µP

MICROPOWER

VOLUME 2, NUMBER 1

A MAGAZINE FOR NASCOM USERS

February, 1982

95 p

PROGRAM POWER

NASCOM

1 & 2

Nasprint 80

Nasprint 80 is a 2K progam which greatly extends and simplifies the operation of Nas-Pen.New functions supplied by Nasprint 80 include:

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The program contains a parallel printer routine for a Centronics type interface, specifically designed for the Epron MX-80,but the program can be used with any printer, parallel or serial, as the output is routed through an address in RAM.

The program also facilitates the operation of a printer with Zeap, Nas-Dis, De-bug, Nas-Sys & ROM Basic; the software/firmware being used is selected from a menu and Nasprint 80 then changes the necessary addresses to produce hard copy output.

The program is supplied in 2x2708's or in one 2716,together with instructions for fitting 2716's in the RAM A card. £14.95

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CONTENTS

EDITORIAL

This is the first issue of Volume 2 of micropower and the start of our first full year of publication. There will be six issues this year at approximately 2 month intervals, so the next magazine will appear at the end of April.

When we started the magazine in August last year (what a long time ago that seems) we were unsure that there would be enough interest in a Nascom magazine to provide the necessary support, although we felt that was a tremendous fund of enthusiasm in the Nascom clubs and computer groups up and down the country.

It appears that the interest does exist - the magazine has sold well (we have had to have reprints of the early issues) and, even more important, articles have been sent in for publication. This does not mean that we have enough articles for the magazine - we are always pleased to receive more, so sit down NOW and write up your pet projects.

Remember that the composition of the magazine reflects the interests of the ‘active’ readers - that is, the readers who also contribute. If you feel that the magazine should contain articles on a certain topic you could write in and ask someone to write them, but a better way is to write a short article yourself. You have a head start, because all your readers will be Nascom enthusiasts; all you have to do is to communicate your particular interest.

NASCOM CONTROLS WASHING MACHINE

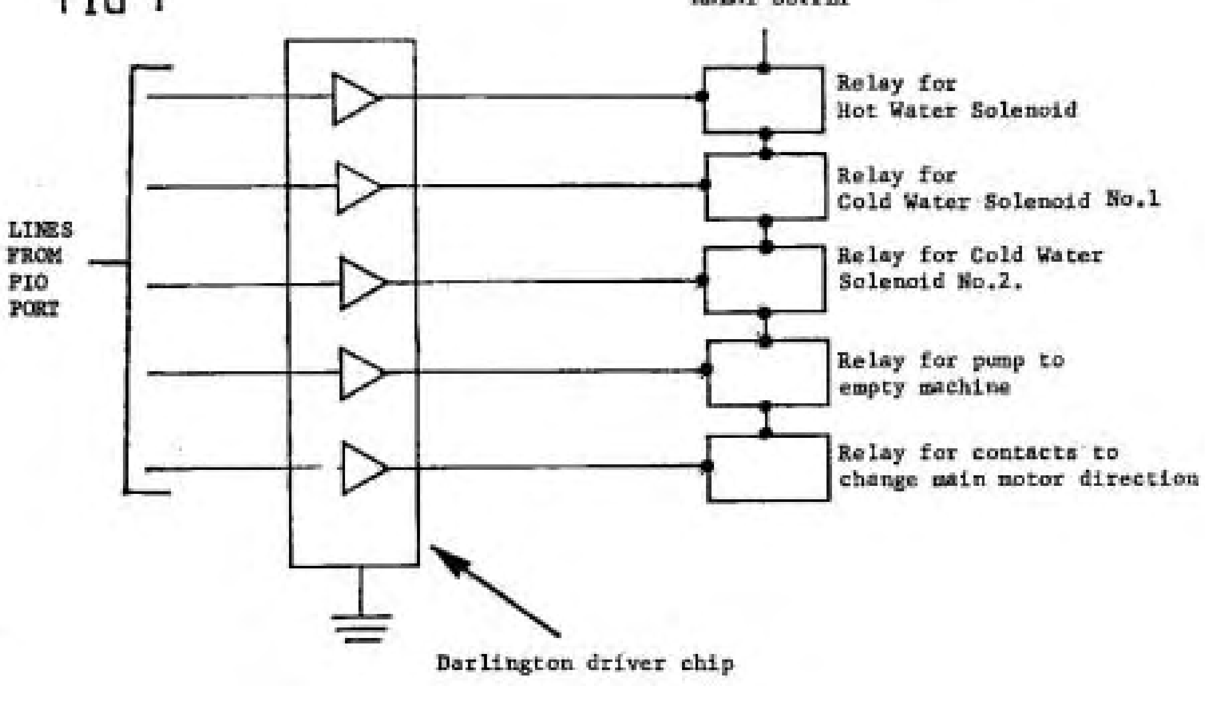
by J. C. Lord

Some months ago I was given a Hoover Keymatic front loading washing machine which needed a new controller. The cost of such a controller being at that time about £60, I decided to have a go at controlling the machine from my Nascom. The project has proved successful, and I think that readers may be interested to see how the job was done using ten P.I.0. lines.

I removed from the washing machine the main motorised controller unit, the motor drive board, and all of the wiring. This left the two level switches (empty and full), the three solenoids (two for cold water, and one for hot), the pump and the main motors. I then built a board to interface between the Nascom and the various items on the washing machine.

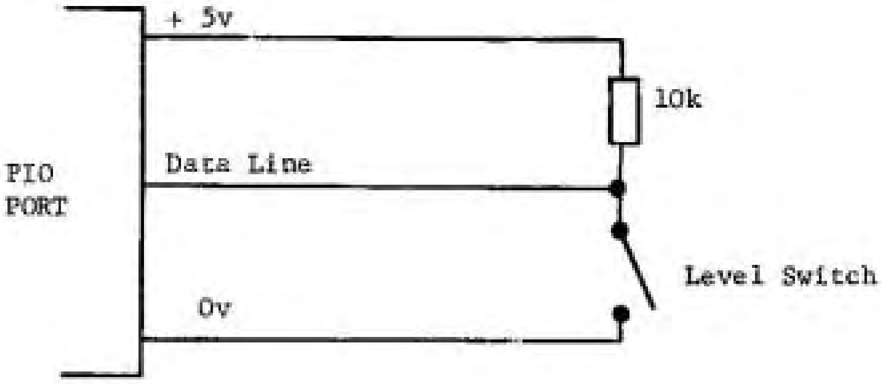
Five of the P.I.O. lines are used as on/off outputs. The output system consists of a Darlington driver chip operating five transistorised relays. The Darlington driver acts as a buffer to provide 7 mA for the relays; the P.I.0. should not source or sink more than 2 mA. The relays switch 240 V. A.C. for the various machine components, as shown in figure 1. The 240 V. to microprocessor isolation in this circuit is provided by the relays. An alternative method would be to use optically isolated solid state relays.

FIG 1



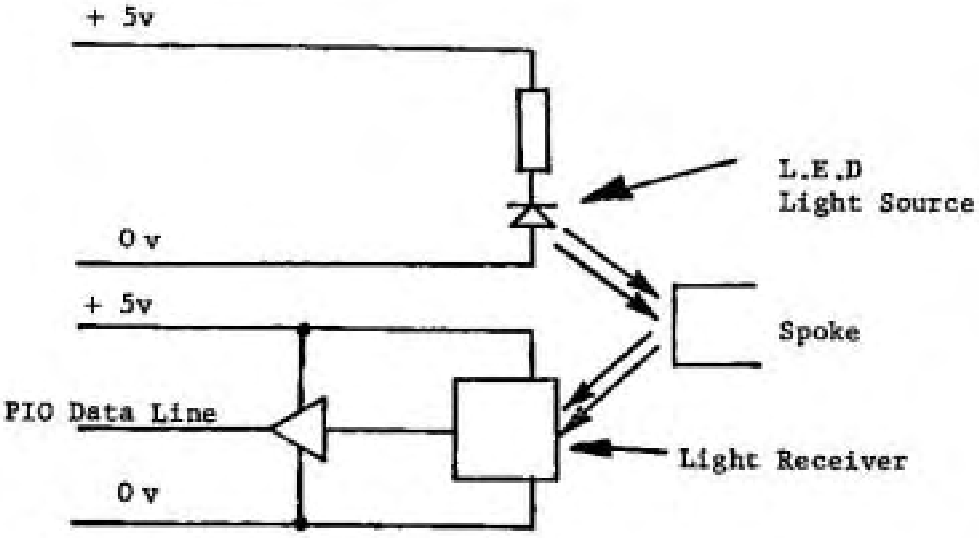
Three lines are used as Inputs. Two input signals come from the level switches which indicate when the drum is full and empty. As shown in figure 2, these switches are connected to +5 V. through 10 Kohm pull up resistors.

FIG 2



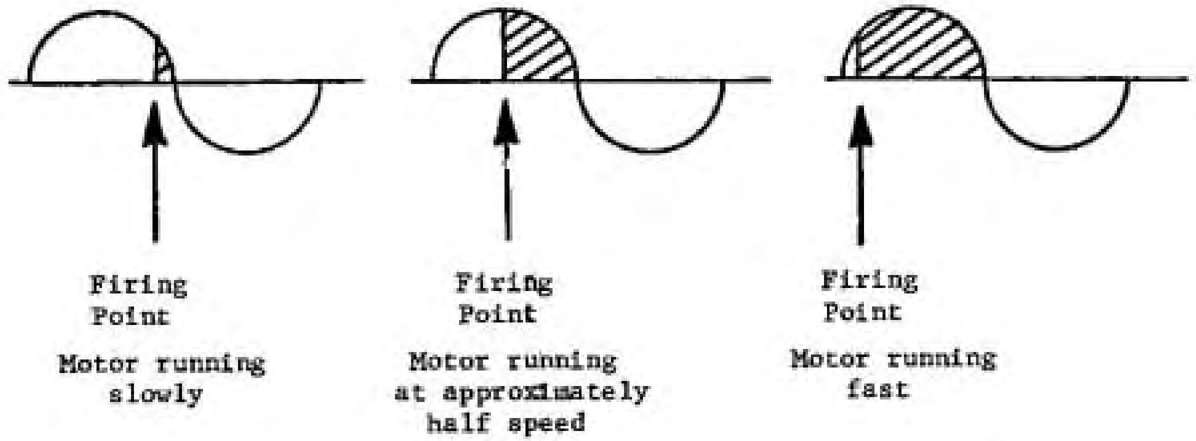
The third input is used by the processor to determine the speed of the drum for feedback purposes. A reflective optical switch points at the metal spokes of the pulley which turns the drum. When a spoke goes past the switch light is reflected and a ‘1’ is generated on the P.I.0. input line, which is usually at ‘0’. The circuit requires a transistor amplifier to step up the output from the receiver to TTL level for the P.I.0.

