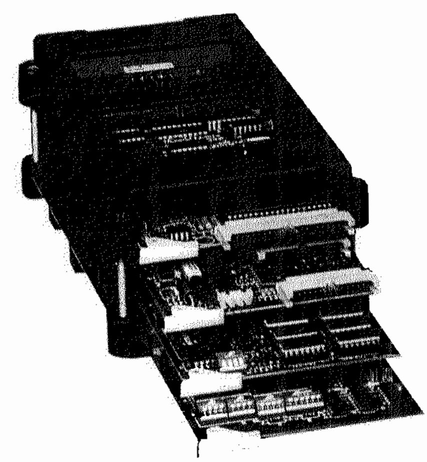
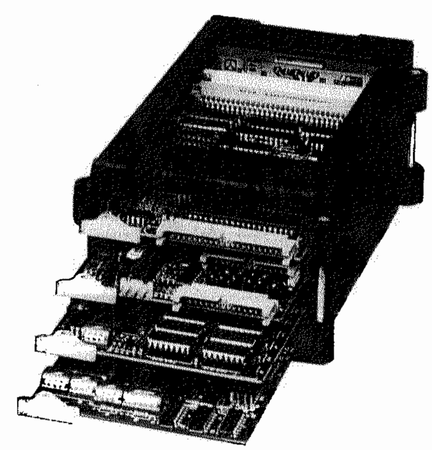
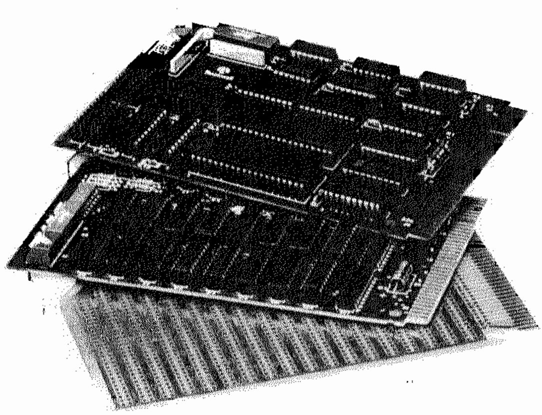
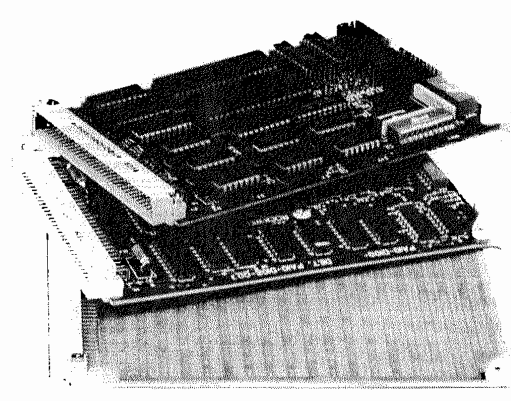
INTERACTIVE

ISSUE NO. 3

MICROFLEX 65

. . . lets you expand your AIM 65 or build a standalone microcomputer system.

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EDITORS CORNER

I'd like to devote an entire issue on the application of AIM 65 to Computer Aided Design (CAD).

I remember working out design problems with a calculator and thinking how much more efficient it was than the slide rule method (at that time, it was almost against the rules to have a calculator in school). I also remember having to work out the same equation over and over, changing one parameter each time, until it came out right. Those types of repetitive tasks are ideal for the computer to work on.

There must be quite a large number of design problems where parameters must be changed and solutions checked. One area that immediately comes to mind is in active filter design. Plenty of equations to work out and parameters to change here.

I'm sure that a number of you are using a BASIC equipped AIM 65 for CAD. How 'bout sharing some of those programs with the rest of us???

SUBMITTING ARTICLES

Please try to type your article double spaced. If you can't get to a typewriter, then print neatly. Don't use the editor on your AIM 65 because it is upper case only and will drive a typist to drink. Programs should be submitted on AIM 65 cassette as a BASIC or assembly language text file so the program can be assembled on a machine with a wider carriage printer for increased readability. Use a tape gap of about $20 to compensate for any differences in equipment. Your tape will be returned to you from an appreciative editor.

PUBLISHED PROGRAMS

Several of you have mentioned that you are having problems getting the AIMPLOT program from issue # 2 to run correctly. Besides the corrections to AIMPLOT that are mentioned in this issue, I don't know where the problem is as of yet, but should have it figured out by the next issue. If you can't wait, send me a self addressed stamped envelope and I'll send you the fix when I get it. I will, if at all possible, try to run the programs that are published in Interactive and ask that all programs be submitted on cassette in source form. (The only program in this issue that I haven't tried is the one in the BASIC USR HELPER article.)

Eric C Rehnke

Editor

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MICROFLEX 65 ADD-ON FAMILY NOW AVAILABLE

The first eight members of the new Microflex 65 products have been introduced by Rockwell.

The units include a module adapter for single cards, a buffer module that adapts AIM 65 to multiple-card motherboards, a 4-slot piggyback module stack, a prototyping module, an extender card for troubleshooting, an 8K static RAM card, a 16K PROM/ROM card and a two-port asynchronous communications interface adapter.

The Microflex 65 bus offers memory addressing up to 128K bytes, high immunity to electrical noise, and growth provisions for user functions.

The RM65-7101 Single-Card Adapter connects any Microflex 65 module to the AIM 65 microcomputer's system expansion connector.

The RM65-7104 Adapter/Buffer Module interfaces the AIM 65 to any Microflex 65 motherboard and will drive up to 15 modules. The RM65-7004 4-Slot Piggyback Module Stack (PMS) is the first available card cage and motherboard assembly in the Microflex 65 family. The compact PMS form factor allows low-profile packaging of a Microflex 65/AIM 65 system in a desktop or terminal style enclosure. The PMS is $150 in single quantities.

The RM65-7201 Design Prototyping Module allows Microflex 65 users to develop their own custom circuits. Power and return lines are pre-routed and plated-through holes allow manual or automatic wire wrapping of components and sockets. The RM65-7211 Extender Card provides easy access to circuitry for probing by extending a card from a cage at enclosure, simplifying signal tracing and troubleshooting.

The RM65-3108 8K Static RAM Module uses R2114 devices arranged in two 4K memory blocks. Module features include address assignment, write protect and bank select and enable. The RM65-3216 16K PROM/ROM Module has eight 24-pin sockets, allowing installation of standard 2K, 4K or 8K ROM or PROM devices.

The RM65-5451 ACIA Module interfaces two independent, asynchronous serial I/O channels. Each may operate as a data terminal or a data set. Channel 1 provides RS-232C and 20 ma current loop interfaces and Channel 2 is an RS-232C port. Program-selectable features on each channel include word length, number of stop bits, parity, internal/external receiver clock source, and 15 data rates from 50 to 19,200 baud. On-board DC/DC converter allows +5V only operation.

The Rockwell Microflex 65 product line expands the capabilities of the AIM 65 microcomputer in Industrial, OEM, Educational and Product Development applications. The Microflex 65 family is available in edge connector or Eurocard versions.

MORE MICROFLEX 65 "ON THE WAY"

Three additional Microflex 65 family boards (the SBC, a 32K dynamic RAM, and a GPIO module) are slated for delivery in December 1980.

The SBC (Single Board Computer) features an R6502 CPU, sockets for up to 16K of PROM/ROM, 2K of 2114 RAM, and an R6522 VIA. The SBC is ideal for applications which are form-factor sensitive because of its rather compact board size (about 4" × 6.5") and also for applications requiring several additional boards because of its compatability with all the other Microflex 65 cards.

The 32K dynamic RAM is addressable in 4K sections and features a scheme of refreshing that is complete transparent to the rest of the system. Write protect and bank select switches are included for increased versatility. An on-board DC-DC converter furnishes the necessary −5 volts so only +5 and +12 are required from the Microflex 65 bus.

The GPIO (General Purpose Input/Output) module contains two R6522 VIA devices which provide four 8-bit I/O ports and eight control lines. The 8-bit ports are fully buffered as are the control lines.

The data direction of each I/O port can be under either manual or software control.

These boards are available in either edge connector or Eurocard versions.

For further information contact your local Rockwell sales office.

PL/65 NOW AVAILABLE

PL/65, an intermediate level system-implementation language, is now available for the AIM 65.

PL/65 is designed to improve the productivity of the programmer and to increase program readability. Control statements such as conditional execution (IF-THEN-ELSE), conditional looping (FOR-TO-BY), coupled with a simplified block capability, support structured program design techniques.

The PL/65 compiler generates R6500 assembly language source code. In addition, PL/65 allows assembly language instructions to be incorporated in-line in portions of programs where timing or code optimization requirements are critical. The result is a system implementation language which has the power and flexibility of assembly language and the structuring potential of a high-level language.

