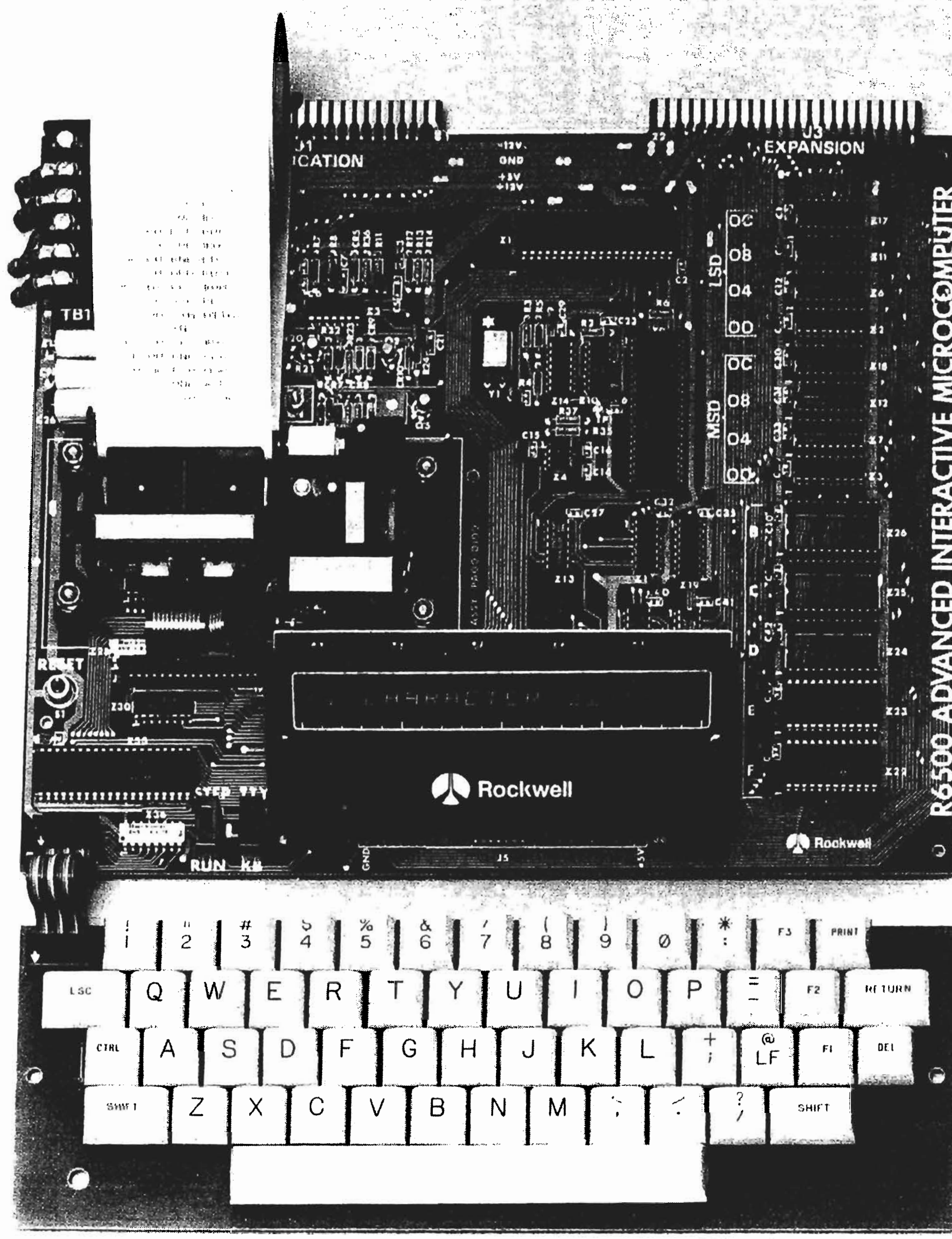
# INTERACTIVE

ISSUE NO. 1




Rockwell International
...where science gets down to business

As you page through this first issue of the newsletter, you'll notice that most of the articles have been written by Rockwell employees. Since the purpose of the newsletter is to provide you with a medium to exchange ideas with other AIM 65/6502 users, we'll be looking forward to having an article from YOU (or even a comment about what you'd like to see) for the next issue.

You don't need to be a professional writer to submit an article. We can smooth over and edit any rough spots there may be, as long as it's readable. So please type it. We can also re-draw any diagrams that accompany your article. The best way to send assembly source listings is on cassette. Be sure to let us know if you'd like it returned. If you don't have an assembler, we can accept handwritten source listings as long as they are easy to read and well commented — don't forget to use labels for every referenced memory location.

I'll look forward to hearing from you.

Best Wishes,

Eric C. Rehnke

Eric C. Rehnke
Editor

To keep receiving this newsletter, subscribe now! The cost is $5 for 6 issues (or $8 overseas). As an incentive for charter subscriptions, we'll send you the next 8 issues for $5 ($8 overseas) — that's 2 additional issues free - if you subscribe now. This a one-time offer that will not be repeated. Just fill in the attached subscription request, add your check or money order payable to ROCKWELL INTERNATIONAL, and mail in the attached, postage paid envelope. (Payment must be in U.S. funds drawn on a U.S. bank.) No purchase orders.

All correspondence and articles should be sent to:

NEWSLETTER EDITOR
ROCKWELL INTERNATIONAL
P.O. Box 3669, RC55
ANAHEIM, CA 92803



## AIM 65 SELF-TEST PROGRAM AVAILABLE

Rockwell is making the AIM 65 self-test program available through it's spare parts facility. Order part numbers #EA74-M800 and #PL74-J100 for the Test Manual and Program Listing, respectively.