FIG 3



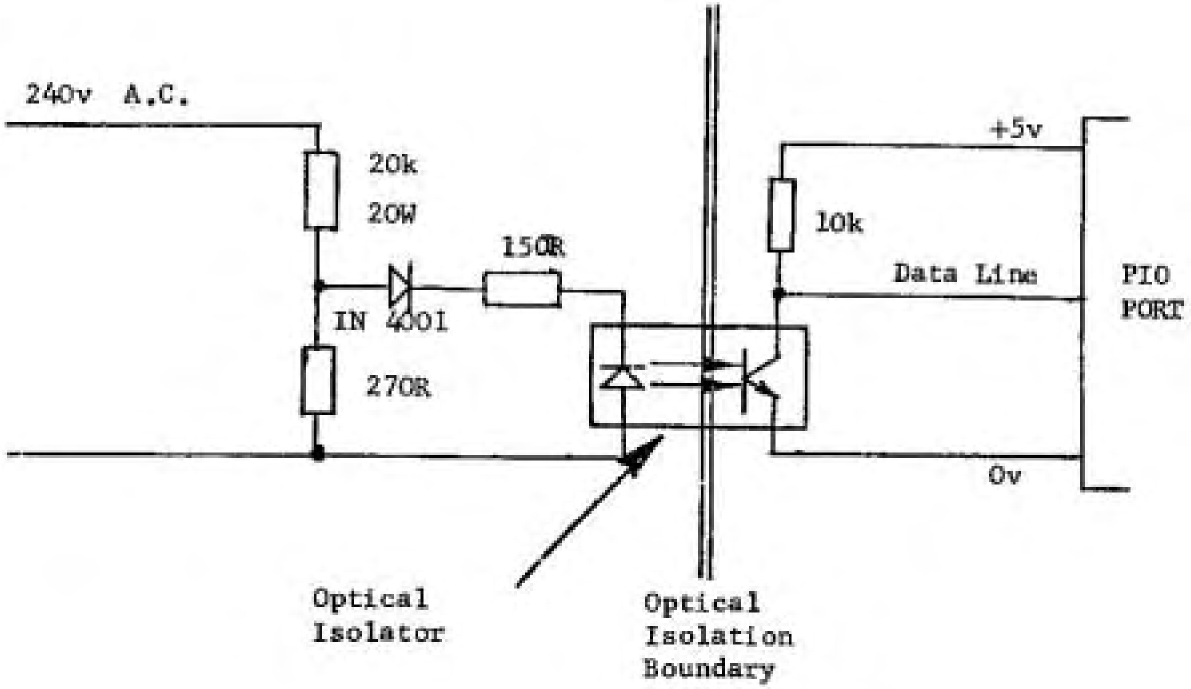
By timing the interval between successive spokes, the speed of the drum can be found, and hence the required speed feedback is obtained. An alternative to this optical sensor would be a 5 V. proximity switch.

So far so good, now we come to the problem of controling the speed of the main motor. The circuit uses a thyristor - a device which can be made to pass current into the motor for part of the positive half of the A.C. wave. The earlier in the half wave it is switched on, the more current it will pass and the faster the motor will go (see figure 4).



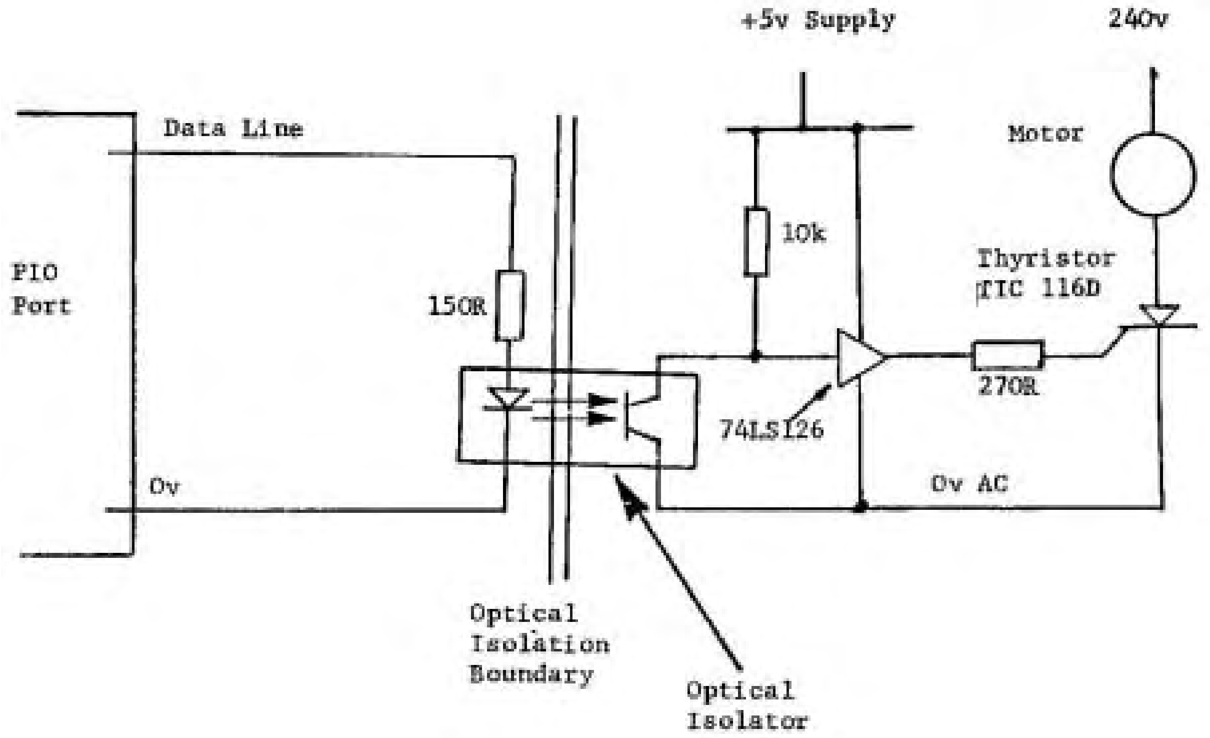
Thus in order to control the speed a pulse has to be sent to the thyristor to switch it on at the required point in the positive half cycle. The circuit of figure 5 generates a reference pulse for the processor shortly after each positive-going zero crossing point.

FIG 5



t15The P.I.0. line which receives the signal is an interrupt line, so that each time the zero crossing point signal is received the processor enters an interrupt service routine. In this routine the thyristor is fired after a delay calculated from the programmed speed requirement and the feedback speed. Figure 6 shows the firing circuit. Adequate suppression has to be included to prevent interference with other domestic equipment.

FIG 6

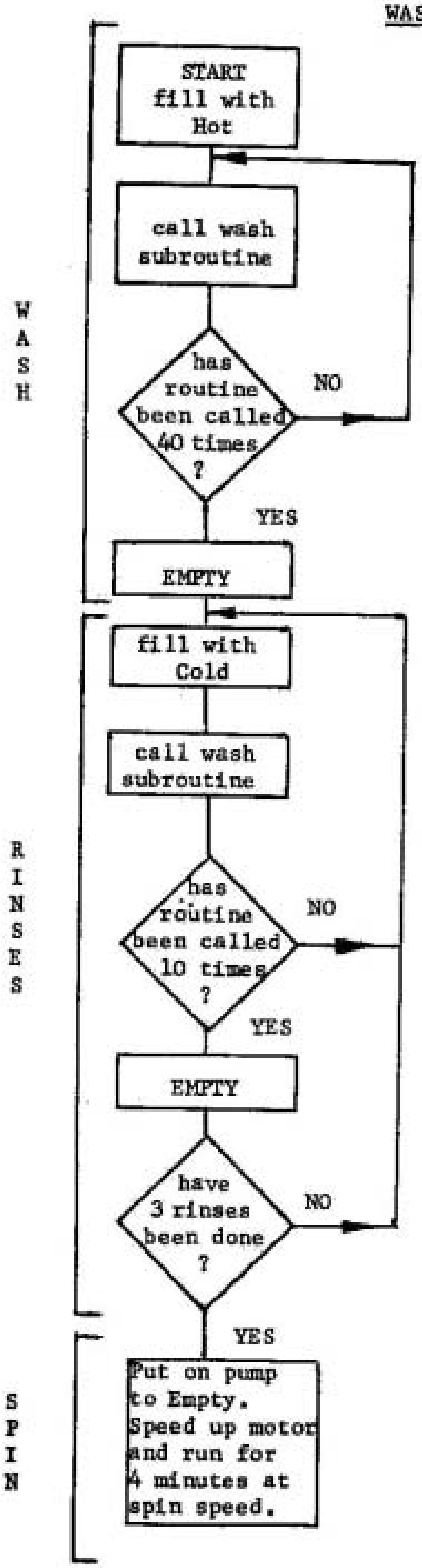


The 5 V. power supply for the circuit to the right of the isolation boundary must be derived from the 240 V. supply. If the 5 V. Nascom supply was used, there would be no isolation.

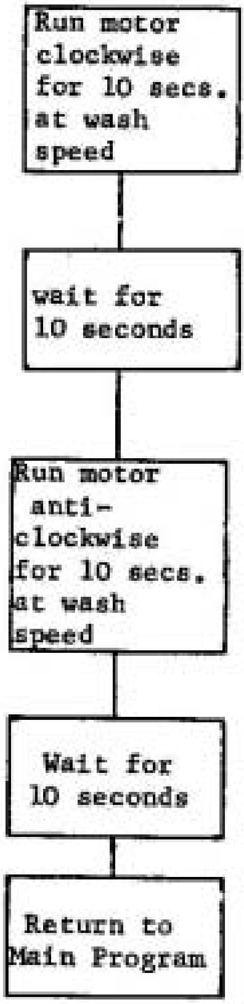
The program for controlling the operation of the system, which consists of sequencing for filling, emptying, pumping out and the motor control subroutine, was developed using the Zeap assembler. A flow chart for the system on which the program was based, is shown on the next page.

* + · + * + · + * + · + * + *

WASHING MACHINE FLOW CHART


W A S H
START fill with Hot
call wash subroutine
has routine been called 40 times ?
NO
YES
EMPTY
R I N S E S
fill with Cold
call wash subroutine
has routine been called 10 times ?
NO
YES
EMPTY
have 3 rinses been done ?
NO
YES
S P I N
Put on pump to Empty. Speed up motor and run for 4 minutes at spin speed.

WASH SUBROUTINE


Run motor clockwise for 10 secs. at wash speed
wait for 10 seconds
Run motor anti-clockwise for 10 secs. at wash speed
Wait for 10 seconds
Return to Main Program

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BEYOND THE 64K BARRIER

by Chris Blackmore

Anyone who has owned a Nascom for any great length of time will tell you that, unlike systems that arrive in ready-made plastic cases, Nascoms tend to expand almost indefinitely. The abilty to expand was designed into the system from the very beginning, and it shows. When you start out, you think that a 32K RAM board will never be too small. There is left over space in the memory map, and a great many of the expansion boards that are available are memory mapped, which means that they appear to the CPU to be memory, and they take up memory space. Then one day you upgrade your system to 64K of RAM, or perhaps even more than that, because the Nascom will allow you to have enormous amounts of RAM (unlike the aforementioned plastic boxes...). Now your memory mapped sound generator board, programmable character generator, and home made digital clock card become nuisances, as they overlap some of your nice new memory.