The AIM 65 PL/65 compiler is contained in two 4k byte ROMs which plug directly into the AIM 65 BASIC sockets. For further information, contact Electronic Devices Division, Rockwell International, P.O. Box 3669, Anaheim, CA 92803, (714) 632-3729 or your local Rockwell sales office.

SOLVING SIMULTANEOUS EQUATIONS USING BASIC

George Sellers

(ED. NOTE: The first time I entered this program into my system, I tried to make it "look nice" by inserting spaces between commands and operands. The program wouldn't run until I eliminated all unnecessary spaces (it ran out of room). So type the program in EXACTLY as shown.)

Here is a BASIC program you might find of interest for solving simultaneous equations with up to 20 equations and 20 unknowns. It is directly transcribed from the FORTRAN program in reference (1) and is based on what is called the Gauss-Jordan Method with maximum pivot feature.

The program just fits into 4K of RAM on the AIM 65. The following table shows run times for various numbers of unknowns:

NUMBER OF EQUATIONS	RUN TIME IN SECONDS
3	1.325
5	3.015
10	14.325
20	92.485

The input is organized with the coefficients of each equation being a row of matrix "A" which is called the coefficient matrix. The right side of the equations are organized into a column which is called the constant matrix "B." The solutions are also organized into a column and this column is called the solution matrix "X."

Thus A*X=B in matrix algebra.

The data are entered into the program by way of the prompts for each column. The coefficient matrix can then be printed out to verify the accuracy of the input and corrections can be made if necessary. Finally, the constant matrix can be input and after a short time, the solution matrix is printed.

If matrix notation is not familiar to you, I suggest you check an advanced algebra text.

This technique forms the basis of many important types of problems i.e. network theory, regression analysis, linear programming (see BYTE magazine for most recent method of trying to solve large systems of linear equations) and economics (see Sept '80 Scientific American pg 207) to name a few.

1) Golden, James T., FORTRAN IV PROGRAMMING AND COMPUTING, Prentice Hall, Englewood, N.J. 1965

```
0 REMSIMULTANEOUS EQUATIONS
10 DIMA(20,21),X(20),LC(20),CK(20)
15 INPUT"ENTER N";NM
20 FORJ=1TONM:FORI=1TONM
40 PRINT"COL ";J;"ROW ";I;
50 INPUTA(I,J):NEXTI:NEXTJ
60 INPUT"CHECK INPUT";AN$:IFAN$="NO"GOTO90
70 FORI=1TONM:PRINT:PRINT"ROW ";I"    ";
75 FORJ=1TONM:PRINTA(I,J);
79 NEXTJ:NEXTI:PRINT
80 INPUT"CHANGE INPUT";AN$:IFAN$="NO"GOTO90
85 INPUT"ROW, COL,& NEW VALUE";I,J,A(I,J):GOTO80
90 FORI=1TONM:PRINT"B(";I;")";
100 INPUTA(I,NM+1):NEXTI
110 FORI=1TONM:CK(I)=0:NEXTI
130 NP=NM+1
140 FORI=1TONM
150 IP=I+1
160 AX=0
```

```
170 FORK=1TONM
180 IF(AX-ABS(A(K,I)))>=0GOTO215
190 IFCK(K)>0GOTO215
200 LC(I)=K
210 AX=ABS(A(K,I))
215 NEXTK
220 IFABS(AX)<=10E-6GOTO500
230 CK(L)=1.0
240 L=LC(I)
250 CK(L)=1.0
260 FORJ=1TONM
270 IF(L-J)=0GOTO300
280 F=-A(J,I)/A(L,I)
290 FORK=IPTONP
295 A(J,K)=A(J,K)+F*A(L,K):NEXT K
300 NEXTJ
310 NEXTI
315 PRINT"SOLUTION IS"
320 FORI=1TONM
330 L=LC(I)
340 X(I)=A(L,NM+1)/A(L,I)
350 PRINT"X(";I;")";X(I)
360 NEXTI
370 END
500 PRINT"AX < 10E-6":END
```

```
RUN
ENTER N? 5
COL  1 ROW  1 ? 5
COL  1 ROW  2 ? 3
COL  1 ROW  3 ? 1
COL  1 ROW  4 ? 2
COL  1 ROW  5 ? 4
COL  2 ROW  1 ? -1
COL  2 ROW  2 ? 3
COL  2 ROW  3 ? -2
COL  2 ROW  4 ? 1
COL  2 ROW  5 ? 6
COL  3 ROW  1 ? 1
COL  3 ROW  2 ? -2
COL  3 ROW  3 ? 4
COL  3 ROW  4 ? -1
COL  3 ROW  5 ? -5
COL  4 ROW  1 ? 1
COL  4 ROW  2 ? -6
COL  4 ROW  3 ? 2
COL  4 ROW  4 ? -1
COL  4 ROW  5 ? -3
COL  5 ROW  1 ? 2
COL  5 ROW  2 ? 3
COL  5 ROW  3 ? -1
COL  5 ROW  4 ? 2
COL  5 ROW  5 ? 3
```

```
CHECK INPUT? YES
ROW  1      5 -1  1  1
   2
ROW  2      3  3 -2 -6
   3
ROW  3      1 -2  4  2
  -1
ROW  4      2  1 -1 -1
   2
ROW  5      4  6 -5 -3
   3
CHANGE INPUT? NO
B( 1 )? 4
B( 2 )? -6
B( 3 )? 4
B( 4 )? -2
B( 5 )? 1
SOLUTION IS
X( 1 ) 2
X( 2 ) .333333334
X( 3 )-.499999999
X( 4 ) .833333335
X( 5 )-3
```

LEARN TO TOUCH TYPE

(ED. NOTE: I LIKE this program! Talk about CAI (Computer Aided Instruction). The sound output from the last issue could easily be adapted into TOUCH to signal the operator he made a boo-boo.)

Mel Evans
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Ann Arbor, MI 48103

If you use your AIM 65 keyboard much at all, you can increase both the speed and the accuracy of your input by learning to touch-type. All it takes is the right kind of practice, and after you've got it, you'll be able to input as fast as you can read the characters, and with almost no typos. And here's the best part: you don't have to go to school to get "the right kind of practice." With the TOUCH program listed in Fig. 1, your AIM 65 can give it to you whenever, and as long as, you feel like practicing.

TOUCH is a modification for AIM 65 of a BASIC program written by Art Armstrong ("Thirty Days to a Faster Input," BYTE, Dec. 79, p.250). If you try TOUCH and decide you really want to use it, read Armstrong's article first: it is full of good tips on how to speed up the learning process.

A sample run is shown in Fig. 2. The program first asks for a set of characters to be used in the practice session. Type in any sequence of printing characters, ending with RETURN. (Start small, with ASDFG.) The program prints the selected character set, and then asks for the length and number of "words" to be used in the practice session. It then presents the first "word": a string of characters randomly chosen from the practice set.

Put your fingers on the "home" keys (ASDF left, JKL; right, as shown in the BYTE article). Your goal is to type the word without peeking at the keyboard, but peek if you must at first. After typing a character, return to the "home" keys for reference. As Armstrong says, "The important thing is to always use the same finger for each key. Otherwise the process cannot become automatic."

The teaching technique is "operant conditioning": the instant you press a wrong key, the printer tells you about it, and you start over with a new word. After the last word, the program prints your score and a list of the characters you missed (and number of misses each). You can use this list to determine which characters to emphasize in the next session, and you can emphasize them as shown in the second session in Fig. 2. Notice that the H key was typed five times into the practice set. This makes H occur five times as often as the other characters in the resulting words.

With printer ON, you get a full record of each session, as in Fig. 2. With printer OFF, the display is the same, but only mistakes, score, and error list are printed. (This is done by using PRINT for display-only and PRINT! for display-and-print.)

Most of the differences between TOUCH and Armstrong's program are just conversion to the AIM 65 dialect of BASIC, but there are a few functional changes. The printout option mentioned above is one. I didn't incorporate his "echo" feature: it would use a lot of paper on the AIM 65 printer, and like he says, it's better practice not using it. Another change: after each session, TOUCH asks you if you want another session with the same practice characters. To quit, on SAME KEYS AGAIN? type N, and on WHICH KEYS? hit F1. Now you're back in BASIC entry mode.

For reading single keys, TOUCH uses the GET instruction, which is mentioned, but not fully explained, in the AIM 65 BASIC manual. GET reads the keyboard and returns with a character. If no key is down, it returns with the null character. If a key is down, it returns with that single character. If you GET again while the key is still down, it does not return until key up, and then returns with the null character.

This makes GET easy to use for entering strings. Observe lines 15-50 in the listing (Fig. 1). Until you press a key, line 20 repeatedly gets the null character and line 30 repeatedly adds it to C$ (which of course does not change C$). When you finally hit a key, it gets added to C$ just once: GET then waits until you release the key.

But watch out! Observe line 310. It GETs B$; but then, if it is the null character, GETs again. Otherwise it would proceed to line 350, find that B$ (the null character) didn't match the word character, and give you an error. Try deleting that IF, and you will get a score of 0% before you can reach the first key!