Refer to the spare parts list elsewhere in this newsletter for further information.

## LOW COST PRINTER FOR AIM 65 (?)

An article in the February 1980 issue of MICROCOMPUTING page 186 (remember KILOBAUD?) explained the hows of interfacing a surplus Model 2970 Communications Terminal (Selectric-based) to a KIM or SYM.

The low price (the author paid $100 for his 2970) and the excellent print quality could offset the slow speed and complicated design of the Selectric mechanism for your application.

Since the SYM also uses a 6522 as its user I/O, conversion to AIM 65 would seem straightforward.

Although the author didn't mention the printing speed of the Selectric, I understand it to be quite slow (around 10-15 characters per second). That works out to one fifth the speed of the DIABLO at about one thirtieth the price.

Hmmm . . . that's not too bad.

## COLOR GRAPHICS

That same issue of MICROCOMPUTING (Feb. 1980) also published the design of a low-cost video display which uses the AMI S68047 VDG.

The Video Display Generator operates in three modes: alphanumerics (32 x 16), semigraphics, or full graphics (up to 256 x 192 resolution).

Although the display chip was interfaced to an 8080 system in the article, an experienced AIM 65 user should have very little trouble in adpating the interface to his system.

The software must, of course, be completely re-written.

## AIM 65 SPARE PARTS PROCUREMENT

Here's an abbreviated spare parts price list with some of the more commonly requested items. (All parts are available.)

For C.O.D. orders or inquiries, call: 800/351-6018.

Mail Orders should be directed to:
ROCKWELL INTERNATIONAL
SPARES CONTROL
P.O. BOX 3669, RC48
ANAHEIM, CA 92803

Add your state and city tax. On orders under $10.00, add $2.00 shipping and handling.

**AIM SPARE PARTS LIST**

| ROCKWELL PART NO. | DESCRIPTION | PRICE |
|---|---|---|
| 208R02-001 | THERMAL PRINTER | $74.70 |
| 208R02-010 | PRINT HEAD | 13.00 |
| 341R29-001 | RESET SWITYCH (S1) | .30 |
| 470R03-002 | DARLINGTON TRANSISTOR ARRAY (Z21,Z30) | 2.71 |
| TT270 | THERMAL PRINTING PAPER 3 ROLLS/BOX | 3.50 |
| PA00-D020-001 | KEYBOARD-TO-AIM 65 CABLE | 7.50 |
| PA00-D124-003 | RED DISPLAY FILTER | 3.85 |
| PA00-D125 | DISPLAY ANTI-STATIC SHIELD | 2.00 |
| PA00-D131-001 | PAPER TEAR BAR | 73 |
| PA00-D133-001 | PAPER HOLDER | 7.13 |
| R2114 | RAM CHIP | 13.05 |
| R3222 | MONITOR ROM (Z22) | 35.45 |
| R3223 | MONITOR ROM (Z23) | 35.45 |
| R6502 | CPU (Z9) | 9.80 |
| R6520 | PIA (U1) | 6.55 |
| R6522 | VIA (Z1mZ32) | 9.10 |
| R6532 | RIOT (Z33) | 12.35 |
| EA74-M800 | TEST MANUAL | 7.50 |
| PL-EA74-J100 | TEST PROGRAM LISTING | 7.50 |
| 210R12-001 | 4-DIGIT DISPLAY MODULE (MUST SPECIFY INTENSITY CODE WHICH IS FOUND ON LOWER LEFT HAND CORNER OF MODULE. THE CODE WILL BE A LETTER (A THROUGH E) OR A COLOR (RED THROUGH WHITE) | 29.25 |

## CRT APP. NOTE INFO

If you've been climbing the walls trying to find the Standard Microsystems CG-5004 character generator specified in our application note entitled "CRT MONITOR OR TV INTERFACE FOR AIM 65", (#R6500N12) then listen up.

Standard Microsystems has discontinued that part and has replaced it with their CRT 7004. The newer part will retain for well under $20 and is available through their distributors. Contact the factory for more info:

STANDARD MICROSYSTEMS CORP.
35 Marcus Boulevard
Hauppauge, New York 11787

(516) 273-3100

## WARNING !!!

Care must be taken so that the locations $A406 and $A407 in AIM 65 RAM are not accidentally altered by the user or his programs.

These locations ($A406 and $A407) contain the display linkage vector. Since the warm start sequence does not re-initialize this vector, once the locations are changed, pressing the RESET key will cause the machine to jump off into never-never-land. The only way to gain control is to turn the power off and then on again so AIM 65 can perform it's cold start sequence. Turning off the power will, of course, cause any user programs to be lost.

## USING EPROMS IN AIM 65

If you don't have the optional BASIC or ASSEMBLER ROMS installed in your AIM 65, one or more EPROMS can be used. Two EPROMS which will plug in with no modification to the AIM are: the TMS 2516 and TMS 2532 from Texas Instruments and the Intel 2716.

The TMS 2532 (4K x 8 EPROMS) is a perfect match for AIM 65 because it occupies the same amount of address space as the Rockwell R2332 ROM. This allows programs to span two or more contiguous blocks of EPROM memory.

The TMS 2516 and Intel 2716, on the other hand, will occupy the lower 2K of AIM 65's 4K per ROM slot. This is because All (address line 11) on AIM 65 will connect with CE (chip enable - pin 18) on the 2716/2516 and needs to be low to read from the EPROPM device.

The Intel 2732 is not AIM 65-compatible because the functions of pins 18 and 21 (CE and A11) have been reversed.

## FOR YOUR INFORMATION

No, I don't mind if you also look elsewhere for AIM 65 information. Here are some other sources.