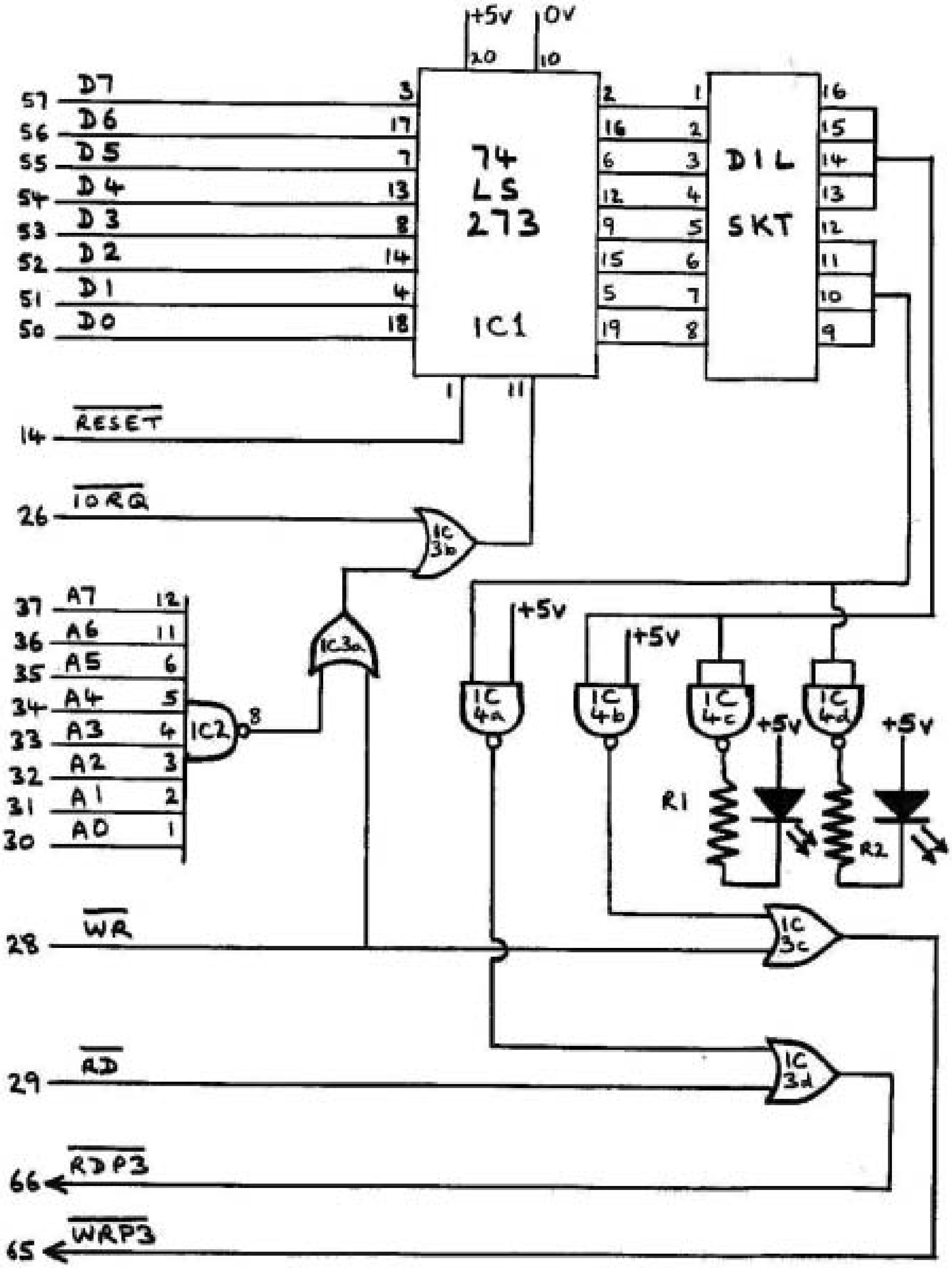
So you have to find a way of preventing the waste of memory, and the Nascom provides it in the form of memory paging. Your main RAM board will be on page 0, and all your memory mapped ‘extras’ (unless you have more than 64K of them) will be on page 1, 2 or 3.

So this means that you will have to fit a paging circuit to each of these boards, doesn’t it? No, it doesn’t - one will do! There are some spare lines on the bus, called NDEF1 and NDEF2 in the Gemini 80 specification, and shown as ‘reserved’ in the Nasbus specification, which can be used in more or less any way you wish. I suggest that they should be used to carry the read and write signals to all boards that are on memory page 3.

Only a simple modification is needed on each of these boards, instead of the quite complex task of adding a paging circuit to each of them. The single paging circuit can be built on a prototyping board, of which there tends to be at least one in any system that has reached this stage of development.

Modify each board that is to appear on page 3 as shown in diagram 2, or fit the board with equivalent switching if you want the board to be usable on systems without the page 3 signals, or with software that has not allowed for the use of paged addressing.

The circuit to provide the page 3 read and write signals is shown in diagram 1. It will not take up much space on the prototyping board, as it consists of very few components. It could even be fitted to the end of the mother board if you are that short of space. A header should be made up with links from pins 1 to 16 and 5 to 12 for page 3 operation; different header connections will allow for different page selections it is even possible to have the read signal on one page and the



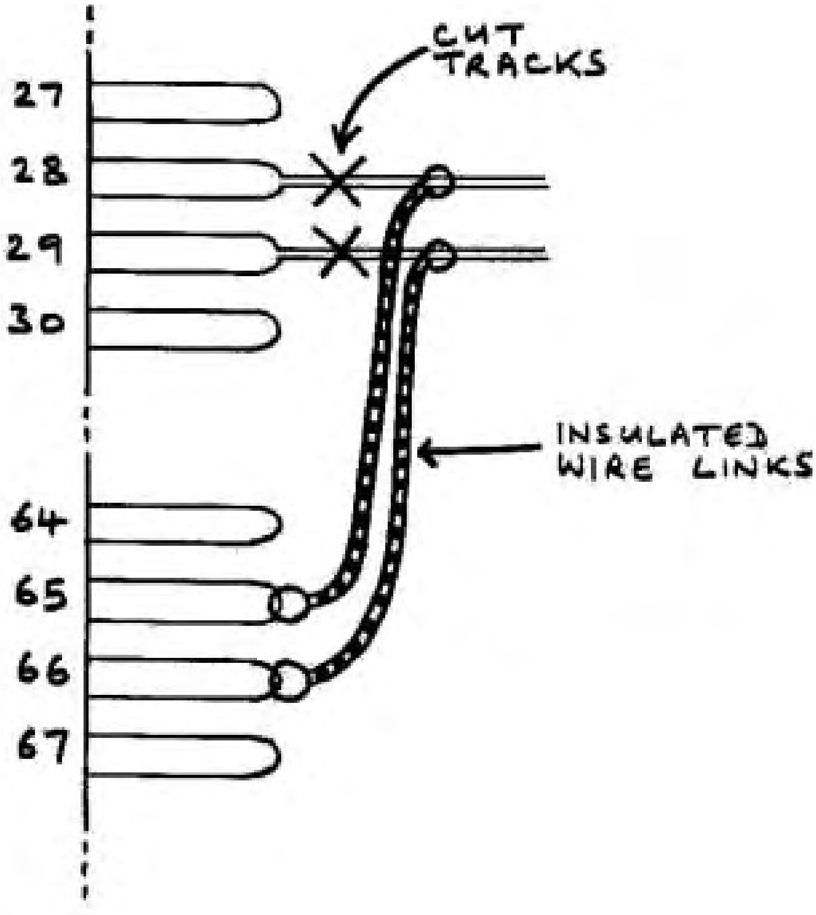
DIARAM 1: PAGING CRCUIT

IC 1	74 LS 273	IC 4	74 LS 00
IC 2	74 LS 30	R1	150 Ohms
IC 3	74 LS 32	R2	150 Ohms

write signal on another, but even I don’t know why anyone would want to do this! Two LEDs have been added for the benefit of those who, like me, feel that computers should have flashing lights on them - these are handy for checking that the circuit is actually operating, when your program to use it seems not to be working....

REFERENCES:
The full definition of the Gemini 80 bus can be found in INMC-80, No. 4, pages 24-30
The original Nasbus is defined in Nascom Document PF/007 Issue No. 1.

DIAGRAM 2: BOARD MODIFICATIONS



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R – Read a file.
T – Transfer file to another drive.
W – Write a file.
X – Exit and rewind cassettes.
Z – Warm start to Basic.