The program as listed runs in about 1350 bytes of RAM. If you omit REMs and spaces, it will probably run on a 1K AIM 65. Now then. Don't just sit there. Read Armstrong's article, and then get busy!

```
2 REM LET AIM TEACH YOU TOUCH-TYPING
4 REM ORIG. BY ART ARMSTRONG  (BYTE, DEC 1979 PAGE 250)
6 REM AIM MOD  BY MEL EVANS (5/11/80)
8 REM
10 PRINT"WHICH KEYS?"
12 REM BUILD KEY STRING
15 C$=""
20 GET A$
22 REM  EXIT ON CR
25 IF A$=CHR$(13) THEN 60
```

```
30 C$=C$+A$
50 GOTO 20
55 REM STRING BUILT SO PRINT IT
60 PRINTC$:PRINT" "
70 L=LEN(C$):DIM A(L)
80 INPUT "WORD SIZE";WL
90 INPUT "HOW MANY WORDS";NT
95 REM CLEAR SCORE COUNTERS
100 NR=0:NP=0
105 REM CLEAR ERROR COUNT
110 FOR I=1 TO L:A(I)=0:NEXT
200 FOR T=1 TO NT
205 REM BUILD WORD # T
210 NP=NP+WL
220 A$=""
230 FOR I=1 TO WL
235 REM SELECT RANDOM CHARACTER
240 P=INT(L*RND(1)+1)
250 A$=A$+MID$(C$,P,1)
260 NEXT I
265 REM  PRINT WORD
270 PRINT A$
300 FOR I=1 TO WL
305 REM READ KEY & CHECK FOR MATCH
310 GET B$:IF B$="" THEN 310
350 IF B$<>MID$(A$,I,1) THEN 500
360 NR=NR+1
370 NEXT I
380 NEXT T
390 REM COMPUTE & PRINT SCORE
400 PRINT" ":PRINT!"SCORE:";INT(100*NR/NP);"%"
402 IF NR=NP THEN 414
405 PRINT!"ERRORS:":FOR I=1 TO L:IF A(I)=0 THEN 410
407 PRINT!MID$(C$,I,1);A(I)
410 NEXT I
414 PRINT" "
416 INPUT "SAME KEYS AGAIN";A$
420 IF LEFT$(A$,1)="Y" THEN 100
430 RUN
495 REM UPDATE ERROR COUNT
500 FOR J=1 TO L
510 IF MID$(C$,J,1)<>MID$(A$,I,1) THEN NEXT:GOTO 520
515 A(J)=A(J)+1
520 PRINT!"**** ERROR ON ";MID$(A$,I,1)
525 REM WAIT A BIT & THEN RETURN
530 FOR I=1 TO 300:NEXT
540 GOTO 380
```

BASIC TIME SAVER

Gordon Smith
Rockwell International

(EDITORS NOTE: According to Gordon, the basis for the program came from a similar program published in TARGET which he modified quite extensively and added auto-line numbering. This article was reprinted from the Rockwell Anaheim Hobby Club Newsletter.)

This issue I have what I think is a real goody for all of you who are using AIM BASIC and are either marginal or lazy typists or both – I suspect that includes most of us. I have named the program "BASIC HELPER" because that is what it does. It is a combination automatic line numberer and common basic command automatic typist.

I will describe usage of the program first and then how it works. The program occupies the top two pages of a 4K AIM (0E00-0FFF). Consequently when BASIC is entered via the "5" Key, you must respond to the "MEMORY SIZE" question with 3584 or less. This gives you 3054 bytes free for keying-in segments of your program. Note that this places no limitation on the size of the program you are keying-in, because as these 3054 bytes are filled they may be dumped on tape. Then the next segment with its proper line numbers may also be keyed in after typing "NEW."

As each segment fills memory it is dumped on tape and the next segment then keyed-in. This is permissible on AIM because unlike PET and APPLE, loading a program from tape does not automatically wipe out the old program. It appends the later program to the earlier one and only if both segments have some common line numbers is there any conflict. In this case any common numbered lines from the last blocked tape will be the lines that survive.

Sooo – this is an unusual machine language program used with BASIC because it ultimately takes none of the BASIC space.

After the BASIC is enabled, exit via ESCAPE and load the BASIC HELPER PROGRAM (or VISA VERSA). I use the F1 and F3 keys to activate automatic line numbering with shorthand and F2 to activate only the shorthand. This later option is used when keying in someone else's program (or fixes to your own) when nice even increments between lines are not achievable.

With the F1 keys the display asks "FROM = " to which you respond with the starting line number desired (delete is allowed or the last four hex characters will be used-no leading zero's required). Hit "space" or "RETURN" and the display will prompt with "INC = ." At this point key-in the increment you want and hit "space" or "RETURN" and you are in WARM START BASIC with the starting line number already showing. Enter the rest of the line, hit RETURN, and the new line number is there ready for you.

This automatic line numbering is handy but it is only part of the story. By using the control key and any of the alphabet keys (Except M) and F2 and F3 you can also get an automatic entry of what I think are the most used, longest, or messiest-to-type BASIC commands. For instance Control I gives you "INPUT," Control L gives you "LEFT$(" etc. There are even some split BASIC commands. Control 0 gives you "ON" then you type the variable name or expression without any spaces. When you key in "space," the program completes the GOTO portion of the ON---GOTO statement. Control F3 gives ON---GOSUB and Control T gives you IF---THEN.

The complete list of shorthand commands and mnenomic aids for helping to remember them are given in a table following the program listing and command tables.

As I see it there are three major benefits of this program:

1) It makes it much faster to type
2) There are many fewer typing errors
3) The correct form for these commonly used statements are either input or prompted ($ in strings aid the left (as a prompt)).

The program works as follows: The F1 key jumps to 0E00 which clears the display and then calls the "FROM" subroutine. The line number is stored in two places OFFB,C where it is held for updating and OFF1,2 for processing to input it to BASIC which then displays it. The segment starting at 0E18 inserts a space and then sequentially outputs INC by three output subroutine calls.

The JSR EAAE at 0E27 is the ADDIN subroutine which is not described in the manuals. It outputs " = " and waits for four (more or less) hex characters. If less it assumes leading zero; if more it accepts the last four. The increment value may be as many as four digits and is stored in OFF3,4. In all of the above cases the data is stored in high byte-low byte sequence (it is not an address in the conventional sense).

The segment of the program from OE39 through OE3F sets a Flag in OFF7 to indicate if the auto increment mode is ON (OO) or OFF (FF). The F2 entry point is at OE3D.

The group of instructions from OE42 through OE4E set up the user input mode (55 in A412 and the user input vector to location OE62 in Location 0108,9).

The next group through OE5E initializes conditions so that the last character output (OFF5) was apparently a carriage return so that the line number will be output if that mode is active. Any value other than 20 in OFFD is OK-20 indicates that a split command has had the first part entered and is waiting for the "space" code to enter the second segment.

The OO in OFF6 indicates that the program is not in the middle of inputing a line number.

The segment named 'USER PROCESSOR' is the point where the user input is vectored to. In BASIC at this point, the Y register is pointing to the BASIC input buffer location for the next key-in so it must be saved (in this case on the stack). The USER input may have to turn something on when it is entered the first time so the first time the carry is clear on subsequent entries the carry must be set. In this case it doesn't make any difference so that I could have left out the instructions in OE64, 66, and 67 and the SEC instructions in OE92 and OECF. But I left them in because I am trying to teach some with this column too.

The mode decode function works as follows: The test at OE6E determines if the auto-line option is desired-if it is the test at OE72 determines if it is necessary to output a line number or if we are in process-if the answer is yes we execute the segment at OE94. We will come back to this later. The test at OE76 determines if we are in process of generating a command. These in-process tests are necessary because only one character is generated and supplied to BASIC and BASIC comes back for the next one. If we are in process of generating a command, the jump at OE78 is executed. Otherwise, we use the CUREAD subroutine to read a character from the keyboard and then save it in the last character buffer, OFF5.

This character must be examined to see if it is a control-alpha (OE83) to start outputing a new command at OEF9 or if it matches (20 matching 20) the split command wait indicator in OFFD (OE88). If so, the JMP OFIA in OE8A is executed. If it is none of these, it is an old-fashioned, plain ordinary key stroke input. In this case BASIC's Y register is restored, the input character recovered, and the RTS takes it back to the BASIC input processing.

The Auto increment processing is performed as follows: The test in OE97 determines if this is the first digit to be processed. If it is, the Line input in Process Flat at OFF6 is set to 4 and and also the character count is checked for zero (OEA4). If it is, the segment of instructions from OEOl through OEF7 restores flags and increments (in decimal) the line number for the next line. This program then returns to look for the next input character.

If it was not the final pass, the segment from OEA6 through OEBD shifts the next digit (most significant digit first) into OFFO. OEB4 counts the number of digits down by one and OEC2 through OEC7 converts it to ASCII and holds it in OFFA for output after the BASIC Y register is restored OECA through OEDO.