COMPUTE MAGAZINE
POB 5119
Greensboro, N. C. 27403

TARGET (newsletter)
c/o Donald Clem
R.R. No. 2, Conant Rd.
Spencerville, Ohio 45887

MICRO
POB 6502
So. Chelmsford, Mass. 01824

MICROCOMPUTING (formely KILOBAUD)
Peterborough, NH 30458

65xx MICRO MAG
Roland Lohr
Hansdorfer Str 4
2070 Ahrensburg
W. Germany

(This publication is written almost entirely in German)

Also, here is a list of application notes published by ROCKWELL for the 6502/AIM 65. They can be obtained for the asking from:

ROCKWELL INTERNATIONAL
MARKETING SERVICES
POB 3669, RC55
Anaheim, CA 92803

| Document No. | Document Name |
|---|---|
| 223 | R6502/R6532 Timer Interrupt Precautions |
| 224 | System 65 to AIM 65 Interface |
| 230 | RS-232C Interface for AIM 65 |
| 231 | Intferfacing R6500 Microprocessors to a Floppy Disk |
| 235 | Interfacing KIM-4 to AIM 65 |
| 247 | Using KIM-1 Tapes with AIM 65 |
| 238 | A CRT Monitor or TV Interface for AIM 65 |
| 241 | Preparing an AIM 65 Basic Program for PROM/ROM Operation. |

Be sure to specify the document number and name.

## AIM 65 SYMBOL TABLE ROUTINE

Sometimes it's useful to obtain a symbol table from a assembly. Here is a short, fully relocatable routine that will do just that.

Simply install this program in some out-of-the-way spot (it now resides in the top page of a 4K AIM 65 system) and run it right after the assembly is done.

It's handy to set the F1 user Vector (locations $010C-$010E) to point to the start of the symbool table printing routine. This lets the F1 key call for the symbol table printout.

**NOTE:** This routine destroys the contents of the Symbol Table Starting Address Low and High ($0034 and $003B) and the Number of Symbols High and Low ($000B and $000C) so can only be used once per assembly. Of course, the program could be modified to transfer the data in these locations to other locations, but this is left up to the user.

```
0000                   ;THIS SYMBOL TABLE
0000                   ;PRINTING ROUTINE
0000                   ;WAS WRITTEN BY
0000                   ;ERIK SHOVGAARD OF
0000                   ;DENMARK
0000                   ;IT WILL MAKE ONLY
0000                   ;ONE LISTING OF
0000                   ;THE SYMBOL TABLE
0000                   ;PER ASSEMBLY.
0000                   ;PRESS THE 'F1' KEY
0000                   ;AFTER THE ASSEMBLY
0000                   ;TO GET A LISTING OF
0000                   ;THE TABLE.
0000                           *=$010C
010C   4C 00 0F                JMP SYM
010F                   LNK     =$3A
010F                           *=$F00
0F00   20 71 E8        SYM     JSR $E871
0F03   20 F0 E9                JSR $E9F0
0F06   A0 00           NEW     LDY #0
0F08   B1 3A           SYMLP   LDA (LNK),Y
0F0A   20 BC E9                JSR $E9BC
0F0D   C8                      INY
0F0E   C0 06                   CPY #6
0F10   D0 F6                   BNE SYMLP
0F12   A9 3D                   LDA #'=
0F14   20 BC E9                JSR $E9BC
0F17   A9 24                   LDA #'$
0F19   20 BC E9                JSR $E9BC
0F1C   B1 3A                   LDA (LNK),Y
0F1E   20 46 EA                JSR $EA46
0F21   C8                      INY
0F22   B1 3A                   LDA (LNK),Y
0F24   20 46 EA                JSR $EA46
0F27   20 F0 E9                JSR $E9F0
0F2A   18                      CLC
0F2B   A9 08                   LDA #8
0F2D   65 3A                   ADC LNK
0F2F   85 3A                   STA LNK
0F31   A9 00                   LDA #0
0F33   65 3B                   ADC LNK+1
0F35   85 3B                   STA LNK+1
0F37   38                      SEC
0F38   A5 0C                   LDA $0C
0F3A   E9 01                   SBC #1
0F3C   85 0C                   STA $0C
```

```
0048  0F3E  A5 0B        LDA $0B
0049  0F40  E9 00        SBC #0
0050  0F42  85 0B        STA $0B
0051  0F44  05 0C        ORA $0C
0052  0F46  D0 BE        BNE NEW
0053  0F48  60           RTS
0054  0F49                END
```

## EDIT BASIC PROGRAMS

I'll bet you didn't know that the AIM 65 text editor can be used to edit BASIC programs. Well, it can.

When you're in BASIC and perform a SAVE to cassette - the program is saved in its ASCII format (not in the tokenized format as it's stored in memory.) If you've ever had the printer on when you read in a BASIC program, you've seen how it's saved on cassette.

There are three things you need to keep in mind, though, when you edit your programs:

1. Since the AIM 65 text editor limits the character per line count to 60, there can be no more than 60 characters per line in your BASIC program (BASIC normally permits 72 characters per line.) Any more than 60 characters will be ignored.

2. When BASIC programs are read into the editor, the first line of the text buffer will be blank. Leave this blank line in there or things will get fouled up.

3. When finished editing, go to the bottom of the text buffer with the "B" key and drop down past the last line with the "D" key. Next, press the "I" key (for insert), followed by a Control "Z" (hold the "CTRL" key down while pressing the "Z" key), and then a "RETURN" to terminate the insert.

The tape gap in locaion $A409 should be at least $20 to allow the BASIC interpreter time to interpret.

Now save the program to cassette using the editor "L" (List) command after you have moved to the top of the buffer with the "T" command.

