9 Circuit	1.75
1	1625-12PRT	"	12 Circuit	1.90
1	1625-15PRT	"	15 Circuit	2.30
1	1625-24PRT	"	24 Circuit	3.25
1	1772-36PRT	"	36 Circuit	4.55
5	1619PRT	Std.(.093")	1 Circuit	1.75
3	1545PRT	"	2 Circuit	1.90
3	1396PRT	"	3 Circuit	2.10
2	1490PRT	"	4 Circuit	2.10
2	1653PRT	"	5 Circuit	2.20
2	1261PRT	"	6 Circuit	2.35
1	1292PRT	"	9 Circuit	1.80
1	1360PRT	"	12 Circuit	1.90
1	1375PRT	"	15 Circuit	2.45

Prototype hand tools combine efficiency with economy. Ideal for prototype or limited production runs.

HT 1919 for .093" pin dia. terminals — $8.95 each

HT 1921 for .062" pin dia. terminals — $8.95 each

Econo-Extractor removes terminal from nylon connector housing with smoothness and ease.

HT 2054 for extracting .093" pin dia. terminals — $2.25 each

HT 2023 for extracting .062" pin dia. terminals — $2.25 each

Deluxe ejector tools, spring loaded for simple, efficient removal of terminal from nylon connector housing extracts either male or female terminals of same pin diameter.

HT 2038 for extracting .093" pin dia. terminals — $6.70 each

HT 1010-282 Replacement tip for HT 2038 — $2.50 each

HT 2285 for extracting .062" pin dia. terminals — $6.70 each

HT 1672-3 replacement tip for HT 2285 — $2.50 each

INTEGRATED CIRCUITS

555 Timer 8 pin mini-DIP	.49
741 Compensated OP-Amp 8 pin DIP	.37
LM 1889N RF Video Modulator	7.45
CA3130 Bipolar/Mos-FET Op Amp	1.19
CA3140 MOS-FET Op Amp, Bi-polar out	.99
LM3909 Lo Voltage Led Pulser	1.50
LM3911 Temp Control CHIP	1.50
Signetics 2504TA 1024 bit S.R. memory (1404A)	$1.75
MCM 6571P Character Generator	11.95
MCM6571AP Character Generator	11.95
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LM2907N Tachometer F/V Converter	2.65
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DATA AQUISITIONS SUBSYSTEM

ADC0817 is a 40 pin CMOS I.C. with an 8-bit analog-to-digital converter, a 16 channel multiplexer and microprocessor compatible control logic. Converter features high impedance chopper stabilized comparator, voltage divider with analog switch tree and a sucessive approximation register. Latched Tri-State outputs for easy u-processor interface. Require only 15 mW of power from single 5V supply. Fast, 100uS conversion time.

ADC0817......(40 pin DIP)..................$29.88

Spec sheets.................................$1.00

Annie Sez:

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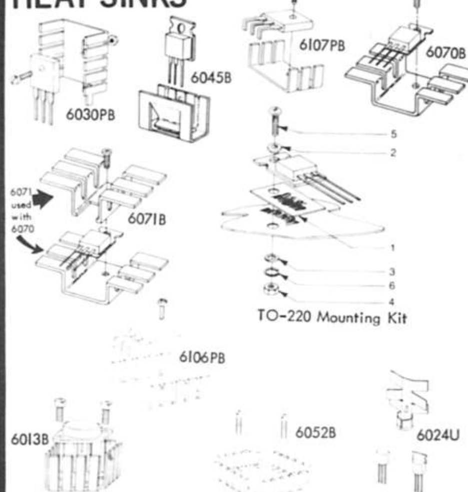

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THM 6024-U	Unfinished TO-92	10/$1.00, 100/$5.00
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Molded body encloses postive screw activated clamp which will accomodate wire sizes 14-30 AWG. Contacts and pins are solder plated copper. Pins are on .200 inch (5.08mM) for standard P. C. mounting. 10Amp rating. Compare our prices before you buy.

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Gold, Solder tail for Mother boards $4.50, 4/$17.00

Tin-Nickel, (NASGLO) Solder tail $3.75, 4/$14.00

Gold, wire-wrap................ $4.50, 4/$17.00

Tin-Nickel, (NASGLO) wire-wrap $3.75, 4/$14.00

HEX DARLINGTON ARRAY

MC1413P is a 16 pin DIP package with (6) 50V 500mA Darlington pairs.