If the character input was a control character (value less than 1F) the program will commence from OEF9. Since this entry is for the start of a new command the code input 01 to 1E will be used as a pointer to the start of text. It is moved to the Y register and is used to point to a byte in Table 1 "POINTERS TO START OF EACH COMMAND." This is accomplished in locations OEF9 through OEFA. That byte is then used to index the text table. 'COMMANDS IN ASCII," Table 2. The Y value is then incremented and saved for the next pass. If the input byte was 00 (0F07), it indicates "end of text" so some flags are restored and the next key is input (OF27 to OF2c). If the input byte was 20 (OFOB) it indicates a split command so the wait code (20) is stored in OFFD and the next key is input (OF14-OF17). If neither of these, the code is output using the sequence of instructions OEC7-OEDO in the auto- line number output section.

If the 20 matches 20 test in OE88 indicates that the second segment of a split statement is to be inserted, the program starting at OF1A through OF25 is executed. This cancels the "wait" Flag at OFFD and puts a low value (00) into the last command byte (OFF5) so that it indicates a shorthand command in-process and then loads the pointer for the next character of the command. It then continues to execute as if it were a normal shorthand command.

This is a longer and more complex program than I have generated for this column before but I think that you will like it. I think I will have it loaded whenever I am keying-in a BASIC program. It saves so much time and aggravation.

SHORTHAND COMMANDS AND MNEMONIC AIDS

A	= ABS(	P	= POKE
B	= TAB(TABBBB	Q	= RND(QUANTITY
C	= MID$(CENTER$	R	= RETURN
D	= DATA	S	= STR$(
E	= RIGHT$(END$	T	= IF+++THEN TEST
F	= FOR	U	= USR(
G	= GOTO	V	= VAL(
H	= LEN(HOW LONG	W	= INT(WHOLE VALUE
I	= INPUT	X	= RESTORE X-OUT READ
J	= GOSUB JUMPSUB	Y	= READ PARAMETER
K	= GET GET KEY	Z	= STEP SIZZZE
L	= LEFT$(	F1	= IS NOT USABLE
M	= IS NOT USABLE	F2	= DEFFN FUNCTION
N	= NEXT	F3	= ON+++GOSUB
O	= ON+++GOTO		

```
010C  4C JMP  0E00
010F  4C JMP  0E3D
0112  4C JMP  0E00
```

BASIC HELPER PROGRAM

```
0E00  20 JSR  E9F0
0E03  20 JSR  E7A3
0E06  AD LDA  A41C
0E09  8D STA  0FF2
0E0C  8D STA  0FFC
0E0F  AD LDA  A41D
0E12  8D STA  0FFB
0E15  8D STA  0FF1
```

INPUT INCREMENT

```
0E18  20 JSR  E83E
0E1B  A9 LDA  #49
0E1D  20 JSR  E97A
0E20  A9 LDA  #4E
0E22  20 JSR  E97A
0E25  A9 LDA  #43
0E27  20 JSR  E97A
0E2A  20 JSR  EAAE
0E2D  AD LDA  A41C
0E30  8D STA  0FF4
0E33  AD LDA  A41D
0E36  8D STA  OFF3
```

BYPASS AUTO LINE NO.

```
0E39  A9 LDA  #00
0E3B  F0 BEQ  0E3F   02
0E3D  A9 LDA  #FF
0E3F  8D STA  0FF7
```

SET UP USER INPUT

```
0E42  A9 LDA  #55
0E44  8D STA  A412
0E47  A9 LDA  #62
0E49  8D STA  0108
0E4C  A9 LDA  #0E
0E4E  8D STA  0109
```

PARAMETER SET UP AND GO TO WARM START

```
0E51  A9 LDA  #0D
0E53  8D STA  OFF5
0E56  8D STA  0FFD
0E59  A9 LDA  #00
0E5B  8D STA  0FF6
0E5E  4C JMP  B003
```

USER/PROCESSOR

```
0E62  98 TYA
0E63  48 PHA
0E64  B0 BCS  0E68   02
0E66  68 PLA
0E67  60 RTS
```

MODE DECODE — SUBSTITUTE OR READ

```
0E68  AC LDY  0FF5
0E6B  AD LDA  0FF7
0E6E  D0 BNE  0E74   04
0E70  C0 CPY  #0D
0E72  F0 BEQ  0E94   20
0E74  C0 CPY  #1F
0E76  B0 BCS  0E7B   03
0E78  4C JMP  0F0F
0E7B  20 JSR  FE83
0E7E  8D STA  0FF5
0E81  C9 CMP  #1F
0E83  90 BCC  0EF9   74
0E85  CD CMP  0FFD
0E88  D0 BNE  0E8D   03
0E8A  4C JMP  0F1A
0E8D  68 PLA
0E8E  A8 TAY
0E8F  AD LDA  0FF5
0E92  38 SEC
0E93  60 RTS
```

AUTO-INCREMENT

```
0E94  AD LDA  0FF6
0E97  D0 BNE  0EA1   08
0E99  A9 LDA  #04
0E9B  8D STA  0FF6
0E9E  8D STA  0FF8
0EA1  AD LDA  0FF8
0EA4  F0 BEQ  0ED1   2B
0EA6  A9 LDA  #00
0EA8  8D STA  0FF0
0EAB  A9 LDA  #04
0EAD  8D STA  0FF9
0EB0  18 CLC
0EB1  2E ROL  0FF2
0EB4  2E ROL  0FF1
0EB7  2E ROL  0FF0
0EBA  CE DEC  0FF9
0EBD  D0 BNE  0EB0   F1
0EBF  CE DEC  0FF8
0EC2  AD LDA  0FF0
0EC5  69 ADC  #30
0EC7  8D STA  0FFA
0ECA  68 PLA
0ECB  A8 TAY
0ECC  AD LDA  0FFA
0ECF  38 SEC
0ED0  60 RTS
```

PREPARE FOR NEXT LINE

```
0ED1  A9 LDA  #20
0ED3  8D STA  0FF5
0ED6  A9 LDA  #00
0ED8  8D STA  0FF6
0EDB  F8 SED
0EDC  18 CLC
0EDD  AD LDA  0FFC
0EE0  6D ADC  0FF4
0EE3  8D STA  0FFC
0EE6  8D STA  0FF2
0EE9  AD LDA  0FFB
0EEC  6D ADC  0FF3
0EEF  8D STA  0FFB
0EF2  8D STA  0FF1
0EF5  D8 CLD
0EF6  B8 CLV
0EF7  50 BVC  0E7B   82
```

SHORTHAND COMMAND INSERTION

```
0EF9  A8 TAY
0EFA  B9 LDA  0FD1,Y
0EFD  A8 TAY
0EFE  B9 LDA  0F2F,Y
0F01  C8 INY
0F02  8C STY  0FFE
0F05  C9 CMP  #00
0F07  F0 BEQ  0F27   1E
0F09  C9 CMP  #20
0F0B  F0 BEQ  0F14   07
0F0D  D0 BNE  0EC7   B8
0F0F  AC LDY  0FFE
0F12  D0 BNE  0EFE   EA
0F14  8D STA  0FFD
0F17  4C JMP  0E7B
0F1A  A9 LDA  #00
0F1C  8D STA  0FFD
0F1F  8D STA  0FF5
0F22  AC LDY  0FFE
0F25  D0 BNE  0EFE   D7
0F27  A9 LDA  #20
0F29  8D STA  0FF5
0F2C  4C JMP  0E7B
```

POINTERS TO START OF EACH COMMAND

```
<M>=  0FD1  00 01 06 0B
<  >  0FD5  11 16 1E 22
<  >  0FD9  27 2C 32 38
<  >  0FDD  3C 43 45 4A
<  >  0FE1  52 57 5C 63
<  >  0FE5  69 71 76 7B
<  >  0FE9  80 88 8D 8D
<  >  0FED  8D 94 9A
```

COMMANDS IN ASCII

```
<M>=  0F30  41 42 53 28
<  >  0F34  00 54 41 42
<  >  0F38  28 00 4D 49
<  >  0F3C  44 24 28 00
<  >  0F40  44 41 54 41
<  >  0F44  00 52 49 47
<  >  0F48  48 54 24 28
<  >  0F4C  00 46 4F 52
<  >  0F50  00 47 4F 54
<  >  0F54  4F 00 4C 45
<  >  0F58  4E 28 00 49
<  >  0F5C  4E 50 55 54
<  >  0F60  00 47 4F 53
<  >  0F64  55 42 00 47
<  >  0F68  45 54 00 4C
<  >  0F6C  45 46 54 24
<  >  0F70  28 00 0D 00
<  >  0F74  4E 45 58 54
<  >  0F78  00 4F 4E 20
<  >  0F7C  47 4F 54 4F
<  >  0F80  00 50 4F 4B
<  >  0F84  45 00 52 4E
<  >  0F88  44 28 00 52
<  >  0F8C  45 54 55 52
<  >  0F90  4E 00 53 54
<  >  0F94  52 24 28 00
<  >  0F98  49 46 20 54
<  >  0F9C  48 45 4E 00
<  >  0FA0  55 53 52 28
<  >  0FA4  00 56 41 4C
<  >  0FA8  28 00 49 4E
<  >  0FAC  54 28 00 52
<  >  0FB0  45 53 54 4F
<  >  0FB4  52 45 00 52
<  >  0FB8  45 41 44 00
<  >  0FBC  53 54 45 50
<  >  0FC0  00 00 00 44
<  >  0FC4  45 46 46 4E
<  >  0FC8  00 4F 4E 20
<  >  0FCC  47 4F 53 55
<  >  0FD0  42
```

(EDITOR'S NOTE: If you'd like a set of stick-on labels for the basic one-key entry program, send $1 to Ron Riley, POB 4310, Flint, Mich. 48504. These Labels are printed on adhesive-backed stock with all the proper Basic commands printed on them.)