## CHECKSUM PROGRAM

**Gordon Smith**
**Rockwell Hobby Computer Club**

Here is a technique for verifying that your ROM's are correct. The technique determines a check sum for each of the ROM's or ROM pair. To make this easy to do, I am enclosing a check sum program which also could be used with some modification as a check sum subroutine.

The first section of the program uses the CRLF monitor subroutine to clear the display and the FROM and TO subroutines to get the starting and stopping addresses.

The second section of the program initializes the check sum to zero and also sets up a dummy third address byte for the start and stop addresses. The reason that the third address byte is used is to allow a proper ending of the checksum when the last address is FFFF.

The third section (starting at 032C) actually forms the running check sum by adding the currently addressed memory cell to the prior check sum.

The next section increments the start address until it equals the stop address + 1 as determined by the section starting at 0349. When the stop address is FFFF the incremental address must be 010000 at the time of termination. This is the reason for carrying the third address byte. If only two address bytes were used for the comparison, FFFF would increment to 0000 and the stop would never occur.

The final section uses the BLANK2 subroutine to space the display over so that the monitor prompt will not wipe out a digit of the result and then uses the NUMA subroutine three times to print out the three byte check sum.

The results of these check sums are as follows:

| | | | | | |
|---|---|---|---|---|---|
| **BASIC CHIPS** | **B000** | **TO** | **CFFF** | = | **OFC76B** |
| | **B000** | **TO** | **BFFF** | = | **07CC47** |
| | **C000** | **TO** | **DFFF** | = | **07FB24** |
| **ASSEMBLER CHIP** | **D000** | **TO** | **DFFF** | = | **071A67** |
| **MONITOR CHIPS** | **E000** | **TO** | **FFFF** | = | **0EB11B** |
| | **E000** | **TO** | **EFFF** | = | **078675** |
| | **F000** | **TO** | **FFFF** | = | **072AA6** |

**(CHECKSUM PROGRAM CONT'D)**

**INITIALIZE 'F1' KEY**
**010C 4C JMP 0300**

**PICK UP START AND STOP ADDRESSES**

```
010C   4C  JMP  0300
0300   20  JSR  E9FO
0303   20  JSR  E7A3
0306   AD  LDA  A41C
0309   85  STA  01
030B   AD  LDA  A41D
030E   85  STA  02
0310   20  JSR  E83E
0313   20  JSR  E7A7
0316   AD  LDA  A41C
0319   85  STA  04
031B   AD  LDA  A41D
031E   85  STA  05
```

**CLEAR 3RD BYTE TEST ADDRESSES AND CHECK SUM**

```
0320   A0  LDY  #00
0322   84  STY  00
0324   84  STY  03
0326   84  STY  06
0328   84  STY  07
032A   84  STY  08
```

**FORM CHECK SUM**

```
032C   18  CLC
032D   B1  LDA  (01),Y
032F   65  ADC  08
0331   35  STA  08
0333   A9  LDA  #00
0335   65  ADC  07
0337   85  STA  07
0339   A9  LDA  #00
033B   65  ADC  06
033D   85  STA  06
```

**INCREMENT ADDRESS TO PICK UP NEXT VALUE**

```
033F   E6  INC  01
0341   D0  BNE  0349    06
0343   E6  INC  02
0345   D0  BNE  0349    02
0347   E6  INC  00
```

**TEST FOR LAST TERM**

```
0349   A5  LDA  04
034B   C5  CMP  01
034D   A5  LDA  05
034F   E5  SBC  02
0351   A5  LDA  03
0353   E5  SBC  00
0355   B0  BCS  032C    D5
```

**PRINT FINAL RESULTS AND RE-ENTER MONITOR**

```
0357   20  JSR  E9F0
035A   20  JSR  E83B
035D   A5  LDA  06
035F   20  JSR  EA46
0362   A5  LDA  07
0364   20  JSR  EA46
0367   A5  LDA  08
0369   20  JSR  EA46
036C   4C  JMP  E1A1
```

```
FROM=B000          TO=BFFF
  07CC47
<[>
FROM=C000          TO=CFFF
  07FB24
<[>
FROM=D000          TO=DFFF
  071A67
<[>
FROM=E000          TO=EFFF
  078675
<[>
FROM=F000          TO=FFFF
  072AA6
<[>
FROM=B000          TO=CFFF
  0FC76B
<[>
FROM=E000          TO=FFFF
  0EB11B
```

# DATA FILES FOR AIM 65 BASIC

**Ralph Reccia**
**Rockwell International**

The ability to operate with data files greatly enhances the usefulness of AIM 65 BASIC.

The BASIC program listed here requires the use of two tape recorders and both must be in the remote control mode.

Note that lines 30 through 140 are an assembly language program which gets poked into memory locations $0F00 through $0F68 ($=hexadecimal.) Locations $0F69 through $0FFF are used to store the data files that are being used. Assembly language programs are inserted into BASIC programs as follows:

> The assembly language program is assembled normally into its final destination address. Each data byte is then converted from a binary value to a decimal (BCD) value. (This part is a real drudge and could be made much easier with a utility program that does all this conversion automatically. Such things are simple for computers.) These decimal values are then put into our BASIC Program as a series of DATA statements (see lines 30-140). The program sequence in lines 10-20 is used to POKE these numbers into memory. The assembly language program is then accessed as a subroutine by the USR function (see Appendix F1 in the AIM 65 BASIC manual.)

The user MUST limit the amount of memory available for BASIC to 3,839 bytes. This is done by entering 3839 in answer to "MEMORY SIZE?"

Subroutines 3000 and 3100 set up delays which allow the operator to perform the manual functions on the tape recorder and read the display as the program prompts the user as to functions that need to be performed. The program waits until the user responds that he is finished by use of the GET command. (See lines 1996, 3220, and 3330.)