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XTAL BASIC EXTRA

by David Elliott

Here are six more commands tor Crystal Basic 2.2. OLD recovers a program which has been ‘exterminated’ by a NEW or a cold start. STRING$(nn,cc) creates a string of nn characters with ASCII code cc. LOWER$(..) and UPPER$(..) convert a given string to lower and upper case respectively, while REVERSE$(..) changes the case of the characters in a string. Finally, EVAL(…) returns the value of a given string. The assembler listing of the commands is followed by the code to be entered using the loader program described in the last issue.

```
2D00                0090              ORG £2D00
                    0100      ;
                    0110      ; @@@@@@@@@@@@
                    0120      ; @@    O  L  D    @@
                    0130      ; @@@@@@@@@@@@
                    0140      ;
                    0150      ; OLD RECOVERS A PROGRAM PREVIOUSLY
                    0160      ; ERASED BY A ‘NEW’ COMMAND
                    0170      ;
2D00    FD2A8312    0180      OLD       LD IY, (1283H)      ; GET TEXT START
2D04    FDE5        0190                PUSH IY             ; SET IX TO START
2D06    DDE1        0200                POP IX
2D08    AF          0210                XOR A
2D09    0600        0220                LD B, 0             ; DOING FIRST LINE
2D0B    110400      0230                LD DE, 4            ; SKIP LINE NUMBER
2D0E    FD19        0240                ADD IY, DE          ; AND LINK ADDRESS
2D10    FDBE00      0250      OLD1      CP (IY)             ; END OF LINE?
2D13    2804        0260                JR Z, OLD3          ; IF SO, JUMP
2D15    FD23        0270      OLD2      INC IY              ; NO, TRY NEXT BYTE
2D17    18F7        0280                  JR OLD1
                    0290      ;
2D19    78          0300      OLD3      LD A,B              ; END OF 1ST   LINE?
2D1A    B7          0310                OR A
2D1B    200D        0320                JR NZ, OLD4
2D1D    0601        0330                LD B,1              ; IF SO, RESET FLAG
2D1F    FD23        0340                INC IY              ; RESTORE LINK
2D21    FDE5        0350                PUSH IY             ; TO SECOND LINE
2D23    D1          0360                POP DE
2D24    DD7300      0370                LD (IX),E
2D27    DD7201      0380                LD (IX+1),D
                    0390      ;
2D2A    AF          0400      OLD4      XOR A
2D2B    FDBE01      0410                CP (IY+1)           ; END OF PROGRAM?
2D2E    20E5        0420                JR NZ,OLD2          ; NO, TRY AGAIN
2D30    FDBE02      0430                CP (IY+2)           ; END OF PROGRAM?
2D33    20E0        0440                JR NZ, OLD2         ; NO, TRY AGAIN
                    0450      ;
                    0460      ; END OF PROGRAM FOUND
                    0470      ;
2D35    110300      0480                LD DE, 3            ; RESTORE POINTERS
2D38    FD19        0490                ADD IY, DE
```

```
2D3A   FD22B70C   0500            LD (£0CB7), IY     ; END OF TEXT
2D3E   FD22BB0C   0510            LD (£0CBB), IY     ; END OF ARRAYS
2D44   C9         0520            RET
                  0530   ;
                  0540   ; @@@@@@@@@@@@@@@@@@@@
                  0550   ; @@        STRING$(NN,CC)        @@
                  0560   ; @@@@@@@@@@@@@@@@@@@@
                  0570   ;
                  0580   ; CREATES A STRING OF NN CHARACTERS
                  0590   ; WITH AN ASCII CODE CC
                  0600   ;
2D43   E1         0610   STRING   POP HL
2D44   23         0620            INC HL
2D45   CD5022     0630            CALL IN255         ; GET NUMBER 0-255
2D48   F5         0640            PUSH AF
2D49   CD4C15     0650            CALL TSTCOM        ; GET COMMA
2D4C   CD5022     0660            CALL IN255         ; GET CHAR. CODE
2D4F   F5         0670            PUSH AF            ; SASVE CHARACTER
2D50   CD5115     0680            CALL TSTCHR        ; TEST FOR
2D53   29         0690            DEFB “)            ; CLOSING BRACKET
2D54   F1         0700            POP AF             ; RECOVER CHAR.
2D55   47         0710            LD B,A             ; PUT IN B
2D56   F1         0720            POP AF             ; RECOVER NUMBER
2D57   E5         0730            PUSH HL            ; SAVE TEXT POINTER
2D58   4F         0740            LD C, A            ; PUT NUMBER IN C
2D59   79         0750            LD A, C
2D5A   C5         0760            PUSH BC            ; SAVE BC
2D5B   CDAB1F     0770            CALL ASNSTR        ; CREATE NEW STRING
2D5E   C1         0780            POP BC             ; RECOVER BC
2D5F   EB         0790            EX DE, HL          ; SET HL TO START
2D60   70         0800   ST1      LD (HL), B         ; COPY CHARACTER
2D61   23         0810            INC HL             ; INCREMENT POINTER
2D62   0D         0820            DEC C
2D63   20FB       0830            JR NZ, ST1         ; LOOP
2D65   C3D91F     0840            JP STREND          ; RETURN TO BASIC
                  0850   ;
                  0860   ; @@@@@@@@@@@@@@@@@@@@@@@@@@@
                  0870   ; @@           CONVERT TO LOWER CASE          @@
                  0880   ; @@@@@@@@@@@@@@@@@@@@@@@@@@@
                  0890   ;
2D68   3E4C       0900   LOWER    LD A, “L           ; SET FLAG TO
2D6A   32FE2D     0910            LD (CONV), A       ; LOWER CASE
2D6D   180C       0920            JR CONVRT
                  0930   ;
                  0940   ; @@@@@@@@@@@@@@@@@@@@@@@@@@@
                  0950   ; @@           CONVERT TO UPPER CASE          @@
                  0960   ; @@@@@@@@@@@@@@@@@@@@@@@@@@@
                  0970   ;
2D6F   3E55       0980   UPPER    LD A, “U           ; SET FLAG TO
2D71   32FE2D     0990            LD (CONV), A       ; UPPER CASE
2D74   1805       1000            JR CONVRT
                  1010   ;
                  1020   ; @@@@@@@@@@@@@@@@@@@@
                  1030   ; @@        REVERSE STRING        @@
                  1040   ; @@@@@@@@@@@@@@@@@@@@
                  1050   ;
2D76   3E52       1060   REVRSE   LD A, “R           ; SET FLAG TO
```

```
2D78    32FE2D    1070                LF (CONV), A       ; REVERSE
                  1075    ;
                  1080    ; CONVERT STRING
                  1085      ;
2D7B    E1        1090    CNVERT      POP HL
2D7C    23        1100                INV HL
2D7D    CD8B1B    1110                CALL EXPR          ; GET STRING
2D80    CD5115    1120                CALL TSTCHR        ; TEST FOR
2D83    29        1130                DEFB “)            ; COSING BRACKET
2D84    E5        1140                PUSH HL
2D85    CD6A21    1150                CALL ASCO          ; GET STRING ADD.
2D88    2B        1160                DEC HL             ; AND LENGTH
2D89    2B        1170                DEC HL
2D8A    2B        1180                DEC HL
2D8B    46        1190                LD B, (HL)         ; B=STRING LENGTH
2D8C    EB        1200                EX DE, HL          ; HLSTRING ADDRESS
                  1210    ;
                  1220    ; GOT STRING ADDRESS
2D8D    E5        1230                PUSH HL            ; SAVE IT
2D8E    E5        1240                PUSH HL            ; SAVE IT
2D8F    78        1250                LD A, B            ; SET A TO LENGTH
2D90    CDA81F    1260                CALL ASNSTR        ; CREATE NEW STRING
2D93    C1        1270                POP BC
2D94    E1        1280                POP HL
2D95    3AFE2D    1290    CNV1        LD A, (CONV)       ; GET FLAG
2D98    FE52      1300                CP “R              ; REVERSE?
2D9A    2824      1310                JR Z, REVSTR       ; IF SO, JUMP
2D9C    FE4C      1330                JR NZ, CVNU        ; IF NOT, UPPEROOD
2DA0    7E        1340                LD A, (HL)
2DA1    FE41      1350                CP “A              ; BEFORE “A”?
2DA3    3813      1360                JR C, CNV2         ; IF SO, LEAVE
2DA5    FE5B      1370                CP “Z+1            ; AFTER “Z”?
2DA7    300F      1380                JR NC, CNV2        ; IF SO, LEAVE
2DA9    C620      1390                ADD A, 20H         ; CONVERT
2DAB    180B      1400                JR CNV2
2DAD    7E        1410    CNVU        LD A, (HL)
2DAE    FE61      1420                CP “a              ; BEFORE “a”?
2DB0    3806      1430                JR C, CNV2         ; IF SO, LEAVE
2DB2    FE7B      1440                CP “z+1            ;   AFTER “z”? 2DB4
3002              1450                JR NC, CNV2        ; IF SO, LEAVE
2DB6    D620      1460                SUB 20H            ; CONVERT
2DB8    12        1470    CNV2        LD (DE), A         ; SAVE CHARACTER
2DB9    13        1480                INC DE
2DBA    23        1490                INC HL
2DBB    10D8      1500                DJNZ CNV1
2DBD    C3D91F    1540                JP STREND          ; BACK TO BASIC
2DC0    48        1550    REVSTR      LD C, B            ; SET BC TO LENGTH
2DC1    0600      1560                LD B, 0
2DC3    09        1570                ADD HL, BC         ; ADD TO START
2DC4    2B        1580                DEC HL             ; TO GET END
2DC5    41        1590                LD B,C             ; SET B TO LENGTH
2DC6    7E        1600    REV1        LD A, (HL)         ; COPY CHARACTER
2DC7    12        1610                LD (DE), A
2DC8    13        1620                INC DE             ; ALTER POINTERS
2DC9    2B        1630                DEC HL
2DCA    10FA      1640                DJNZ REV1          ; LOOP
2DCC    C3D91F    1650                JP STREND          ; BACK TO BASIC
```

```
                  1670   ; @@@@@@@@@@@@@@@@@@@@@@@@@
                  1680   ; @@         EVALUATE A STRING          @@
                  1690   ; @@@@@@@@@@@@@@@@@@@@@@@@@
                  1700   ;
2DCF   E1         1710   EVAL       POP HL
2DD0   23         1720              INC HL
2DD1   CD8B1B     1730              CALL EXPR        ; GET STRING
2DD4   E5         1740              PUSH HL
2DD5   CD6A21     1750              CALL ASCO        ; GET ADDRESS IN DE
2DD8   2B         1760              DEC HL           ; FIND LENGTH
2DD9   2B         1770              DEC HL
2DDA   2B         1780              DEC HL
2DDB   7E         1790              LD A, (HL)       ; GET LENGTH IN A
2DDC   FE5A       1800              CP 90            ; IS IT TOO LONG?
2DDE   3805       1810              JR C, EVAL2      ; IF NO, JUMP
2DE0   1E0F       1820              LD E, 15         ; IF YES, WRITE
2DE2   C31913     1830              JP ERROR         ; ERROR MESSAGE
2DE5   4F         1840   EVAL2      LD C, A
2DE6   0600       1850              LD B, 0
2DE8   EB         1860              EX DE, HL
2DE9   11D50C     1870              LD DE, BUFFER
2DEC   EDB0       1880              LDIR
2DEE   23         1890              INC HL
2DEF   3600       1900              LD (HL), 0
2DF1   21D50C     1910              LD HL, BUFFER    ; COMPRESS OVER
2DF4   CD4914     1920              CALL CMPRSS      ; ITSELF
2DF7   23         1930              INC HL
2DF8   CD771B     1940              CALL EXNMCK      ; EVALUATE EXPR.
2DFB   C3AA2B     1950              JP FNEND         ; BACK TO BASIC
2DFE   00         1960   CONV         DEFS 1         ; CONVERSION FLAG
                  1965   ;
                  1970   ; ROUTINES IN CRYSTAL BASIC
                  1980   ;
2DFE   154C       1990   TSTCOM     EQU 154CH        ; TEST FOR COMMA
2DFE   2250       2000   IN255        EQU 2250H      ; GET NUMBER 0 – 255
2DFE   1FAB       2010   ASNSTR     EQU 1FABH        ; CREATE NEW STRING
2DFE   1FD9       2020   STREND     EQU 1FD9H        ; RETURN WITH RESULT
2DFE   1551       2030   TSTCHR     EQU 1551H        ; TEST FOR NEXT BYTE
2DFE   215B       2040   LEN1       EQU 215BH        ; GET STRING LENGTH
2DFE   1B8B       2050   EXPR       EQU 1B8BH        ; EVALUATE EXPRESSION
2DFE   216A       2060   ASCO       EQU 216AH        ; GET ADDRESS & LENGTH
2DFE   1449       2070   CMPRSS     EQU 1449H        ; COMPRESS TO BUFFER
2DFE   2BAA       2080   FNEND      EQU 2BAAH        ; RETURN FROM FUNCTION
2DFE   1B77       2090   EXNMCK     EQU 1B77H        ; EVALUATE NUMERIC EXP.
2DFE   0CD5       2100   BUFFER     EQU 0CD5H        ; BASIC INPUT BUFFER
2DFE   1319       2110   ERROR      EQU 1319H        ; PRINT ERROR MESSAGE
```

These routines should can be entered into the crystal basic interpreter in the normal way, or they can be added by means of the loader program given in the last issue. The code to be entered when using this program is given below.

NAME:OLD

```
0000    FD  2A  83  12  FD  E5  DD  E1  AF  06  00  11  04  00
```

```
        000E    FD   19   FD   BE   00   28   04   FD   23   18   F7   78   B7   20
        001C    0D   06   01   FD   23   FD   E5   D1   DD   73   00    D   72   01
        002A    AF   FD   BE   01   20   E5   FD   BE   02   20   E0   11   03   00
        0038    FD   19   FD   22   B7   0C   FD   22   BB   0C   C9   .
```

NAME:STRING$(

```
        0000    E1   23   CD   50   22   F5   CD   4C   15   CD   50   22   F5   CD
        000E    51   15   29   F1   47   F1   E5   4F   79   C5   CD   AB   1F   C1
        001C    EB   70   23   0D   20   FB   C22D9     1F   .
```

NAME:LOWER$(

```
        0000    3E   4C   32    +0096    18   0C
```

NAME:UPPER$

```
        0000    3E   55   32    +008F    18   05
```

NAME:REVERSS$(

```
        0000    3E   52   32   +0088     E1   23   CD   8B   1B   CD   51   15   29
        000E    E5   CD   6A   21   2B   2B   2B   46   EB   E5   C5   78   CD   AB
        001C    1F   C1   E1   3A   +0088     FE   52   28   24   FE   4C   20   0D
        002A    7E   FE   41   38   13   FE   5B   30   0F   C6   20   18   0B   7E
        003B    FE   61   38   06   FE   7B   30   02   D6   20   12   13   23   10
        0046    D8   C3   D9   1F   48   06   00   09   2B   41   7E   12   13   2B
        0054    10   FA   C3   D9   1F   .
```

NAME: EVAL(

```
        0000    E1   23   CD   8B   1B   E5   CD   67   21   2B   2B   2B   7E   FE
        000E    5A   38   05   1E   0F   C3   19   13   4F   06   00   EB   11   D5
        001C    0C   ED   B0   23   36   00   21   D5   0C   CD   49   14   23   CD
        000A    77   1B   C3   AA   2B   4C   00   00   00   .
```

– – – – – – – – – – – – – –

In the last issue a section of code was omitted from the command loader listing on page 13. The following text should be added between line 850 and line 1020

```
4EA5    FD7500      0850              LD (IY), L
4EA8    FD7401      0860              LD (IY+1),H
4EAB    FD23        0870              INC IY
4EAD    FD23        0880              INC IY
4EAF    18D9        0890              JR IN1
4EB1    CDCD4E      0900    IN2       CALL NUM8
4EB4    FD7100      0910              LD (IY), C
4EB7    FD23        0920              INC IY
4EB9    18CF        0930              JR IN1
4EBB    E5          0940    NUM6      PUSH HL
4EBC    DF64        0950              SCAL NUM
4EBE    E1          0960              POP HL
4EBF    381C        0970              JR C, ERROR
4EC1    ED4B210C    0980              LD BC, (NUMV)
4EC5    3A200C      0990              LD A, (NUMV)
4EC8    FE04        1000              CP 4
4ECA    20 11       1010              JR NZ, ERROR
```

* * * * * * * * * * * * * *

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EPROM PROGRAMMER/CHECKER/READER

Part 2

By C. Bowden

The previous article described an EPROM programmer that I recently designed and built. The present article gives the circuit diagrams of the programmer and a suitable power supply, together with a Veroboard layout for the programmer and the source code of the software necessary for its operation.