PROM PROGRAMMER CARD FOR AIM 65

A PROM Programmer and Code Editor (CO-ED) module is now available as a plug-on peripheral for the AIM 65 printing microcomputer from Rockwell.

The PROM memory devices programmed with the new module may then be used with any 6500-based system, including AIM 65, Microflex 65, and SYSTEM 65.

The module provides PROM check, read and verify functions in addition to programming. Data load, verify and dump, each with offset, and an object code editor (CO-ED) are additional features included in the module's built-in ROM firmware. CO-ED controls a program pointer and can search, disassemble and modify R6500 object code programs.

The PROM programmer CO-ED module, part number A65-901, plugs directly into the expansion connector of the AIM 65 microcomputer. The module includes 1K byte of R2114 static RAM which, when used with the 4K RAM AIM 65 model, allows single-pass programming of 4K × 8 PROMs. It also includes internal logic to select PROM programming characteristics for the Intel 2758, 2716, or 2732, or the TI 2508, 2516 or 2532 without switch or jumper changes.

The module requires only a single supply voltage, +5 VDC @ 0.7 amp, which is usually available from the power supply for the host AIM 65. Appropriate PROM programming voltage levels are generated by an on-board DC-DC converter.

The module measures approximately 4.4 inches wide by 6.7 inches long and is fully assembled, tested and warranted.

For more information contact the Electronic Devices Division of Rockwell International, P.O. Box 3669, Anaheim, CA 92803. Telephone (714) 632-3729 or your local Rockwell sale office.

R6551 ACIA CHIP NOW AVAILABLE

The R6551 Asynchronous Communication Interface is now available from Rockwell. This new device offers several advantages over older ACIA designs. The main advantage is that the R6551 contains its own on-chip baud rate generator with 15 program-selectable rates from 50 baud to 19,200 baud. The only additional component required is a standard 1.8432 MHZ crystal.

The R6551 has programmable word lengths of 5, 6, 7, or 8 bits; even, odd, or no parity; and 1, 1½ or 2 start bits. Besides the normal interface control lines (RTS-Request To Send, CTS-Clear To Send, and DCD-Data Carrier Detect) the R6551 provides two additional lines, to further enhance the modem interface. These two lines are DTR-Data Terminal Ready (which indicates the R6551 status to the modem) and DSR-Data Set Ready (indicates the status of the modem to the R6551).

The built-in programmable baud rate generator offers certain advantages to the system designer. Since fewer external components are required for boards designed around the R6551, more compact and/or more densely designed systems are possible. This in turn translates to a cost savings which can become very substantial as the quantity of systems to manufacture increases.

For data sheets and more information on the R6551 ACIA contact your local Rockwell sales office.

NEW APPLICATION NOTE

A new application note entitled PRINTER CONTROL WITH THE R6522 is (document #256) is now available from Rockwell. This note describes how the AIM 65 can be used to directly control all the functions of a dot matrix printer mechanism through the on-board user R6522 VIA chip. The printer mechanism chosen is the Two-Day Corporation 80 column bidirectional 10600 series.

This 24 page app. note actually contains two complete software/hardware interface schemes—one for each of the two printer mechanisms available from the Two-Day Corp.

One of the models (the 10600A) has a synchronous motor drive while the other (the 10600B) has a stepper motor drive and an independent paper feed.

For a copy of this or other app. notes write: Literature Request, Rockwell International, Box 3669 RC55, Anaheim, CA 92803. Be sure to specify the document numbers.

INTERRUPT DRIVEN KEYBOARD

Marvin DeJong
Pt. Lookout, MO

(Ed. note-Although the author cites amateur radio as an example application for an interrupt driven keyboard, this technique is just as relevent in the possible industrial uses of the AIM 65. Interrupt driven systems are becoming increasingly useful in data gathering applications as well as machine control areas.)

The AIM 65 Monitor polls the AIM 65 keyboard for key depressions by calling subroutines. These subroutines *wait* for a key to be depressed before continuing to execute the commands that have been entered or before continuing to process the data that have been entered. There are certain situations in which this treatment of the keyboard is undesirable. In this application note such a situation is described, and a routine to read the keyboard on an interrupt basis is described.

Suppose an amateur radio operator wishes to use the AIM 65 to send either Morse code or RTTY (radioteletype). The AIM 65 monitor routines could be used for this, but the send routine would have to wait for a key depression before it could send the character, and the operator would have to wait for the send routine to finish sending the character before he could type in a new character. The usual technique calls for a buffer that stores the characters typed on the keyboard, and concurrently sends the characters at a prescribed speed. Thus, the operator can type in characters as quickly as he can type, and the send routine empties the buffer at the prescribed speed. This form of keyboard operation is difficult, if not impossible, to achieve with the AIM 65 monitor software which, in addition to reading the keyboard, must also debounce the keys.

An alternative approach is to let the send program (or any other program in which this interrupt approach is used) continue operating, but use a regular interrupt to scan the keyboard to see if any new characters have been entered. If a new character has been entered on the keyboard, it can be stored in a buffer to await its turn to be processed by the main program. If no new character has been keyed, the interrupt routine branches around the buffer storage instructions.

The listings given here form a routine that will read the AIM 65 keyboard on an interrupt basis. The initialization routine sets up the interrupt vector to point to the interrupt routine at $OBFF (of course, the locations of all of these routines may be changed). Next the initialization routine sets up the T1 timer on the user's 6522 to produce equally spaced interrupts, at five millisecond intervals. (Longer intervals can also be used, but shorter intervals may produce keybounce errors.) The last instruction in the initialization routine produces an infinite loop that simulates the user's main program, a Morse code send program for example.

The interrupt routine starting at $OBFF is very similar to the AIM 65 GETKEY subroutine in the AIM 65 monitor. Most of the coding is taken from that routine, with some important modifications to make it operate on an interrupt basis. Note that all the registers are saved by the interrupt routine. Also note that the interrupt routine contains a JSR $ODOO instruction. If a key depression is detected, then the accumulator contains the ASCII representation of the key just prior to the JSR $ODOO instruction. The subroutine at $ODOO is expected to place the accumulator contents in a memory location where it can be processed by the main program, a buffer for example.