The data file in the example program is a fixed record format type. There are four fields per record (see lines 1230 - 1260): the CATALOG # field, the AUTHOR field, the TITLE field, and the REMARKS field. These categories can easily be changed to suit whatever application you may have in mind. The number of fields per record can also be changed as long as you realize that in the present design, the data buffer length is 151 characters long ($EF69 - $EFFF).

However, all 151 characters are not available for user data. Some space is needed for element separation and an end-of-record character. Looking at lines 195, 196, and 219, you'll see that the element separator is a semicolon (;) and the end of record is signified by an exclamation point (!). These characters are inserted at the appropriate points in the data buffer by the software and need not be entered by the operator. Furthermore, they cannot be used as data anywhere else in the file. Of course, these special characters can easily be changed by the user to any other convenient ASCII characters.

Each record needs one element separator per field and one end-of-record marker. To calculate the "actual" buffer space available to the user simply subtract the number of fields plus one (for the end of record character) from the total buffer length.

Our example file system has a 151-character buffer and four fields, so the user can enter 146 characters into the text buffer, since

$$151 - (4 + 1) = 146$$

Advanced experimenters can change the size and location of the data buffer by changing the references in BASIC (lines 1040, 1290, 1320, and 2020) and the references to the label DATA contained in the assembly language subroutine.

Other routines can be added to do such things as search for and/or print various fields of the record, etc.