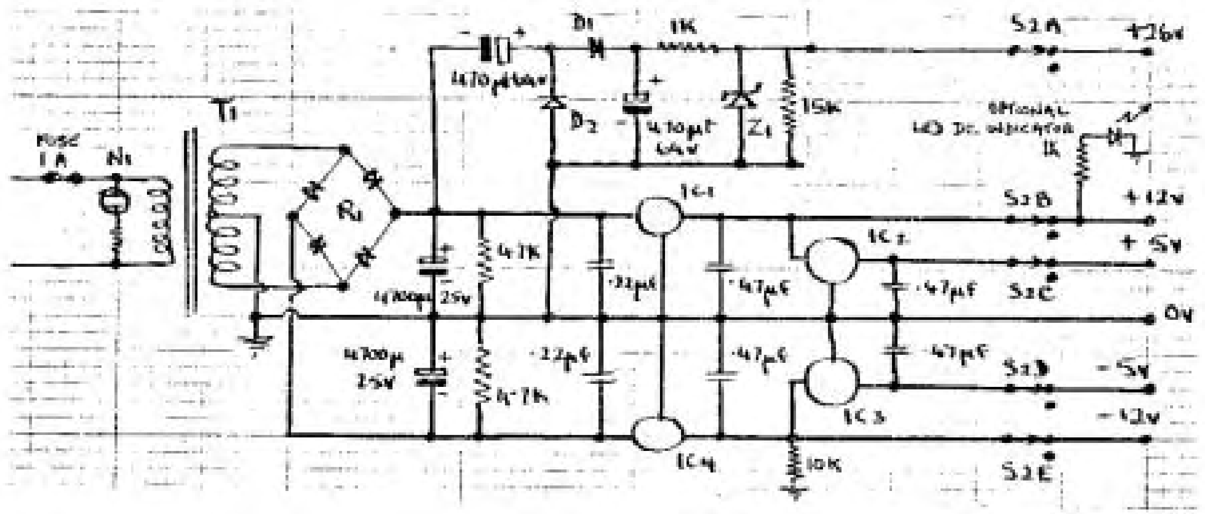

Fig. 0 PROGRAMMER POWER SUPPLY

```
;***************************************
;*                                     *
;*    EPROM PROGRAMMER FOR 2708/2716   *
;*                                     *
;***************************************
;
;     FOR NASCOM 2 WITH 4 MHZ CLOCK.
;
;            (NO WAIT STATES)
;
;
;               WRITTEN FOR MACRO 80 ASSEMBLER.
;
;   WILL NEED TO BE MODIFIED FOR ZEAP ASSEMBLER.
;
;         C.BOWDEN                NOV.  1981
;
;***************************************
;
;         EQUATES:-
```

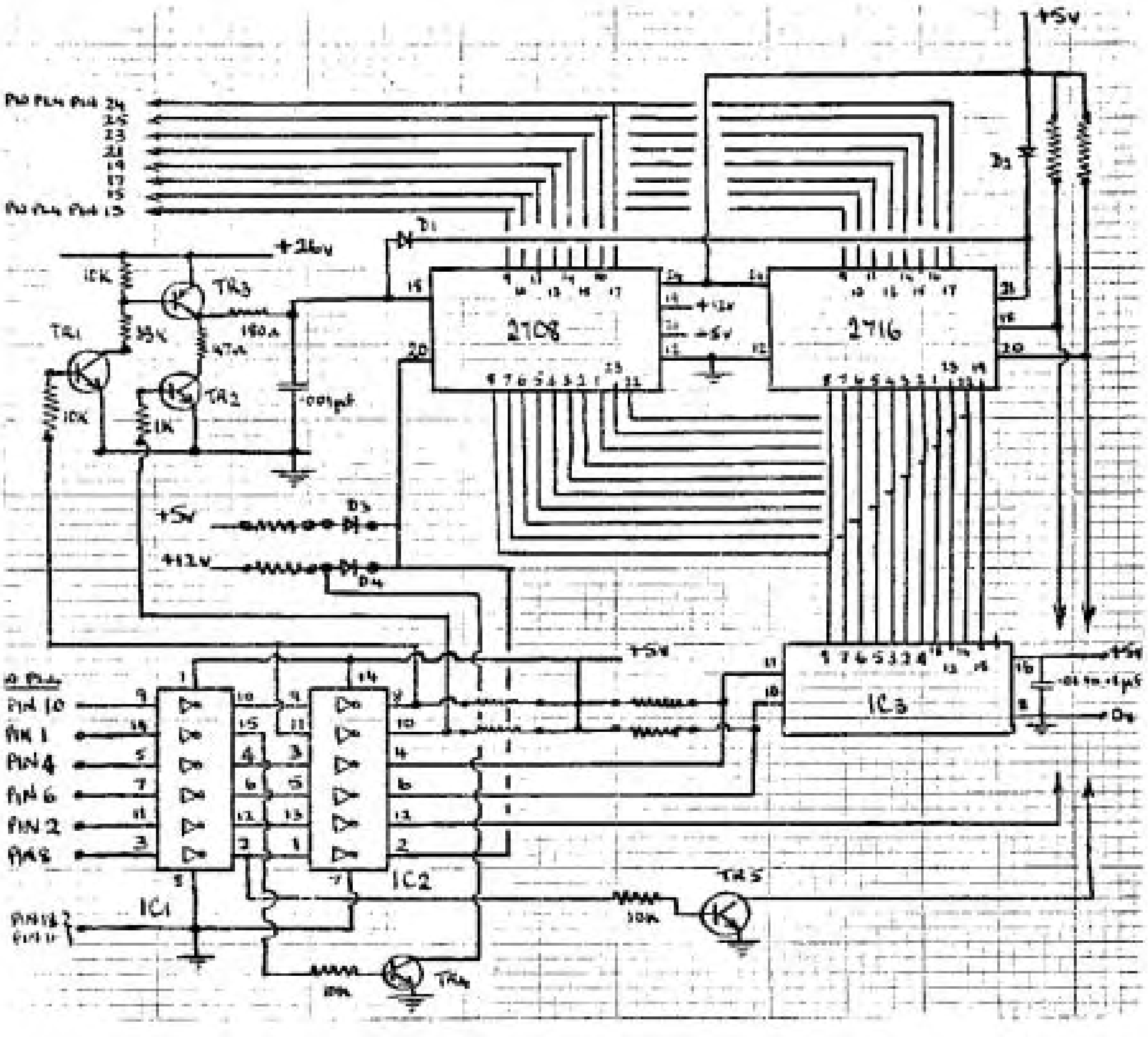

Fig. 1 2708 PROGRAMMER CIRCUIT

NOTES: 1) PORT A OF PIO USED FOR DATA, PORT B FOR CONTROL

2) DECOUPLING CAPACITORS 0.01 – 0.1 uf SHOULD BE USED ON EACH IC (AS ON IC 3)

3) THE PIN NUMBERS SHOWN REFER TO THE NASCOM 2 26-WAY PIO CONNECTOR

4) OBSERVE CMOS HANDLING PRECAUTIONS WITH ICs 1 AND 3, AND THE EPROMS

5) IF POSSIBLE USE ZERO INSERTION FORCE SOCKETS FOR THE EPROMS

6) UNMARKED PULL UP RESISTORS CAN BE IN THE RANGE 4.7K TO 10K

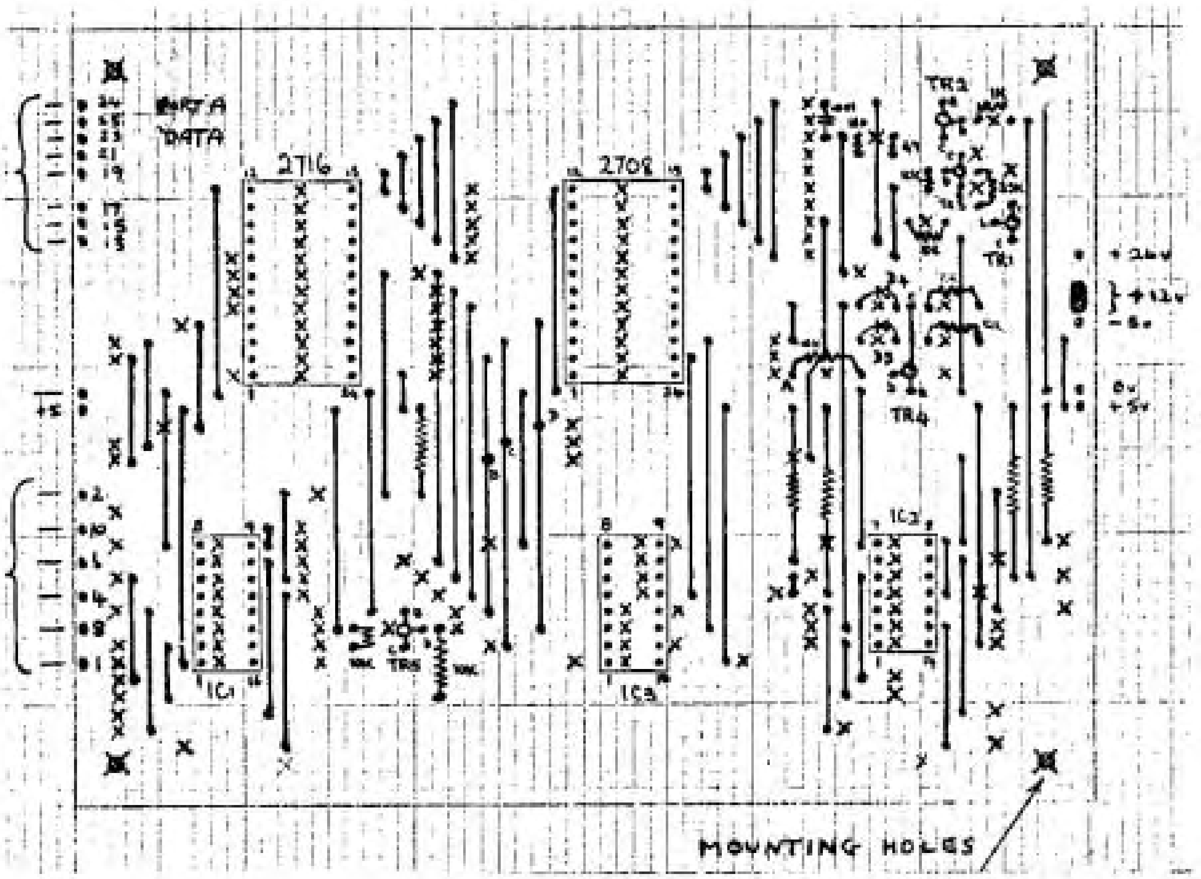

Fig. 2 A SUITABLE VERO BOARD LAYOUT

NOTES: 1) THE LAYOUT IS SHOWN FROM THE COPPER SIDE. ALL COMPONENTS EXCEPT THE LINKS AND 2 DIODES NOTED BELOW ARE MOUNTED ON THE OTHER SIDE OF THE BOARD

2) IF ZERO INSERTION FORCE SOCKETS ARE USED MOUNT ALL LINKS NEAR THEM FIRST AS THEY WILL COVER THE HOLES

3) x SIGNIFIES A TRACK CUT THROUGH, ● IS A SOLDERED CONNECTION, LINES SHOWN AS ●———● ARE TINNED COPPER LINKS, THREE OF WHICH ARE TAPPED PART WAY ALONG THEIR LENGTH (B, C AND D)

4) DECOUPLING CAPACITORS ARE NOT SHOWN, BUT 0.01 TO 0.1 µF ARE RECOMMENDED (1 PER IC)

5) THE FOLLOWING INSULATED WIRE LINKS, MOUNTED ON THE COPPER SIDE OF THE BOARD, ARE NOT SHOWN:

IC1 PIN 15 TO 10KOhm A	IC3 PIN 9 TO 2708 PIN 8
TR5 COLL. TO 2716 PIN 20	IC3 PIN 13 TO 2708 PIN 1
IC3 PIN 15 TO 2716 PIN 19	