Finally, we have included a display routine at $ODOO that displays the key just pressed on the AIM 65 display. This routine is included to test the initialization and interrupt routines. It has no other use.

```
;I/O
UT1L    =$A004
UT1CH   =$A005
UT1LL   =$A006
UARC    =$A00B
UIER    =$A00E
IRQV2   =$A404
CPIY    =$A42A
CPIY1   =$A42B
ROLLFL  =$A47F
DRA2    =$A480
DRB2    =$A482
;MONITOR SUBROUITNES
ONEKEY  =$ED05
ONEK2   =$ED0B
OUTDD1  =$EF7B
PHXY    =$EB9E
PLXY    =$EBAC
ROW1    =$F421
```

```
2000                    *=$0E00
0E00
0E00  A9 FF             LDA #<INTRN
0E02  8D 04 A4          STA IRQV2
0E05  A9 0B             LDA #>INTRN
0E07  8D 05 A4          STA IRQV2+1
0E0A  78                SEI
0E0B               ;
0E0B               ;SET T1&CB1 INT FLAG
0E0B  A9 C0             LDA #$C0
0E0D  8D 0E A0          STA UIER
0E10               ;
0E10               ;
0E10               ;SET T1 IN FREE
0E10               ;RUNNING MODE
0E10  A9 40             LDA #$40
0E12  8D 0B A0          STA UARC
```

```
0E15                ;
0E15                ;SET T1 LATCHES
0E15   A9 88                LDA #$88
0E17   8D 06 A0             STA UT1LL
0E1A   A9 13                LDA #$13
0E1C   8D 05 A0             STA UT1CH
0E1F   58                   CLI
0E20                ;
0E20                ;PROGRAM SIMULATION
0E20                ME
0E20   4C 20 0E             JMP ME

0E23                        *=$0BFF
0BFF
0BFF                ;SAVE REGISTERS
0BFF                INTRN
0BFF   48                   PHA
0C00   20 9E EB             JSR PHXY
0C03                ;
0C03                ;CLEAR T1 INT
0C03   AD 04 A0             LDA UT1L
0C06                ;
0C06                ;SEE IF KEY DOWN
0C06   AD 82 A4             LDA DRB2
0C09   C9 FF                CMP #$FF
0C0B   F0 07                BEQ R001
0C0D                ;
0C0D                ;ACCEPT LAST KEY
0C0D   0D 7F A4             ORA ROLLFL
0C10                ;
0C10                ;INVERT STROBES
0C10   49 FF                EOR #$FF
0C12   D0 43                BNE ROONEK
0C14                ;
0C14                ;CLEAR MASK
0C14                R001
0C14   A2 00                LDX #00
0C16   8E 2A A4             STX CPIY
0C19                ;
0C19                ;GO THROUGH KB ONCE
0C19                ;AND RETURN IF ANY
0C19                ;KEY
0C19                ;Y=ROW(1-8)& STBKEY
0C19                ;=COLUMN. IF NO KEY
0C19                ;Y=0,
0C19                STBKEY =$FF
0C19                ;
0C19   20 05 ED             JSR ONEKEY
0C1C   88                   DEY
0C1D   30 7C                BMI NOKEY
0C1F                ;
0C1F                ;CHCK CLMN 5,6,7
0C1F   A9 8F                LDA #$8F
0C21   8D 80 A4             STA DRA2
0C24                ;
0C24                ;CHECK ROW 1
0C24   AD 82 A4             LDA DRB2
0C27   4A                   LSR A
0C28                ;
0C28                ;IF=1, NO CTRL OR
0C28                ;SHIFT
0C28   B0 20                BCS GETK1
0C2A                ;
0C2A                ;CLMN 5,6,7(CNTRL
0C2A                ;SHIFTL,SHIFTR)
0C2A   A2 03                LDX #$3
0C2C                ;
0C2C                ;CTRL OR SHIFT,WHICH
0C2C   A9 7F                LDA #$7F
0C2E                GETK0
0C2E   38                   SEC
0C2F   6A                   ROR A
0C30   48                   PHA
0C31                ;
0C31                ;LETS GET CTRLL OR
0C31                ;SHIFT INTO X
0C31   20 0B ED             JSR ONEK2
0C34   AD 82 A4             LDA DRB2
0C37                ;
0C37                ;ONLY ROW 1
0C37   4A                   LSR A
0C38   90 06                BCC GETK00
0C3A   68                   PLA
0C3B   CA                   DEX
0C3C   D0 F0                BNE GETK0
0C3E                ;
0C3E                ;NO KEY, SO EXIT
0C3E   F0 5B                BEQ NOKEY
0C40                ;
0C40                ;GET STBKEY INTO X
0C40                GETK00
0C40   68                   PLA
0C41                ;
0C41                ;CLMN INTO X
0C41   AD 2B A4             LDA CPIY1
0C44                ;
0C44                ;COMPLEMENT STRBS
0C44   49 FF                EOR #$FF
0C46                ;
0C46                ;CTRL OR SHIFT TO X
0C46   AA                   TAX
0C47                ;
0C47                ;SET MSK=$01
0C47   EE 2A A4             INC CPIY
0C4A                ;
0C4A                ;NOW GET ANY KEY
0C4A                GETK1
0C4A   20 05 ED             JSR ONEKEY
```

```
0C4D                ;
0C4D                ;CHCK THE ROW (1-8)
0C4D   88                  DEY
0C4E                ;
0C4E                ;CHCK IF CTRL OR
0C4E                ;SHIFT
0C4E   D0 09               BNE GETK1B
0C50                ;
0C50                ;ENTERED LAST
0C50   AD 2B A4            LDA CPIY1
0C53                ;
0C53                ;
0C53                ;IF CLMN 5,6,,8 DO
0C53                ;IT AGAIN
0C53   C9 F7               CMP #$F7
0C55   B0 04               BCS GETK2
0C57                ;
0C57                ;GET CTRL OR SHIFT
0C57                ROONEK
0C57   90 42               BCC NOKEY
0C59                GETK1B
0C59   30 40               BMI NOKEY
0C5B                GETK2
0C5B   EA                  NOP
0C5C   EA                  NOP
0C5D   EA                  NOP
0C5E                ;
0C5E                ;MULT BY 8
0C5E   98                  TYA
0C5F   0A                  ASL A
0C60   0A                  ASL A
0C61   0A                  ASL A
0C62                ;
0C62                ;NOW A HAS ROW ADDR
0C62                ;FROM ROW 1
0C62   A8                  TAY
0C63                ;
0C63                ;ADD CLMN TO Y
0C63   AD 2B A4            LDA CPIY1
0C66                GETK3
0C66   4A                  LSR A
0C67   90 03               BCC GETK4
0C69   C8                  INY
0C6A   D0 FA               BNE GETK3
0C6C                ;
0C6C                ;GET THE CHR
0C6C                GETK4
0C6C   B9 21 F4            LDA ROW1,Y
0C6F   48                  PHA
0C70                ;
0C70                ;CTRL OR SHIFT USED?
0C70   8A                  TXA
0C71                ;
0C71                ;BRCH IF NO CTRL OR
0C71                ;SHIFT
0C71   F0 24               BEQ GETK7
0C73                ;
0C73                ;CTRL?
0C73   29 10               AND #$10
0C75                ;
0C75                ;NO, GO GETK5
0C75   F0 06               BEQ GETK5
0C77   68                  PLA
0C78                ;
0C78                ;MASK OFF 2 MSB FOR
0C78                ;CONTROL
0C78   29 3F               AND #$3F
0C7A                ;
0C7A                ;EXIT TO DISP
0C7A   4C 98 0C            JMP GETK8
0C7D                GETK5
0C7D   68                  PLA
0C7E                ;SAVE IT
0C7E   48                  PHA
0C7F                ;
0C7F                ;IF ALPHA CHARS DO
0C7F                ;NOT SHIFT
0C7F   29 40               AND #$40
0C81   D0 14               BNE GETK7
0C83   68                  PLA
0C84   48                  PHA
0C85                ;
0C85                ;ONLY LSB
0C85   29 0F               AND #$0F
0C87                ;
0C87                ;DO NOT INTERCHANGE
0C87                ;(SPACE) OR 0
0C87   F0 0E               BEQ GETK7
0C89                ;
0C89                ;ACC>=$0C?
0C89   C9 0C               CMP #$0C
0C8B                ;
0C8B                ;YES ACC>=$0C
0C8B   B0 05               BCS GETK6
0C8D                ;
0C8D                ;EXIT
0C8D   68                  PLA
0C8E   29 EF               AND #$EF
0C90   D0 06               BNE GETK8
0C92                ;
0C92                ;ACC>=$0C
0C92                GETK6
0C92   68                  PLA
0C93                ;
0C93                ;BIT 4=1
0C93   09 10               ORA #$10
0C95   D0 01               BNE GETK8
0C97                GETK7
```

SUPER SIMPLE AUTO-START

Under normal circumstances, when power is applied to the AIM 65, the reset line is automatically asserted by the power-on-reset circuitry associated with the 555 timer (Z4) and the CPU starts executing the reset sequence contained in the Monitor ROM.

While this sequence of events is fine for most uses, there are others, such as OEM installations and dedicated controller applications, which require that the system comes up running a user written operating program without the need for any special operator intervention.

The first solution that usually comes to mind involves the replacement of the Monitor ROMS. However, there is an easier way to accomplish the same effect without having to sacrifice all those built-in I/O drivers.

The only restriction is that the user program must start at address $B000, $B003, or $D000 (corresponding to the '5,' '6' or 'N' key vectors).

If you have the Assembler or BASIC ROMs installed in your system, try holding down the 'N' key (or '5' key) while you turn on the power. Notice how it comes up running in the assembler?

In a dedicated controller application, where the keyboard isn't being used, the same effect can be achieved by installing a 16-pin DIP header in the keyboard socket on the main board and shorting the two pins that correspond to the '5,' '6' or 'N' key.

If you wish the system to automatically jump to $B000 on power up, short pins 11 and 13 on the DIP header (pins 12 and 14 for address $B003) or pins 3 and 14 for a starting address of $D000.