By the way, the end of file indicator consists of a dummy record with a colon (:) as the first character followed by an exclamation point (!).

```
1 REM BASIC FILE HANDLING PROGRAM FOR AIM 65
2 REM THIS ROUTINE DESCRIBES A METHOD OF
3 REM SAVING AND LOADING DATA DURING THE
4 REM EXICUTION OF A BASIC PROGRAM
5 REM
6 REM ROCKWELL INTERNATIONAL 8/24/79
7 REM
8 REM SET ASSEMBLY ROUTINES TO LOC $0F00
9 REM
10 FORI=0TO104 READX
20 POKE3840+I,X NEXT
30 DATA169,183,141,2,168
40 DATA32,29,242,169,35,32,74,242,162,0
50 DATA189,105,15,32,74,242,232,201,33,208,245
60 DATA169,12,141,0,168,96,169,0,141,11,168
70 DATA32,234,237,32,41,238
80 DATA201,35,240,6,201,22,208,242,240,243
90 DATA162,0,32,41,238,157,105,15,232
100 DATA201,33,208,245,169,12,141,0,168,96
110 DATA162,0,189,105,15,232,201,59,240,10
120 DATA201,33,240,12,32,188,233,76,74,15
130 DATA32,240,233,76,74,15,32,240,233
140 DATA32,240,233,96
189 REM
190 REM SET TAPE GAP TO $30, TURN BOTH
191 REM REMOTE CONTROLS OFF,SET UPPER
192 REM BYTE OF USER VECTOR TO $0F AND
193 REM SET TAPEOUT $A435 TO TAPE 2
194 REM NOTE DEFAULT IS TAPE 1
195 REM '!' SYMBOL IS END OF RECORD
196 REM ';' SYMBOL IS ELEMENT SEPARATOR
197 REM
200 POKE41993,48:POKE43008,12:POKE5,15:POKE42037,1
210 ER$="!" ES$=";"
500 PRINT"DO YOU WANT TO 1)" GOSUB3000
510 PRINT"UPDATE A FILE 2)" GOSUB3000
520 PRINT"CREATE A NEW FILE" GOSUB3000
530 PRINT"3)READ A FILE":GOSUB3000
540 INPUT"INPUT 1,2OR3";X
550 ONXGOTO1000,1200,2000
1000 GOSUB3200
1010 GOSUB3300
1020 PRINT"CASSETTE 1 TO PLAY" GOSUB3100
1030 PRINT"CASSETTE 2 TO RECORD" GOSUB3100
1040 POKE4,32:X=USR(Y):A=PEEK(3945)
1044 REM
1045 REM CHECK FOR END OF FILE
1046 REM
1050 IFA=58THEN1220
1060 POKE4,72:X=USR(Y)
1070 PRINT"WANT TO KEEP IT":GOSUB3000
1080 INPUT"TYPE Y OR N";A$
1090 IFA$="N"THEN1040
1100 POKE4,0:X=USR(Y):GOTO1040
1200 GOSUB3300
1210 PRINT"CASSETTE 2 TO RECORD":GOSUB3100
1220 POKE4,0
1230 INPUT"CATALOG #";CN$
1240 INPUT"AUTHOR";AU$
1250 INPUT"TITLE";TI$
1260 INPUT"REMARKS";RE$
1262 REM
1263 REM
1264 REM
1265 REM
1266 REM PUT THE ELEMENTS TOGETHER
1267 REM
1270 A$=CN$+ES$+AU$+ES$+TI$+ES$+RE$+ES$+ER$
1280 FORI=1TOLEN(A$)
1290 POKE3944+I,ASC(MID$(A$,I,1)):NEXT
1300 X=USR(Y) INPUT"MORE Y OR N";A$
1310 IFA$="Y"THEN1230
1320 POKE3945,58:POKE3946,33:X=USR(Y)
1330 GOSUB3200
1340 PRINT"WISH TO READ TAPE":GOSUB3000
1345 INPUT"TYPE Y OR N";A$
1350 IFA$="Y"THEN1990
1360 GOSUB3200
1370 PRINT" TYPE RUN TO RESTART":END
1990 PRINT"CHANGE TAPE TO UNIT":GOSUB3000
1993 PRINT"ONE TYPE D WHEN DONE":GOSUB3000
1996 GETA$:IFA$<>"D"THEN1996
2000 GOSUB3200
2010 PRINT"CASSETTE 1 TO PLAY":GOSUB3000
2020 POKE4,32:X=USR(Y):A=PEEK(3945)
2030 IFA=58THEN2100
2040 POKE4,72:X=USR(Y):GOTO2020
2100 PRINT"END OF FILE" GOSUB3000
2110 GOTO1360
3000 FORI=1TO1500:NEXT:RETURN
3100 FORI=1TO2500:NEXT:RETURN
3200 PRINT"CASSETTES TO REWIND":GOSUB3100
3210 POKE43008,60:PRINT"TYPE D WHEN DONE":GOSUB3000
3220 GETA$:IFA$<>"D"THEN3220
3230 POKE43008,12:RETURN
3300 PRINT"ADVANCE TAPES SO YOU":GOSUB3000
3310 PRINT"ARE PAST LEADER":GOSUB3000
3320 POKE43008,60
3325 PRINT"TYPE D WHEN DONE":GOSUB3000
3330 GETA$:IFA$<>"D"THEN3330
3340 POKE43008,12:RETURN
```

```
0000                ;BASIC FILE HANDLER ASSEMBLY ROUTINES 8/24/79
0000                ;        R. RECCIA
0000                ;
0000                ;THE FOLLOWING SUBROUTINES DESCRIBE A METHOD OF
0000                ;WRITING AND READING FILES WHILE EXECUTING A
0000                ;BASIC PROGRAM ON AIM 65. THE ROUTINES MAY BE
0000                ;RELOCATED
0000                ;
0000                ;
0000                OUTALL=$E9BC
0000                CRLF=$E9F0
0000                TAOSET=$F21D
0000                OUTTAP=$F24A
0000                TAISET=$EDEA
0000                GETTAP=$EE29
0000                ;
0000                        *=$0F00
0F00                ;
0F00                ;THIS ROUTINE OUTPUTS DATA TO TAPE
0F00                ;
0F00  A9 B7                 LDA #$B7        ;SET PB7 TO AN OUTPUT
0F02  8D 02 A8              STA $A802
0F05  20 1D F2              JSR TAOSET      ;SET RECORDER 2 AS OUTPUT
0F08  A9 23                 LDA #'#'        ;OUTPUT # AS BEGINNING OF FILE
0F0A  20 4A F2              JSR OUTTAP
0F0D  A2 00                 LDX #0
0F0F  BD 69 0F      MORE    LDA DATA,X      ;LOAD ACC WITH CHARACTER
0F12  20 4A F2              JSR OUTTAP      ;OUTPUT ACC TO TAPE
0F15  E8                    INX
0F16  C9 21                 CMP #'!'        ;COMPARE TO TOTAL STRING
0F18  D0 F5                 BNE MORE
0F1A  A9 0C                 LDA #$0C        ;TURN RECORDER 2 OFF
0F1C  8D 00 A8              STA $A800
0F1F  60                    RTS
0F20                ;
0F20                ;THE FOLLOWING ROUTINE READS THE TAPE
0F20                ;
0F20  A9 00                 LDA #0
0F22  8D 0B A8              STA $A80B       ;INITIALIZE ACR
0F25  20 EA ED      NO      JSR TAISET      ; SET TAPE 1 FOR INPUT
0F28  20 29 EE      SYNC    JSR GETTAP      ;READ CHAR FROM TAPE TO ACC
0F2B  C9 23                 CMP #'#'        ;CHECK IF BEGINNING OF FILE
0F2D  F0 06                 BEQ YES
0F2F  C9 16                 CMP #$16        ;CHECK FOR SYNC CHARACTER
0F31  D0 F2                 BNE NO
0F33  F0 F3                 BEQ SYNC
0F35  A2 00         YES     LDX #0
0F37  20 29 EE      GETMOR  JSR GETTAP      ;INPUT CHARACTER
0F3A  9D 69 0F              STA DATA,X
0F3D  E8                    INX
0F3E  C9 21                 CMP #'!'        ;CHECK FOR END OF FILE
0F40  D0 F5                 BNE GETMOR
0F42  A9 0C                 LDA #$0C        ;TURN RECORDER 1 OFF
0F44  8D 00 A8              STA $A800
0F47  60                    RTS
0F48                ;
0F48                ;THIS ROUTINE OUTPUTS DATA TO AOD
0F48                ;
0F48  A2 00                 LDX #0
0F4A  BD 69 0F      AGAIN   LDA DATA,X
0F4D  E8                    INX
0F4E  C9 3B                 CMP #';'        ;CHECK FOR RECORD SEPARATOR
0F50  F0 0A                 BEQ LINFD
0F52  C9 21                 CMP #'!'        ;CHECK FOR END OF FILE
0F54  F0 0C                 BEQ DONE
0F56  20 BC E9              JSR OUTALL      ;OUTPUT ACC TO AOD
0F59  4C 4A 0F              JMP AGAIN
0F5C  20 F0 E9      LINFD   JSR CRLF
0F5F  4C 4A 0F              JMP AGAIN
0F62  20 F0 E9      DONE    JSR CRLF
0F65  20 F0 E9              JSR CRLF
0F68  60                    RTS
0F69                ;
0F69                ;
0F69  41            DATA     .BYTE 'A'
0F6A                         .END

ERRORS = 0000 <0000>
END OF ASSEMBLY
```

# A COUPLE OF 6522 APPLICATIONS NOTES

**Conrad Boisvert**
**Synertek, Inc.**

### 6522 - GENERATING LONG TIMED INTERVALS

The 6522 Versatile Interface Adapter contains two 16-bit counter/timers for a variety of purposes, among them the generation of timed interrupts. Each counter is 16 bits long, so the maximum count-down is $2^{16}$ or 65,536 counts. With a 1 MHz processor clock rate, this translates to a maximum time of about 54.4 msec.