MC1413P..................................$1.59

Specs/Apps.................................30¢

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Lo Profile Tin Solder Tail Dip Sockets

8 pin	10/$1.50	100/$14.00	1000/$120.00
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16 pin	10/$1.90	100/$18.00	1000/$160.00

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Specs and applications.........................60¢

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D2135 400 V, 25A Stud	1.00
D2138 600 V, 25A Stud	1.55
D3289R 200 V, 160A Stud Anode	5.85
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2N6101 80V, 10A NON HI GAIN TO-220	.50
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T1

Charge card telephone orders ($20 min.) will be accepted 9-5:30 P.M. except weekends. Telephone 995-9352. No collect calls please.

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1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.10
28-pin	pcb	.35	ww	1.45
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Molex pins	.01	To-3 Sockets	.45
2 Amp Bridge		100-prv	1.20
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TRANSISTORS, LEDS, etc.

2N2222A	NPN (2N2222 Plastic .10)	.15
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2N3904	NPN (Plastic)	.10
2N3054	NPN	.35
2N3055	NPN 15A 60v	.50
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MAN3610	7 seg com-anode (Orange)	1.25
MAN82A	7 seg com-anode (Yellow)	1.25
MAN74A	7 seg com-cathode (Red)	1.50
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C MOS

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4013	.40
4014	.95
4015	.90
4016	.35
4017	1.10
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4019	.50
4020	.85
4021	1.00
4022	.85
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4025	.30
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
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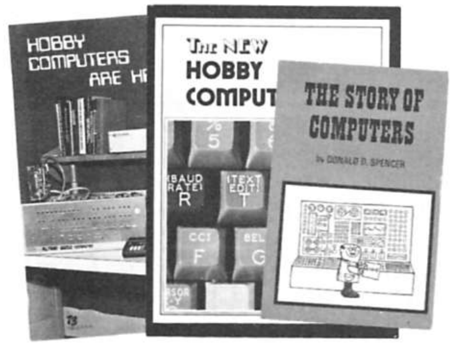

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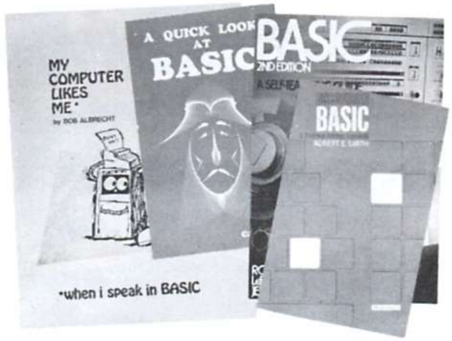