For OEM applications where the keyboard is still needed, the same effect can be achieved by temporarily shorting the correct pins with a reed relay driven by a timer chip. The time constant should be slightly longer than that of the power-on-reset timer (Z4) for proper operation.

```
0C97   68                PLA
0C98            ;
0C98            ;GO DISPLAY
0C98            GETKB
0C98   20 00 0D          JSR DISP
0C9B            ;
0C9B            ;RESTORE REGISTERS
0C9B            NOKEY
0C9B   20 AC EB          JSR PLXY
0C9E   68                PLA
0C9F   A9 00             LDA #$00
0CA1   8D 2A A4          STA CPIY
0CA4   40                RTI
0CA5                     *=$0D00
0D00
0D00            DISP
0D00   A2 13             LDX #$13
0D02   09 80             ORA #$80
0D04            ;
0D04            ;CONVERT X INTO ADDR
0D04            ;FOR DISPLAY
0D04   20 7B EF          JSR OUTDD1
0D07   60                RTS
0D08                     .END
```

CORRECTIONS TO ISSUE #2

In the DISASSEMBLER UTILITY on page 11, the periods should be removed from in front of the labels DEB and LECT in the source listing.

The OFFSET LOADER program on page 13 was missing the immediate symbol (#) from all four of the immediate instructions (locations 0200, 0205, 0222, and 0252).

In the WE'VE GOT OUR EARS ON article on page 10, the correct Post Office box is 3669 (not 33093).

A note table was left out of the AIM 65 SOUND article on page 8. It belongs right before the section headed "HERE'S HOW TO MAKE MUSIC".

B0=251 (B below first C)	B=124
C=237 (first C)	C1=117 (C above first C)
C#=224	C1#=111
D=211	D1=104
D#=199	D1#=99
E=188	E1=93
F=177	F1=88
F#=167	F1#=83
G=157	G1=78
G#=149	G1#=73
A=140	A1=69
A#=132	

In the AIMPLOT program on page 4, the opcode at location 0232 should be 8D (not BD). Also, the bit instructions at locations 02A9 and 02BA are somewhat misleading. What the author really needed in this situation was a BIT IMMEDIATE instruction. But, as the 6502 doesn't have such an instruction, he had to simulate it. He did this by finding the proper bit pattern in the AIM 65 monitor ROMS and using the address of this bit pattern as the operand instead of the bit pattern itself thereby accomplishing the same effect as a BIT IMMEDIATE instruction.

Has anyone generated a table of all the bit patterns ($00-$FF) available in the AIM 65 monitor ROMS? I'd sure like to publish it.

LETTERS TO THE EDITOR

Dear Editor

I would like to see a clearer explanation of how to output data to the printer than that illustrated in the AIM 65 Users Manual, ref Chapter 7. I would like to write an assembly language program, and then at some point in that program have the printer print the contents of either one of the index registers, accumulator, or a memory location. Quite simply put, I'd like an easy to follow subroutine that would do as shown:

```
LDA XXXX ;some memory location
JSR PRINT ;print contents of acc.
```

then return to a users program.
Is there an easy way to do this?

Thank you
R. A. Fairman

Mr. Fairman,

There is a subroutine called NUMA ($EA46) that will output a hex value in the accumulator as two ASCII digits, but if the printer is not enabled, it will just be sent to the display. So, to do what you want will require making sure the printer is on before you JSR to NUMA. The best way to accomplish this is with a short subroutine that gets included in your program. The subroutine will have to save the present printer flag from PRIFLG ($A411), force the printer flag on by making it $80, do a JSR to NUMA, and then restore the printer flag to whatever it was before.

```
PRTBYT SEC
       ROR PRIFLG
       JSR NUMA
       ASL PRIFLG
       CLC
       RTS
```

Bit 7 is the only bit in the printer flag (PRIFLG) that has any meaning. It is this bit that gets tested to see if output gets sent to the printer (see line 2411 and 2412 in the AIM 65 monitor listing for an example of testing the printer flag). This means that the remaining 6 bits are free for our use. The first thing that is done upon entry to PRTBYT is to set the carry flag to a '1.' This will be put into bit 7 of the print flag location by the ROR PRIFLG instruction to "turn the printer on." The ROR PRIFLG instruction actually does two things. First, it rotates the carry flag into the bit 7 position of the printer flag (which turns the printer on) and also saves the previous print flag in bit 6 so it can be restored after we're finished. The instruction JSR NUMA outputs the character to the printer. To restore the printer flag to its original condition we execute the ASL PRIFLG instruction. This simply shifts bit 6 back to the bit 7 position and moves the '1' which was shifted into the bit 7 position from the carry flag back to the carry flag. The carry flag is then cleared to prepare for our return to the main routine.

the Editor

Dear Sir,

Congratulations on a really-usable, cost-effective AIM65 and now a newsletter to match.

ADDITION TO MARK REARDONS REAL TIME CLOCK

(issue #1 p. 11)

```
250 REM NOW THE TIME IS H HOURS, M MINUTES, S
    SECONDS
251 REM BUG! NOT IF H OR M CHANGED WHILE PEEKING.
252 REM IF THEY DID TIME COULD BE OUT BY ONE HOUR.
253 REM FIX! TO DOUBLE CHECK THE TIME.
254 IF PEEK(220)=H OR PEEK(221)=M THEN GO TO 240
255 REM NOW! THE TIME IS H HOURS, M MINUTES, S
    SECONDS.
```

≠ = NOT EQUAL TO (sorry, no arrows).

SORRY! YOU LOSE YOUR BET we did know how to edit BASIC programs but bet you didn't know you don't need tape to do it.

If memory is split between the EDITOR and BASIC then a LOAD can be done using the memory read routine used by the Assembler. The procedure is described below and assumes you have 4K of memory to be split down the middle to the EDITOR and BASIC.

1. Allocate the MREAD routine (FADO) to the user input vector at HEX 0108. 0108 = DO 0109 = FA.
2. Initialize BASIC answering 2047 to MEMORY SIZE? prompt. From here on only re-enter BASIC using command "6."
3. Escape from BASIC and initialize the EDITOR answering: FROM "800" TO "FFF" to the prompts. From here on only re-enter the EDITOR using command "T."
4. You may now load your program into the EDITOR with the usual commands. Entry may be either from tape or the keyboard but observe the following rules;
   a. The top line must always be a SPACE only.
   b. The bottom line must always be CONTROL Z only.
   c. Always exit the EDITOR using "T" then "Q". This leaves the pointer on the top line.
5. When you want to LOAD your program into BASIC exit the EDITOR and re-enter BASIC. LOAD in the usual way but answer "U" to the IN prompt where upon you will find your program being zapped into BASIC memory space.
6. You may now RUN your program in the usual way but escaping to the EDITOR when editing is required and then re-load the program into BASIC for executing.

7. Sometimes you may find it more useful to do program modifications direct on the BASIC program leaving the EDITOR unaltered so you can quickly restore the original by re-loading. To re-load you must re-enter the EDITOR to get the pointer on the top line otherwise nothing will get loaded.

This EDITOR-BASIC technique has hidden depths which only become apparent with use and the application of a little ingenuity. So get to it!

Here are some clues.

1. The EDITOR can have direct commands entered into it such as NEW or RUN and these will be directly executed as the program is loaded.
2. Normal program statements may be entered without line numbers and these will be directly executed as well. This is particularly useful for POKEing in machine code without occupying BASIC program space.
3. If the EDITOR contains two lines with the same number the second will overlay the first. So don't erase a line in order to replace it—just type in the new line after it. Erase a line only when your sure you won't want to go back to it.
4. A line can be temporarily erased either by inserting REM before the line number or by inserting just the line number on the line after the one to be erased.
5. If you are going to LOAD an EDITOR tape containing direct commands into BASIC the tape must have remote control connected.
6. If REMarks are entered into the EDITOR with-out line numbers then they will not get loaded into BASIC space. Thus it is possible to have a lavishly commented EDITOR tape for development use and a fast loading BASIC tape for the user.
7. You can LOAD part of a program in the EDITOR by putting a SPACE line before the section wanted and a CONTROL-Z line after it. Don't use "T" when exiting the EDITOR, leave it pointing at the SPACE line before the section you want.
8. Because LOAD does not erase existing lines, a large program can be built up and debugged by over-laying from a fairly small EDITOR space.

An extension of the above techniques allows the writing of long self-loading over-laid programs operating within the AIM 65's 4K ram. The approach is ideal for Automatic Test Equipment (A.T.E.) programs and if the Editor so wishes I will write further on it in the future.

KEN FULLBROOK
England

Ken,

You're right. I didn't know how to edit BASIC without using the cassette. Thanks a bunch!!! I'm sure our readers will appreciate it.

The Editor

SOFTWARE REVIEW

by the EDITOR

How would you like to develop 1802 programs on your AIM 65?

Or, how would you like to be able to set up a library of MACROS which can be called from your assembly language programs?

If either, or both of these things interests you, then you'll be interested in a new software package for the AIM 65 called MACRO.

MACRO is actually a pre-processor that works in conjunction with the AIM 65 assembler. Its function is to accept a source file that contains macro calls, expand those macros by looking them up in a library file, and outputting a new source file with all the macros expanded so that the AIM 65 ROM assembler can assemble it.

The macro library file must be set up which defines all the macros which are to be used and must be memory resident at the time the input file is submitted for expansion. (makes AIM 65 sound like a large machine, doesn't it?)