In some cases, this may not be long enough. To achieve longer timed intervals, several schemes may be used. Among them are:

1. Increment or decrement a memory location each time the timer interrupt occurs. In this way, an additional factor of up to 256x can be achieved, resulting in a maximum of about 16.8 seconds. However, extra program steps are needed.

2. The two 6522 timers may be connected externally (Figure 2), resulting in an effective 32-bit counter/timer. In this way, intervals longer than one hour may be achieved.

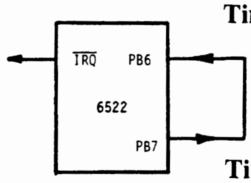



**Figure 1 - Connection to Use T1 and T2 as 32-bit Counter**

### PROGRAMMING CONSIDERATIONS

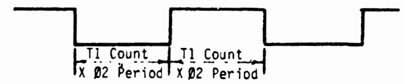
To cascade the two counters together, it is necessary to do the following:

1. Connect PB6 and PB7 together. These pins will not be useable as general I/O functions in this case.

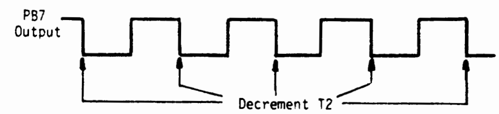
2. Program T1 mode to free-run with output on PB7.

3. Program T2 mode to count pulses on PB6 input.

In this way, the waveform on PB7 is:




Since timer T2 pulse-counting mode counts negative-edge transitions, it is clear that T2 will decrement as follows:




Thus, T2 decrements will occur at the following intervals:

T2 RATE = 2x (T1 COUNT) x (02 PERIOD)
And, hence, the total time will be,
T = 2x (T1 COUNT) x (T2 COUNT) x (02 PERIOD)

Thus, the maximum is 2 X 65,425 X 65,536 X 1 us = 8590 seconds = 142 minutes = about 2-1/2 hours.

### 6522 -GENERATING A 1 Hz SQUAREWAVE SIGNAL

The 6522 (Versatile Interface Adapter) has two integral 16-bit timers intended to perform a variety of programmable functions. One capability is to use timer T1 to generate continuous squarewave output on peripheral pin PB7.

The timer is clocked by the system clock, ϕ 2, which normally operates at 1 MHz. The waveform generated is illustrated in Figure 1.

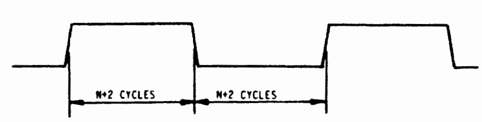



**Figure 1 - PB7 Output Waveform**

Note that the period of the waveform is 2N+4 cycles, with a 16-bit counter, the maximum number of cycles is where N is the number set into the timer.

$N_{MAX} = {}^{16}\text{-}1 = 65,535$

Hence, the maximum programmable period is:

$P_{MAX} = 2N_{MAX} + 4 = 131,074$ cycles

This is about 131 msec for a 1 MHz system clock, considerably less than 1000 msec, the period for a 1 Hz signal.

One way to extend the period is to use the PB7 output signal as a clock input to the sift register on the 6522. If a pattern of 11110000 is set into the shift register, then the output of the sift register will appear as Figure 2.

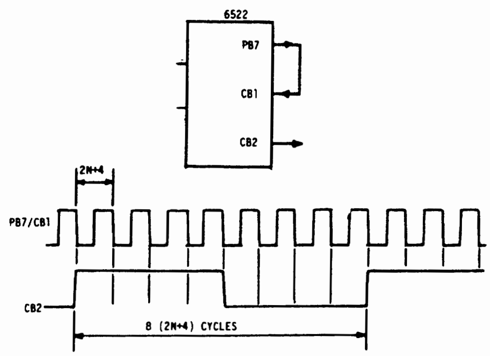



**Figure 2 - Shift Register Output Waveform**

Note that the period is entended by a factor of 8 by this method.

$$P_{MAX} = 8\,(2N+4)$$

Hence for 1 Hz, $P_{MAX}$ = 1,000,000 and N = 62,498. Thus, it is necessary to store the number 62,498 into the timer T1 in order to generate the 1 Hz waveform. Then translated into hexadecimal format, the result is F422, and F4 is loaded into the high byte and 22 into the low. The step-by-step sequence for programming this is shown in Figure 3.

Note especially the following points:

* Loading the T1 high-order counter (Register 5) initiates the timer in its free-running mode.

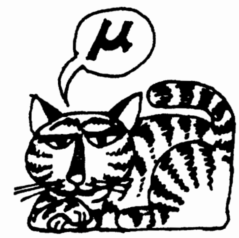
* PB7 data direction must be set to an output for the pulses to occur.

```
2000                       ;PROGRAM TO GENERATE 1HZ SQUARE-WAVE
2000                       ;OUTPUT ON R6522 PB7 OUTPUT PIN USING
2000                       ;T1 TIMER AND SHIFT REGISTER.
2000                       ;
2000                       ;--------------R6522 ADDRESSES-----------
2000                       ;
2000                       DDRB    =$A002          ;DATA DIRECTION REG.
2000                       T1CH    =$A005          ;T1 COUNTER HIGH BYTE
2000                       T1LL    =$A006          ;T1 LATCH LOW BYTE
2000                       SR      =$A00A          ;SHIFT REGISTER
2000                       ACR     =$A00B          ;AUX CONTROL REG
2000                       ;
2000                               *=$0200         ;START ADDRESS
0200                       ;
0200   A9 F0                       LDA #%11110000
0202   8D 0A A0                    STA SR          ;STORE SHIFT PATTERN
0205   A9 DC                       LDA #$DC
0207   8D 0B A0                    STA ACR         ;SETUP T1 AND SHIFT REG
020A   A9 22                       LDA #$22
020C   8D 06 A0                    STA T1LL        ;LOW BYTE
020F   A9 F4                       LDA #$F4
0211   8D 05 A0                    STA T1CH        ;HIGH BYTE AND START IT
0214   A9 80                       LDA #$80
0216   8D 02 A0                    STA DDRB        ;SET PB7 = OUTPUT
0219   4C 19 02        LOOP        JMP LOOP        ;STOP HERE
021C                               .END
```