CONNECT THE 2708 PINS 1,4,5,6,7,8,9, 10, 11, 22 & 23 TO THE CORRESPONDING PINS ON THE 2716 SOCKET

6) A 1N4148 DIODE IS CONNECTED FROM +5V TO PIN 21, 2716 (CATHODE TO PIN21) AND ANOTHER 1N4148 FROM PIN 21, 2716 TO PIN 18, 2708 (CATHODE TO PIN 21)

```
;
LF              EQU 0AH
CR              EQU 0DH
KBD             EQU 62H
B2HEX           EQU 68H
CRLF            EQU 6AH
TDEL            EQU 5DH                 ; ONE SECOND DELAY
SRLX            EQU 6FH
SCAL            EQU 0DFH
ADATA           EQU 14H
ACTRL           EQU 16H
BDATA           EQU 15H
BCTRL           EQU 17H
HSHAKE          EQU 00H
;
                ASEG
                .Z80
;
                ORG 100H
                .PHASE 0A000H
;
; ------------------------------------------------------------
START:          LD HL, TEXT1            ; TITLE TO TOP LINE
                LD DE, 0BCBH
                LD BC, 10H
                LDIR
                CALL STPIO1             ; PORT A TO I/P, B TO O/P
                CALL RESET1             ; RESET COUNTER, CHIP OFF
                JR RESTR1
;
RESTRT:         CALL CLRCRT             ; RETURN HERE AFTER A ROUTINE
REMOVE          LD HL, TEXT3            ; MESSAGE ON EPROM REMOVAL
                LD HL, 0A0BH
                LD BC, 41H
                LDIR
                LD HL, TXT17A           ; “SAME EPROM - ?”
                LD DE, 0B0BH
                LD BC, 17
                LDIR
ANSWER:         DEFB SCAL, KBD          ; SCAL KEYBOARD FOR REPLY
ANS1:           JR NC, ANSWER
                CP “Y”
                JR Z, PROMPT
                CP “N”
                JR NZ, ANSWER           ; TRY AGAIN IF NOT Y OR N
                JP RESTR2
;
RESTR1:         CALL CLRCRT             ; CAUTION MESSAGES FOR 1ST RUN
                LD HL, TEXT20
                LD DE, 090BH
                LD BC, 34
                LDIR
                LD HL, TEXT21
                LD HL, 098BH
                LD BC, 38
                LDIR
                DEFB SCAL, TDEL         ; WAIT APPROXIMATELY 2 SECONDS
                DEFB SCAL, TDEL
```

```
;
RESTR2:     CALL CLRCRT         ; CLEAR TYPE NUMBER
CLRTYP:     LD B, 16            ; TYPE ADDRESS ON SCREEN
            LD HL, 0BE8H        ; SPACE CHARACTER
            LD A, “ “
CLRT1:      LD (HL), A
            INC HL
            DJNZ CLRT1
KEYC:       LD HL, TEXT3        ; EPROM HANDLING MESSAGE
            LD DE, 0A0BH
            LD BC, 41
            LDIR
            LD HL, TEXT4        ; PROMPT FOR KEY “C”
            LD DE, 0B0BH
            LD BC, 19
            LDIR
SCAN:       DEFB SCAL, KBD      ; GET INPUT
            JR C, SCAN1
            JR SCAN
SCAN1:      CP “C”
            JR NZ, SCAN         ; LOOP UNTIL “C” IS PRESSED
ALLOK:      CALL CLRCRT
            LD HL, TEXT1A       ; “KEY A---FOR 2708”
            LD DE, 090BH
            LD BC, 33
            LDIR
            LD HL, TEXT1B       ; “KEY B--------“
            LD DE, 0991H
            LD BC, 27
            LDIR
KEY:        DEFB SCAL, KBD      ; GET INPUT
            JR C, KEY1
            JR KEY
KEY1:       PUSH AF             ; SAVE KEY
            CALL CLRCRT         ; CLEAR SCREEN
            LD HL, TEXT11       ; “KEY ?-----Y/N”
            LD DE, 090BH
            LD BC, 27
            LDIR
            POP AF
            LD HL, 090FH        ; SCREEN ADDRESS FOR KEY
            LD (HL),A           ; PRINT IT
            EX AF, AF’          ; SAVE IT AGAIN
KEY2:       DEFB SCAL, KBD      ; GET KEY AGAIN
            JR NC, KEY2
            CP “Y”
            JR Z, TYPE
            CP “N”
            JR Z, ALLOK
            JR KEY2             ; TRY AGAIN IF NOT Y OR N
;
TYPE:       EX AF, AF’          ; GET ORIGINAL ENTRY BACK
            CP “A”
            JRZ, TYP1K          ; 1K EPROM
            CP “B”
            JR Z, TYP2K         ; 2K EPROM
            CALL CLRCRT
```

```
TYPERR:     LD HL, TEXT12       ; TYPE ---- A OR B”
            LD DE, 090BH
            LD BC, 29
            LDIR
            DEFB SCAL, TDEL     ; WAIT APPROXIMATELY 2 SECONDS
            DEFB SCAL, TDEL
            JP ALLOK
TYP1K:      LD A, 4             ; FLAG FOR 2708
            LD (ROMFLG), A)
            LD HL, TXT13A       ; TYPE TO TOPLINE
            LD DE, 0BE8H
            LD BC, 16
            LDIR
            JR PROMPT 150:      ; FLAG FOR 2K EPROM
            LD (ROMFLG), A
            LD HL, TXT13B       ; TYPE TO TOPLINE
            LD DE, 0BE8H
            LD BC, 16
            LDIR
;
PROMPT:     CALL CLRCRT
            LD HL, TEXT2        ; PROMPT FOR KEY P----.
            LD DE, 094BH
            LD BC, 25
            LDIR
            LD HL, TEXT2A       ; KEY C----
            LD DE, 09D2H
            LD BC, 1EH
            LDIR
            LD HL, TEXT2B       ; KEY T----
            LD DE, 0AD2H
            LD BC, 1FH
            LDIR
            LD HL, TEXT2C       ; KEY E----
            LD DE, 0AD2H
            LD BC, 20H
            LDIR
            LD HL, TEXT2D       ; KEY D----
            LD DE, 0B52H
            LD BC, 1AH
            LDIR
;
OPTION:     XOR A               ; WHICH ROUTINE
            DEFB SCAL, KBD      ; SEE IF KEY PRESSED
            JR C, WHICH         ; IF SO, JUMP TO WHICH
            JR OPTION           ; ELSE KEEP LOOKING FOR KEY
WHICH:      EX AF, AF’          ; SAVE KEY
            CALL CLRCRT
            LD HL, TEXT11       ; KEY ? ---Y/N?
            LD DE, 090BH
            LD BC, 27
            LDIR
            LD HL, 090FH        ; SCREEN ADDRESS
            EX AF, AF’          ; RECOVER A
            LD (HL), A          ; PRINT IT
            EX AF, AF’          ; RESAVE IT
WH1:        DEFB SCAL, KBD
            JR NC, WH1
```

```
                CP “Y”
                JR Z, WH2
                CP “N”
                JR NZ, WH1          ; TRTY AGAIN IF NOT Y OR
                JR PROMPT           ; REPROMPT IF “N”
WH2:            CALL CLRCRT         ; CLEAR SCREEN
                EX AF, AF’
                CP “P”              ; WAS IT A “P”?
                JR Z, PROGRM        ; IF SO, GO TO PROGRAM
                CP “C”              ; WAS IT A “C”?
                JR Z, CMPARE        ; IF SO, GO TO COMPARE
                CP “T”              ; WAS IT A “T”?
                JR Z, TRNFER        ; IF SO, GO TO TRANSFER
                CP “E”              ; WAS IT AN “E”?
                JR Z, ERASED        ; IF SO, TEST FOR ERASURE
                CP “D”              ; WAS IT A “D”?
                JR Z, OUTPUT        ; IF SO, GO TO DUMP ROUTINE
                JR OPTION           ; INVALID ENTRY, TRY AGAIN
; ******************************
; *    ROUTINE TO PROGRAM EPROM      *
; ******************************
PROGRM:         LD HL, TEXT17       ; “COPIED INTO EPROM”
                LD DE, 0A4BH
                LD BC, 11H
                LDIR
                CALL RAMADR         ; GET START ADDRESS
SETPIO:         CALL STPIO3         ; PORT A LINES TO O/P
                LD A, (ROMFLG)      ; 1K OR 2K EPROM?
                CP 8
                JR Z, PR2716        ; JUMP IF 2716
                LD B, 68H           ; NUMBER OF CYCLES TO COUNT
PROGR1:         PUSH BC             ; SAVE CYCLES COUNT
                CALL RESET          ; RESET COUNTER, SET 12V AND WE
                LD DE, 0            ; CLEAR COUNTER
                LD HL, (STOR1)      ; GET START ADDRESS
PROGR2:         LD A, (ROMFLG)      ; FLAG EQUALS 4 FOR 2708
                CP D                ; IS D 4?
                JR Z, PROGR3        ; IF SO, JUMP TO PROGR3
                LD A, (HL)          ; ELSE GET BYTE AND
                OUT (ADATA), A      ; SEND IT TO THE EPROM
                LD B, 10H           ; SHORT DELAY TO ALLOW
HOLD:           DJNZ HOLD           ; DATA TO STABILISE
                LD A, 23H           ; OUTPUT CONTROLS TO PUT
                OUT (BDATA), A      ; 12V AND 26V ON EPROM
                LD B, OEH
DELAY1:         NOP                 ; KEEP 26V ON FOR 1 mS
                DJNZ DELAY1
                LD A, 22H           ; NOW SWITCH 26v OFF
                OUT (BDATA), A      ; BUT KEEP 12V ON
                LD B, 10H           ; SHORT DELAY
HOLD1:          DJNZ HOLD1
                LD A, 26H           ; HOLD 12V AND INCREMENT
:               OUT (BDATA), A      ; ADDRESS COUNTER
                LD B, 10H           ; SHORT DELAY
HOLD2:          DJNZ HOLD2
                LD A, 22H           ; 12V ONLY
                OUT (BDATA), A
                INC HL                  ; POINT TO NEXT BYTE
                INC DE                  ; INCREMENT BYTE COUNT
                JR PROGR2               ; BACK, SEE IF 1K DONE
PROGR3:         POP BC                  ; 1K DONE, GET CYCLES
                LD A, B                 ; PRINT CYCLES LEFT
                DEC A                   ; ADJUST COUNT
                DEFB SCAL, B2HEX        ; PUT ON SCREEN
                DJNZ PROG1              ; IF NOT 104, GO TO PROGR1
PROGR4:         CALL STPIO2             ; PORT A TO I/P
                CALL RESET1             ; 12V OFF, 5V ENABLED, CHIPS OFF
                DEFB SCAL, TDEL         ; TWO SECONDS DELAY
                DEFB SCAL, TDEL
                CALL MESS19
                JP RESTRT               ; BACK TO START
;
; * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
; *     ROUTINE FOR 2516/2716 EPROMS           *
; * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
;
PR2716:         LD DE, 0                ; BYTE COUNTER
                JR PRINTD
PR27A:          LD A, (ROMFLG)          ; FLAG EQUALS 8 FOR 2K ROM
                CP D                    ; 800H BYTES DONE?
                JR Z, PROGR4            ; IF SO, EXIT VIA PROGR4
                LD A, 3                 ;TURN ON 26V AND OE
                OUT (BDATA), A
                LD B, 10H               ; SHORT DELAY
WAIT:           DJNZ WAIT
                LD A, (HL)              ; DATA
                OUT (ADATA), A
                LD B, 10H
WAIT1:          DJNZ WAIT1              ; SHORT DELAY
                LD A, 13H
                OUT (ADATA), A          ; TURN ON 26V, OE, PGM
                LD BC, 1D00H            ; COUNT FOR 50 mSEC.
PR27C:          DEC BC
                LD A, B
                OR C
                JR NZ, PR27C
                LD A, 3                 ; PGM PULSE OFF
                OUT (BDATA) ,A
                LD B, 10H WAIT2
WAIT2:          DJNZ WAIT2              ; SHORT DELAY
                LD A, 1
                OUT (BDATA), 1          ; TURN OE OFF
                LD B, 10H
WAIT3:          DJNZ WAIT3              ; SHORT DELAY
                LD A, 5
                OUT (BDATA), A          ; 26V, INCREMENT COUNTER
                LD B, 10H
WAIT4:          DJNZ WAIT4              ; SHORT DELAY
                LD A, 1
                OUT (BDATA), A          ; INCREMENT PULSE OFF
                INC HL
                INC DE
                LD A, E
                CP 0
```

```
309:                 JR Z, PRINTD
310:                 JP PR27A
311:  PRINTD:        LD A, D
312:                 DEFB SCAL, B2HEX      ; O/P COUNT TO SCREEN
313:                 DEFB SCAL, CRLF
314:                 JP PR27A
315:  ;
316:  ;************************************
317:  ; *   ROUTINE TO COMPARE EPROM/1K BLOCK   *
318:  ;************************************
319:  CMPARE:        LD HL, TEXT8          ; “COMPARED TO EPROM
320:                 LD DE, 0A4BH
321:                 LD BC, 11H
322:                 LDIR
323:                 LD A, 0
324:                 LD (ERRFLG), A        ; SET ERROR FLAG
325:                 CALL RAMADR           ; GET START ADDRESS
326:                 LD DE, 0              ; CLEAR BYTE COUNTER
327:  VERFY2:        LD A, (ROMFLG)
328:                 CP D                  ; ALL DONE?
329:                 JR Z, VERFY4          ; IF SO, JUMP TO VERFY4
330:                 CALL ENABLE           ; TRUN ON CHIP
331:                 IN A, (ADATA)         ; GET BYTE FROM EPROM
332:                 PUSH AF               ; SAVE IT
333:                 CALL COUNT            ; INCREMENT ADDRESS, CHIP OFF
334:                 POP AF;               ; GET BYTE BACK
335:                 CP (HL)               ; ARE THEY THE SAME?
336:                 JR NZ, ERROR          ; IF ERROR, PRINT IT
337:  VERFY3:        INC HL                ; NEXT BYTE TO COMPARE
338:                 INC DE                ; INCREMENT BYTE COUNTER
339:                 JR VERFY2
340:  ERROR:         LD A, 0FFH            ; ERROR FLAG
341:                 LD (ERRFLG), A
342:                 LD A, H               ; PRINT ERROR ADDRESS
343:                 DEFB SCAL, B2HEX
344:                 LD A, L
345:                 DEFB SCAL, B2HEX
346:  ;              DEFB SCAL. TDEL       ; OPTIONAL DELAY
347:  ; IF DELAY REQUIRED, REMOVE FIRST COLON ON ABOVE LINE
348:                 DEFB SCAL, CRLF       ; SCROLL DISPLAY
349:                 JR VERFY3             ; NEXT BYTE
```