Here's an example of what it looks like:

SAMPLE MACRO
INCD POINTR

SAMPLE MACRO DEFINITION
&INCD
INC !1
BNE *+4
INC !1+1
&

SAMPLE MACRO OUTPUT
INC POINTR
BNE *+4
INC POINTR+1

(The '&' character is used both to start and terminate a macro definition)

Now that last little programming sequence (incrementing a double byte pointer) is something 6502 programmers do alot of.

The same technique can be used to set up a cross assembler for most any other CPU. (6800,1802,8080 etc) Pretty excitin' stuff!!!

According to the documentation that accompanies MACRO, the minimum usable system is an AIM 65 with 2K of RAM, the assembler ROM, and remote control of least one cassette deck. The price is $15 which includes documentation and a cassette of the object code. The source code for MACRO is available either on cassette or as a listing for an additional $30. (This would enable you to adapt MACRO to your 6502 floppy system)

So far, I haven't found any bugs in the system (I'm good at finding bugs) and it worked right the first time I tried it.

It's available from: POLAR SOLUTIONS
Box 268
Kodiak, Alaska 99615

TEMPERATURE CONVERSION PROGRAM

(This program was reprinted from the Rockwell Hobby Club Newsletter of the Anaheim CA facility).

If you've ever had the need to convert temperatures from Celsius to Fahrenheit, then here is a program written in AIM 65 BASIC that will make life a little easier.

Just follow the prompts and type in the start and end values in degrees Fahrenheit and the program will print out a table of the temperature in degrees centigrade (Celsius).

PROGRAM

```
490 INPUT "START"; S
492 INPUT "FINISH"; F
493 PRINT! "DEG.", "DEG."
494 PRINT! "FAR.", "CELS."
495 DEF FNA(A)=INT(A*100+.5)/100
500 FOR I=S TO F
505 R=(I-32)*5/9
510 PRINT! I,FNA(R)
515 NEXT I
```

SAMPLE PRINTOUT

```
START? 0
FINISH? 8
DEG.       DEG.
FAR.       CELS.
  0      -17.78
  1      -17.22
  2      -16.67
  3      -16.11
  4      -15.56
  5      -15
  6      -14.44
  7      -13.89
  8      -13.33
```

FOUND HIDING . . .

a BASIC command not found in the manual

Dale Hall
Torrance, CA

Statement	Syntax/Function	Example
POS	POS (expression) Returns print head position 0-19. requires a dummy argument.	Print POS(0)

BASIC USR HELPER

Georges-Emile April
Montreal, Canada

(Ed. note-If you call many machine language subroutines from your BASIC programs, this routine should be able to save you some time.)

I find it inconvenient to have to use POKE statements every time I wish to use machine language programs; so I wrote the following set of machine language programs which may be assembled on top of RAM memory, or placed in a ROM somewhere else.

Version shown here is in last page of 4K RAM. See listings.

The programs work in the following manner:

a) Program SETADD

When called, this program takes the argument passed to it by BASIC and places it in 4 and 5 to be used as an address by next access to "USR" function.

b) Program CALLIT

This program uses program SETADD to set up address of "USR" then calls program

The programs are used as follows:

Two subprograms (lines 1 and 2) are written in Basic.

Line 1 sets up 4 and 5 to point to SETADD, then returns.

Line 2 sets up 4 and 5 to point to CALLIT, then returns.

Two situations may arise:

a) It is desired to call machine language program (lets us call it SUB1), that needs an argument (ARG).

The following sequence will call it the first time:

```
100  GOSUB1:  X=USR(SUB1):  X=USR(ARG)
```

Where SUB1 is decimal value of address of machine language program we wish to call. Subsequent calls to the same program can be made simply by X=USR(ARG) since address has been set up by line 100.

b) It is desired to call machine language program (SUB2). That needs no argument (e.g. input data).

The followings will do just that:

150 GOSUB2: X=USR(SUB2)

or

160 GOSUB1: X=USR(SUB2): X=USR(DUMMY)

Lines 150 and 160 are fully equivalent but line 150 will execute faster. As was the case in a), subsequent calls to same program can simply be X=USR(DUMMY). Where DUMMY can by any valid variable or constant, since program needs no argument.

It should be noted that program SETADD returns a value of 0 to basic so that the following sequence does not modify the value of Y:

170 GOSUB1: Y=Y + USR(SUB1)

Therefore line 100 could have been written:

100 GOSUB1: X=USR(SUB1) + USR(ARG)

ROUTINES TO EASE USE OF USR(X)

```
                              ;$DF=223,$DB=219

==0FD8 FIXIT    6C06B0 JMP (FIXI)       ;TRANSFORM DATA TO FIXED POINT
                ;THE FOLLOWING SETS UP DATA AS ADDRESS OF 'USR',THEN RETURNS
                ;TO BASIC WITH USR(X)=0
                ;SHOULD BE USED WHEN FUNCTION REQUIRES ARGUMENT
                ;'GOSUB1' SETS UP LINK TO THIS ROUTINE


==0FDB SETADD   A5A9   LDA EXP
                C990   CMP #$90         ;SEE IF TOO LARGE FOR SIGNED TREATMENT
                D00D   BNE OK
                A5AA   LDA MSD          ;IF TOO LARGE,TAKE MSD & MSD1 AS DATA
                8505   STA LINKH
                A5AB   LDA MSD1
==0FE7 COMMON   8504   STA LINKL
                A900   LDA #0
                85A9   STA EXP          ;MAKE USR(X)=0
                60     RTS

==0FEE OK       20D80F JSR FIXIT        ;TRANSFORM ARGUMENT TO ADDRESS
                A5AC   LDA LSD1
                8505   STA LINKH
                A5AD   LDA LSD
                4CE70F JMP COMMON       ;GO COMPLETE TRANSFER

                                        ;THE FOLLOWING SETS UP ADDRESS FROM ARGUMENT
                ;THEN CALLS ROUTINE
                ;USED WHEN NO ARGUMENT IS NEEDED
                ;'GOSUB2' SETS UP LINK TO THIS ROUTINE

                                        ;$DF=223,$FA=250

==0FFA CALLIT   20DB0F JSR SETADD
                6C0400 JMP (LINK)       ;CALL ROUTINE
==1000 END             .END
                 ERRORS= 0000
```

QUICK INSERTION ROM SOCKETS

Ron Riley
Flint, MI

I recently purchased PL-65 and after switching between BASIC and PL-65 ROMS several times, I decided to look into using zero-insertion force sockets. The problem with most of these sockets is that they require more room than AIM 65 has available. I did finally locate one that fits, however. It is part #504012459 and is available from WELLS ELECTRONICS INC., 1701 S. MAIN ST., SOUTH BEND, IND 46613. Since the zero insertion sockets gets plugged into the normal ROM socket, no desoldering is necessary. ROMs can now be swapped in and out with no danger of damaging the ROM or the socket.

BASIC RECOVERY PROCEDURE

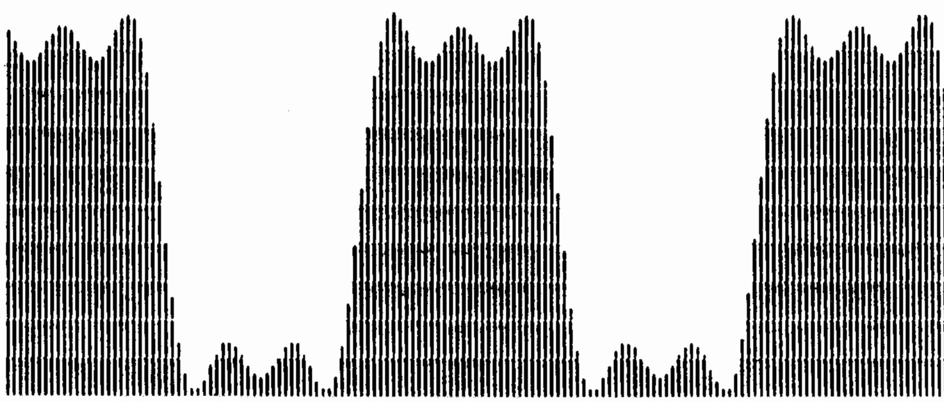
by Antonio Berges
Dominican Republic

How many times have you entered a rather long BASIC program into the AIM 65, confidently entered the monitor and then inadvertently hit the "5" key (rather than the "6" key) to reenter BASIC? You saw the ominous MEMORY SIZE? question and probably thought your BASIC program was "down the tubes."

As long as you don't press the RETURN key, you're safe. The program in memory can be recovered by hitting the ESC key followed by M 01 RETURN / 00 B9. BASIC can now be reentered with the "6" key. What you've done is to replace the JMP $CEA3 at location $0000 to a JMP $B900.

SNEAK PREVIEW

Here's an example of the type of graphics you'll be able to generate with a program that will be in the next issue of INTERACTIVE. Stay tuned!!!



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