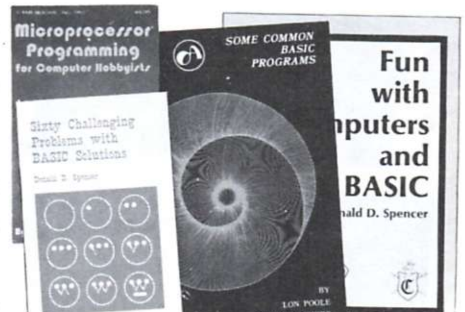

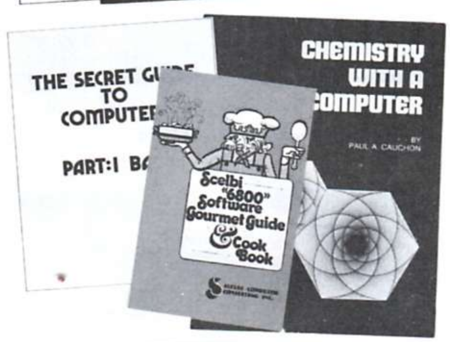

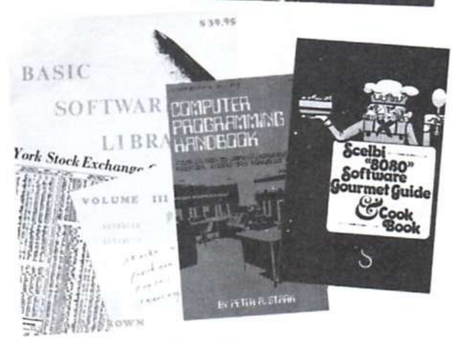

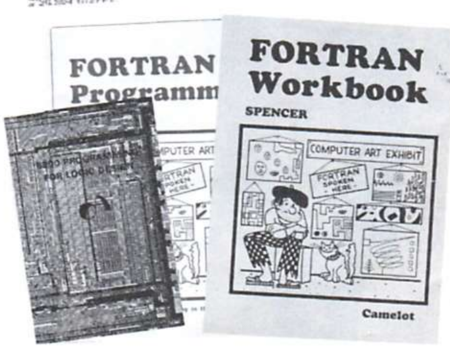

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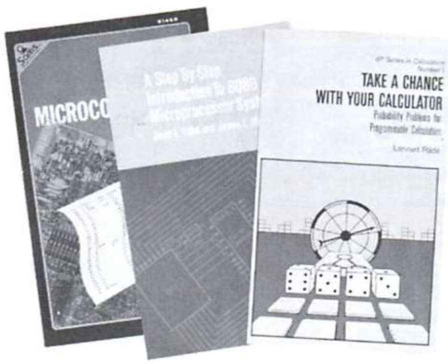

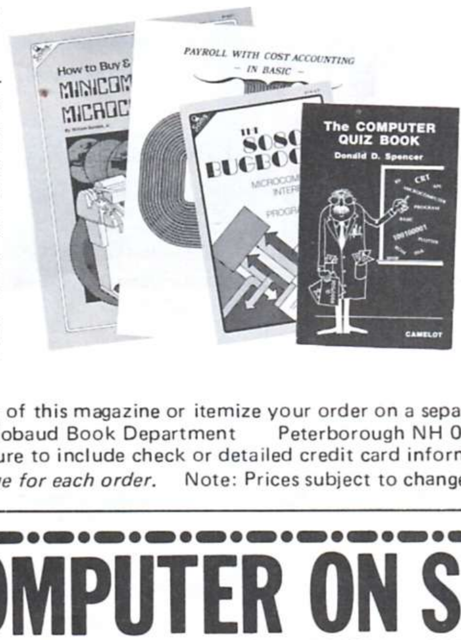

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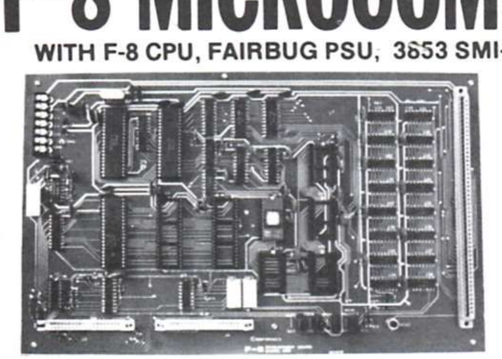

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This 8-bit machine, by itself, is as versatile as a lot of systems that include peripherals

Skeptical? For starters, because of its unique design the H8 is the only machine in its price class that offers full system integration, yet, with just 4K of memory and using only its "intelligent" front panel for I/O, may be operated completely without peripherals!

Memory Display

Register Display

I/O Port Display

In addition, by using the features of its built-in Pam-8 ROM panel control program, the H8 actually allows you to dig in and examine machine level circuitry.

Responding to simple instructions the "intelligent" panel displays memory and register contents, lets you inspect and alter them even during operation. And for greater understanding, the front panel permits you to execute programs a single instruction at a time. The result is a powerful, flexible learning tool that actually lets you "see" and confirm each detail of H8's inner workings.

If you need further evidence, consider the fact that H8's system orientation allows you an almost unlimited opportunity for growth.

Memory is fully expandable, the 8080A CPU extremely versatile, and with the addition of high speed serial and parallel interfacing you gain the added flexibility of I/O operation with tape, CRT consoles, paper tape reader/punches, and soon floppy disk systems!

The H8 offers superior documentation including complete step-by-step assembly and operation manuals, is backed by 54 years of Heath reliability, and comes complete with BASIC, assembler, editor, and debug software – others charge over $60 for!

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470pf 50V	.1mfd 50V

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.22mfd 35V	3.3mfd 25V
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