The remainder of the listing will be published in the next issue. If you don’t wish to wait that long, or you can’t be bothered to type it all in – after all the source code is 18K long – I will provide copies of the source and object codes. Just send me a cassette, or a disc with approximately 26K free, and £1 to cover copying and postage. Source can be supplied in Zeap compatible form or Macro 80 form. Please state which you require. Also please state the disc format required; I can supply single or double density to suit either CP/M or Polydos, for Nascom/Gemini G805/G809

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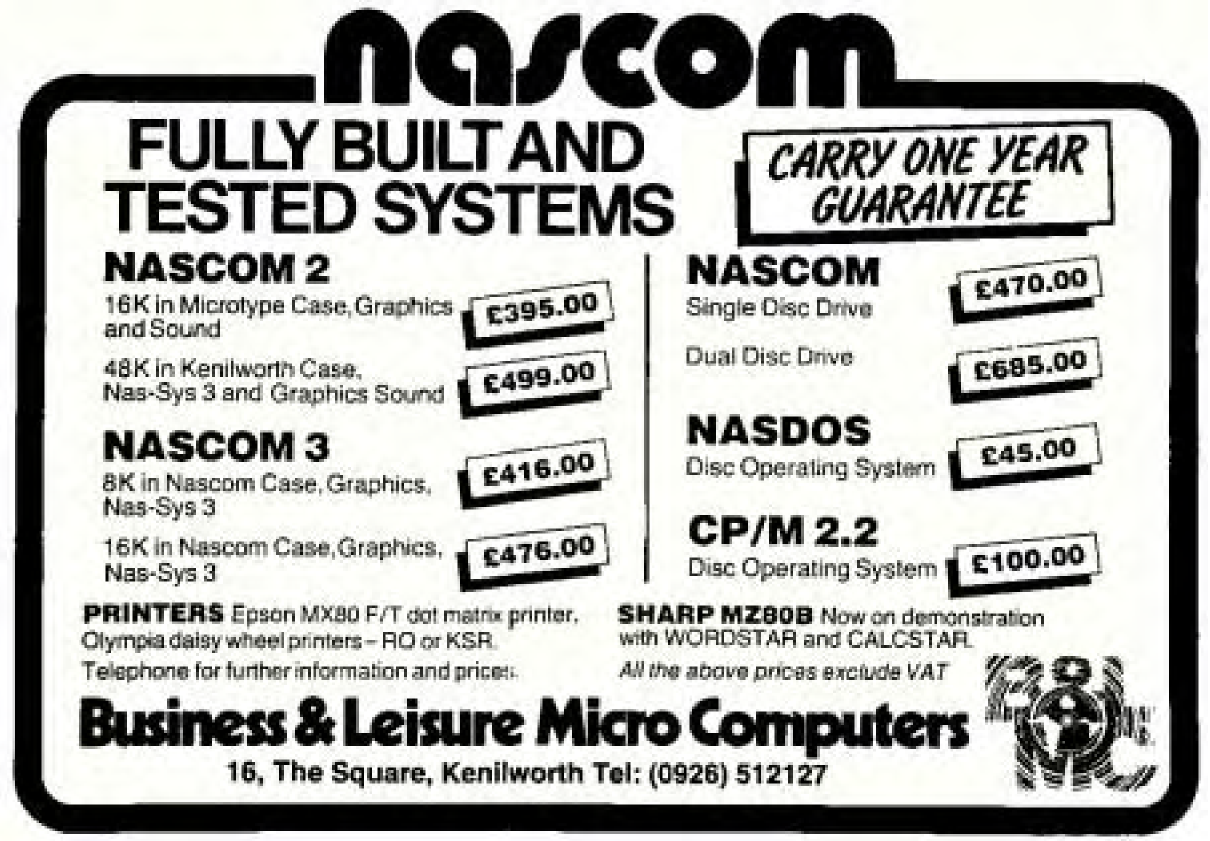

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LETTERS

Dear Sir,

Re the "Nascom 1 Keyboard Upgrade", an interesting article currently under construction, readers may be interested to know that Licon Keys (the later angled variety) are available from Target Electronics, 16, Cherry Lane, Bristol, BS1 3NG. Prices in December 1981 were; Keyswitch 65p each., Keytop 17p each.

My only criticism of the magazine "so far" is that the density of the type varies considerably, some is difficult to read.

On expanding my Nascom 1 to include a 64K RAM card, EPROM expansion card with 8K Basic running under Nasbug T4 I encountered a hardware problem. Executing FOR loops with large values, i.e., greater than 1000, produced "crashes"; Basic programs occasionally jump to machine code, and vice versa. After considerable difficulty I tried connecting a thick lead (20 A current capability) directly from the Z80 earth pin to 0 V on the Buffer board. To date this has cured all programming problems.

P. E. Acton, Leicester

Dear Sir,

In the program "Rings of Hanoi" on p. 31 of the December issue of Micropower, I think the followinq corrections are needed:-

```
220 A (I, 0) = I:A(I ,1) = 0: A (I, 2)=0
290 SCREEN 1,1: PRINT : SCREEN 6,15
400  GOSUB  920: SCREEN  2,2:PRINT: SCREEN 2,2: PRINT   "MOVE
FROM";
410 INPUT IN$
420 GOSUB 1300:TF=IN:IF TF < 0 THEN 400
440 SCREEN 1,1:PRINT:SCREEN1,1
470 GOSUB 920:SCREEN 2,2:PRINT: SCREEN 2,2: PRINT "TO PILE";
```

F. Johnson, Stockport

Dear Sir,

The content of Micropower is quite good and the technical level is about right, I think the hardware/software mix is probably O.K., although I would personally like to see more programs in each issue.

I have managed to make the "Snowdinger" mod work at 2 Mhz and 4 Mhz, although I have had to delay the WAIT signal by two gate propagations in order to get the system to operate at 2 Mhz. The improvement in screen quality is excellent.

The dual monitor (2716 for 2708s) was nearly correct, though it is not permissible to wire ‘or’ the two outputs of a 74LS139 - it is necessary to combine the signals correctly by using, for example, a 7402.

D. R. Piercy, Wareham

Dear Editor,

The contents of the magazine seem quite well balanced - there must be something in each issue of interest to every Nascom user. I would like to see some explanation of essential parts of programmes, i.e. brief notes on those parts of software on which the operation depends. For example, a note on how the high-res graph plotting software works would have been interesting. I would be particularly interested in articles on fault finding techniques for or with the Nascom. If anyone knows of a cheap and reliable MODEM design then the details would be most welcome.

The Lincoln computer club now meets on the 1st and 3rd Wednesday of each month at the Hare and Hounds, 330, High Street, Lincoln, starting at 19.30. Further details from:

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THE EXTERNAL COMMAND X xx

When this command is executed, the low byte of the argument after the X is stored at £0C28, and the pointers to the input and output command tables at £0C75 and £0C73 are reset. Input now scans a routine called XKBD (SCAL £74) and then scans the 'normal' Nascom keyboard routine, which in the case of Nas-Sys 1 is SCAL £61 while Nas-Sys 3 uses the Repeat Keyboard routine SCAL £7D. Output sends data to an external output routine XOUT (SCAL £6E), then to the user output (SCAL £75) and finally to the CRT (SCAL £65).

The external keyboard routine scans the serial input port. If no input is received it returns from this routine and scans the Nascom keyboard in the normal way – any options set under the X command have no effect on the Nascom keyboard, so to the user the operation of the system is unchanged.

If an input is received from the serial input port, bit 7 of the input byte is first set to zero. This is done because many systems use the most significant bit for parity checking to eliminate errors; the number of ones in the lower seven bits is counted and the value of bit 7 is then adjusted so that the number of ones in the byte is either always even (even parity) or always odd (guess what that's called). The Nascom may have to communicate with systems which use either (or no) system of parity checking, and it does this the easy way by merely stripping off the parity bit and ignoring it,

The value of the byte entered as argument to the X command is now used to control various options available, If bit 5 of the byte was zero, the input routine ' echos' each byte received from the external keyboard, that is, it transmits it back to the sender through the serial port; if bit 5 is set, echo is suppressed. Nas-Sys 3 also tests bit 1 of the option byte; if this bit is zero, any echo of an input byte by the user program is suppressed. This is done by using bit 7 of the option byte as a "suppression flag". The flag is tested on output to determine whether to transmit a byte or not, and is then reset. Nas-Sys 1 does not use bit 1 of the option byte

The external output routine tests the parity of the byte to be transmitted; if it is odd it inverts bit 7. Bit 0 of the option byte is now tested; if bit 0 is set, this tells the Nascom to transmit in ' odd parity' format, so it re-inverts bit 7. The byte is now sent out through the serial port. Although you can ignore the parity of the received data, you will usually be communicating with a device which tests parity and must therefore conform to its requirements.

For the same reason, a line feed (code £0A) is output after a carriage return (£0D), as most systems need both signals; however, the line feed can be suppressed by setting bit 4 of the option byte. The Nas-Sys 1 external output routine ignores nulls, but Nas-Sys 3 has been modified so that nulls are output correctly.

The many options available make this a very powerful command. Because the user output routine is automatically brought into operation when the X command is invoked, you can have a parallel printer on line in addition to the Nascom keyboard and an ASCII terminal (for example, a teletype keyboard and printer). Of course, you must set up the user output routine by storing the address at £0C78 in the usual way.

YJUMP Y

In Nas-Sys 1, Y produces an error message - the address in the subroutine table is £030A. Nas-Sys 3 uses Y to jump to £B000; this will normally be used to access software in an EPROM at this address, such as the Basic "Programmer' s Aid' or an entesion to the monitor. I have the initialisation routine for my printer here, so that Y configures the PIO ports, clears the print buffer and resets the printer options.