**BASIC REAL TIME CLOCK**

**Mark Reardon**
ROCKWELL INTERNATIONAL

Here's a machine language program converted to data statements that gets 'poked' into high memory from Basic. This particular program doesn't include the capability for displaying the time — that must be added by the user if needed.




Don't forget to limit the memory size to 4045.

There are plenty of remarks throughout the program so there's no need for a really detailed explanation.

```
 5 REM THIS PROGRAM WRITTEN BY MARK REARDON
10 REM THIS IS A 24 HOUR CLOCK PROGRAM WRITTEN FOR
20 REM BASIC ON THE AIM 65.  IT UTILIZES THE USER
30 REM 6522'S CLOCK ONE.  THE FIRST SIX LINES OF CODE
40 REM STORE THE INTERRUPT CLOCK ROUTINE IN UPPER MEMORY.
50 REM WHEN INITIALIZING BASIC LIMIT MEMORY TO 4045.
60 FORI=1TO50:READX:POKE4045+I,X:NEXTI
70 DATA72,138,72,230,223,166,223,224,16,208,32
80 DATA169,0,133,223,230,222,162,60,228,222,208,20
90 DATA133,222,230,221,228,221,208,12
100 DATA133,221,230,220,162,24,228,220,208,2
110 DATA133,220,104,170,173,4,160,104,64
120 REM THE NEXT TWO LINES OF CODE ENTER THE TIME INTO
130 REM THE COUNTERS.  TO CHANGE THE START TIME INSERT
140 REM NEW VALUES IN THE FIRST THREE ENTRIES OF THE DATA
150 REM STATEMENT.  THEY ARE HOURS, MINUTES, AND SECONDS.
160 FORI=1TO4:READX:POKE219+I,X:NEXTI
170 DATA 0,0,0,0
180 REM SET UP THE INTERRUPT ENABLE AND THE
185 REM AUXILIARY CONTROL REGISTERS
190 POKE40974,192:POKE40971,64
200 REM SET UP IRQ VECTOR TO CLOCK PROGRAM.
210 POKE41984,206:POKE41985,15
220 REM LOAD AND START TIMER ONE.
230 POKE40964,34:POKE40965,244
240 H=PEEK(220):M=PEEK(221):S=PEEK(222)
250 REM NOW THE TIME IS H HOURS, M MINUTES, AND S SECONDS.
260 REM TO ADJUST THE CLOCK THE VALUES IN 40964 (FINE) AND
270 REM 40965 (COARSE) CAN BE CHANGED.  LARGER VALUES
280 REM SLOW DOWN THE CLOCK.
```

## TTY TIP

**From the Editor**

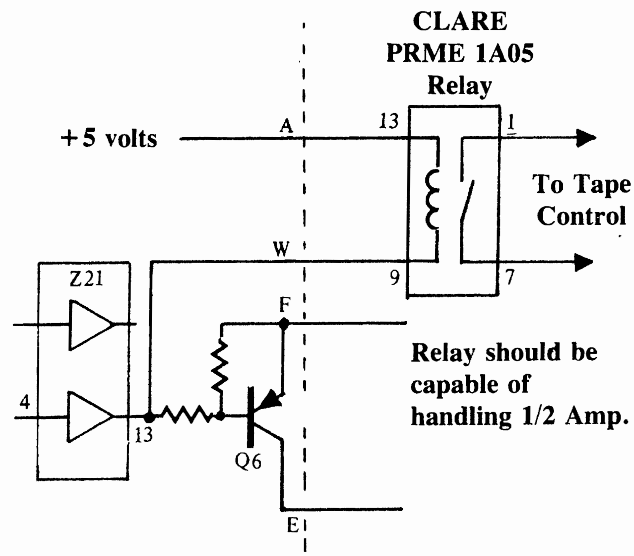
At terminal speeds of 2400 baud and above, AIM 65 has a hard time figuring the correct baud rate. These baud rate values must be entered manually from the AIM 65's keyboard.

Set the KB/TTY switch to KB and press the RESET button (this gets you back in the keyboard mode). You should now see the monitor prompt "<" on the LED display. Press the "M" key and examine location $A417. The display should now be displaying the contents of four memory locations starting with $A417. Press the "/" key to modify memory followed by the correct baud rate values (two bytes) as found in Section 9.2.3 of the AIM 65 USER'S GUIDE. Now press the return key on the AIM 65 keyboard. Next, set the KB/TTY switch to TTY and press the space bar on AIM 65. If your terminal was set to the same baud rate as you set up in AIM 65, you should see the monitor prompt on your terminal which signifies you're up and running in the terminal mode.

## GENERAL PURPOSE REMOTE CONTROL INTERFACE

If you use several different cassette recorders with AIM 65 and have to change the polarity of the remote control cable each time you change recorders, then you'll appreciate this little goodie!

This relay will enable AIM 65 to control most any cassette unit regardless of control signal polarity.

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