ZJUMP Z

This command is normally used to ' warm sta'rt the Microsoft Basic at £FFFD. 0f course, if you haven' t got the Basic in ROM you can use the command to access other software by changing the address stored for the Z command. I use it to access Zeap, using Z for a warm start and ZC for a cold start. Because C is a valid hexadecimal number, you can use it as an argument to a command. The software at the start of the command tests the value in the L register; if it is £0C, it does a jump to the cold start address, otherwise it does a warm start. This has two advantages. Firstly, it gives you two commands for the price of one - when you start modifying your software you soon run out of command letters. Secondly, it reduces the chance of performing a cold start when you meant a warm start; it still happens, but not as often. There always seems to be room in the software you are accessing for the extra code needed to test the value of ARG1.

However, there is a snag. I tried the same ystem for Basic, using J for a warm and JC for a cold start. I then found that I couldn' t RUN programs that appeared to CLOAD correctly. On LISTing garbage was displayed. The reason was that the argument C was used as an offset in the Nas-Sys 3. READ routine used by CLOAD - the program was being read in to an address twelve bytes higher than the correct address.

The solution is simple - after testing the argument the routine should reset ARG1 to zero. Alternatively, you can POKE the value to zero from Basic.

That brings us to the end of the Nas-Sys commands, but there are many more addresses in the subroutine call table - 34 in Nas-Sys 1 and 37 in Nas-Sys 3. These SCALs cannot be accessed directly from the keyboard like the command letters. Many of them correspond to lower case letters, but if you try to enter them as commands you will just get an error message, because the routine which accepts commands test the input character to see if it lies in the range A - Z. Of course they are there to be used in programs.

SCAL MRET DF 5B

This is the normal way to return to the monitor from a program. The routine resets the monitor and user stacks, prints the monitor message (-- NAS-SYS 3 --, or whatever you have substituted) on the screen, restores the byte replaced by any breakpoint that has been set, and then waits for an input. The screen is not cleared, and the monitor message will appear at whatever point the cursor was left by the program - for tidyness you should shift the cursor to the left of the screen by a carriage return if it has been moved. If you want to clear the screen on return to the monitor you can use RST 0 (£C7); this will re-initialise the workspace and clear the screen before jumping to MRET.

SCAL SCALJ DF 5C

This enables you to access any Nas-Sys subroutine by storing the subroutine ' number' at ARGC (£0C0A). The routine saves the HL, AF and DE registers, picks up the routine number from ARGC, and then jumps to section of code in the subroutine call restart where the call address is calculated from the subroutine number. Of course, any requirements of the normal call must be met if a subroutine is accessed ‘indirectly’ by SCALJ; for example, to call the READ command via SCALJ you would have to store £52 ("R") at £0C0A, but you would also have to place £52 at £0C2B, or the routine would only ' verify' the tape.

SCAL TDEL DF 5D

This routine calls the ‘delay’ £FF restart, RDEL (RST £38, £FF) 512 times. As each RDEL takes rate 2.7 msec. with a clock rate of 4 Mhz, the total delay in TDEL is 1.38 seconds. Obviously, at 2 Mhz the above times are doubled. Registers A and B are both set to zero on return from this routine.

JCAL FFLP DF 5E

This routine sets and then resets output lines in port 0. On entering the routine the accumulator must have the bits corresponding to the lines to be changed set to one. This data is exclusive ORed with the byte at £0C00, which maps the current state of port 0, so that only the selected bits are changed, and output to port 0. The original state of port 0 is then recovered from £0C00 and output to port 0.

SCAL MFLP DF 5F

This routine changes the state of the tape LED, which is controlled by bit 4 of port 0. The LED gives an indication that loading or saving of tape data is proceeding, but if a small relay is connected to the output which drives the LED the signal can be more usefully employed to switch the cassette motor on and off through the ' remote' socket. If you don' t use the signal to control a tape motor, and alternative use is to produce "music' by connecting the LED output to a small 80 Ohm speaker. Notes can be produced by flipping bit 4 at different rates. However, there are two spare output lines on port 0, bits 2 and 5, and you can use these to produce sounds by simply adding a simple buffer and loudspeaker. These bits can be flipped by setting the required bit in the accumulator and doing a direct call to £0053 (CD 53 00). Now you are not supposed to use direct calls to Nas-Sys - the whole idea of the subroutine call system is that if changes are made to the monitor software using the monitor does not need to be changed because it does not use absolute addresses. However, providing you realise the full implications of what you are doing, there is no reason why you shouldn' t use a direct call this once. The alternative is to write a short piece of machine code to change the necessary bits of port 0.

SCAL ARGS DF 60

This routine loads the contents of the ARG!, ARG2 and ARG3 (£0C0C, £0C0E, £0C10) into HL, DE and BC. As noted previously, when a program is entered by the Execute command, the contents of HL, DE and BC are picked up from the Register save area in the monitor workspace, and so you cannot pass arguments entered under E directly to a program, you must recover the values atored at ARG1 – ARG3, and this can most easily be done by means of SCAL ARGS,

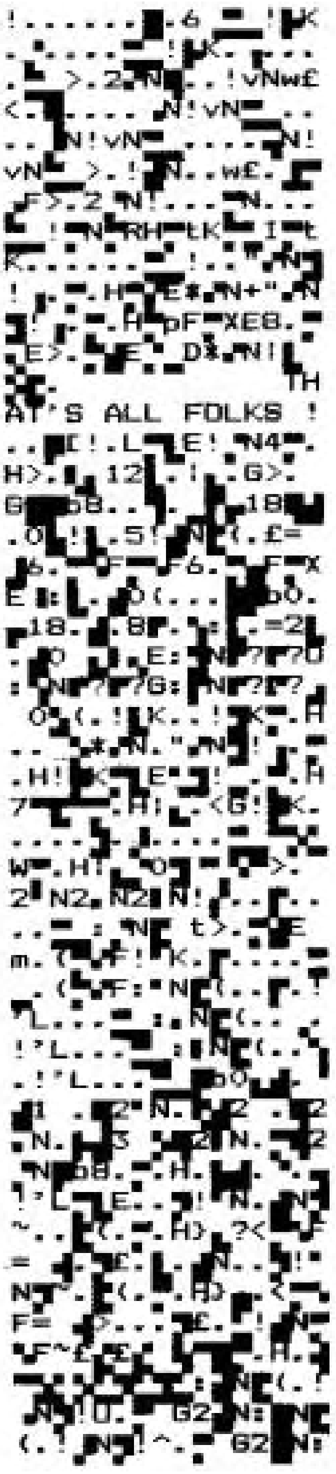
In the next article, I shall continue with the subroutine calls, starting with keyboard calls, DF 61 and DF 62

FRUIT MACHINE

By S. C. Allen

This is a machine code ‘One Armed Bandit’ simulation, which runs under Nas-Sys 1 or Nas-Sys 3 and uses the standard pixel set to draw the symbols on the reels. To start the game enter E4400; after you have read the brief instructions, press ‘Return’ to play. The game ends when you have lost all your money – unfortunately it doesn’t pay out when you win.

```
4400  21 00 08 11 01 08 01 FF 03 36 A0 ED B0 21 D7 4B
4410  11 CC 0A 01 08 00 ED B0 21 D7 4B 11 F0 0A 01 08
4420  00 ED B0 3E 02 32 86 4E AF 06 10 21 76 4E 77 23
4430  3C 10 FB 01 12 00 11 88 4E 21 76 4E ED B0 01 12
4440  00 11 9A 4E 21 76 4E ED B0 01 12 00 11 AC 4E 21
4450  76 4E ED B0 3E 01 21 BE 4E 06 06 77 23 10 FC CD
4460  98 46 3E 01 32 CC 4E 21 00 08 11 CD 4E 01 00 04
4470  ED B0 21 CD 4E CD 52 48 CD 74 4B CD E5 49 CD 74
4480  4B 11 00 08 01 00 04 ED B0 21 0A 00 22 CA 4E FD
4490  21 F0 0B CD 1D 48 CD CE 45 2A CA 4E 2B 22 CA 4E
44A0  FD 21 F0 0B CD 1D 48 CD 70 46 CD 58 45 38 0B CD
44B0  A4 45 3E 06 CD BE 45 CC E4 44 2A CA 4E 7C B5 20
44C0  D5 EF 0C 20 20 20 20 20 20 20 20 20 20 20 54 48
44D0  41 54 27 53 20 41 4C 4C 20 46 4F 4C 4B 53 20 21
44E0  0D 00 DF 5B 21 1B 4C CD B5 45 21 CC 4E 34 CD 05
44F0  48 3E 07 A5 C6 31 32 E7 0B 7C E6 0F 47 3E 10 80
4500  47 FF DF 62 38 04 10 F9 18 E4 CF D6 31 38 FB FE
4510  03 30 F7 21 E7 0B 35 21 BE 4E B7 28 04 23 3D 20
4520  FC 36 01 CD D1 46 CD D1 46 36 02 CD BC 46 CD 58
4530  45 D8 3A E7 0B FE 30 28 1C 06 00 FF DF 62 30 08
4540  D6 31 38 04 FE 03 38 CB 10 F1 3A E7 0B 3D 32 E7
4550  0B FE 30 20 E6 C3 A4 45 3A BB 4E CB 3F CB 3F 4F
4560  3A A9 4E CB 3F CB 3F 47 3A 97 4E CB 3F CB 3F B8
4570  20 30 B9 28 05 21 B5 4B 18 03 21 BB 4B CD 14 48
4580  16 00 5F D5 2A CA 4E 19 22 CA 4E FD 21 F0 0B CD
4590  1D 48 21 DF 4B CD B5 45 E1 FD 21 E4 0B CD 1D 48
45A0  37 C9 B7 C9 CD 05 48 7C E6 03 3C 47 21 DF 4B 11
45B0  0C 00 19 10 FD 11 DC 0B 01 0C 00 ED B0 C9 D5 E5
45C0  57 CD 05 48 7C E6 7F 92 30 FD 82 E1 D1 C9 3E 01
45D0  32 C1 4E 32 C2 4E 32 C3 4E 21 96 0B 11 97 0B 01
45E0  16 00 ED B0 3A CC 4E B7 20 74 3E 06 CD BE 45 20
45F0  6D 06 28 CD CA 46 21 C1 4B 11 97 0B 01 16 00 ED
4600  B0 06 28 CD CA 46 3A C1 4E B7 28 0B 11 97 0B 21
4610  27 4C 01 04 00 ED B0 3A C2 4E B7 28 0B 11 A0 0B
4620  21 27 4C 01 04 00 ED B0 3A C3 4E B7 28 0B 11 A9
4630  0B 21 27 4C 01 04 00 ED B0 DF 62 30 B4 FE 0D C8
4640  FE 31 20 06 AF 32 C1 4E 18 A7 FE 32 20 06 AF 32
4650  C2 4E 18 9D FE 33 20 99 AF 32 C3 4E 18 93 AF 32
4660  CC 4E DF 62 38 05 CD 05 48 18 F7 FE 0D C8 18 F2
4670  21 27 4C CD B5 45 06 03 DD 21 C1 4E 11 BE 4E DD
4680  7E 00 12 B7 28 06 CD 05 48 7D E6 3F 3C CD D1 46
4690  3D 20 FA 13 DD 23 10 E7 11 BE 4E 06 03 DD 21 C1
46A0  4E DD 7E 00 B7 28 10 CD 05 48 7D F6 0F 3C CD D1
46B0  46 3D 20 FA 3E 02 12 13 DD 23 10 E5 21 BE 4E CD
46C0  D1 46 7E 23 B6 23 B6 20 F3 C9 FF CD 05 48 10 FA
46D0  C9 F5 C5 D5 E5 DD E5 FD E5 3A BE 4E B7 28 0D 21
46E0  88 4E DD 21 55 08 CD 20 47 32 BE 4E 3A BF 4E B7
46F0  28 0D 21 9A 4E DD 21 5E 08 CD 20 47 32 BF 4E 3A
```



```
4700  C0 4E B7 28 0D 21 AC 4E  DD 21 67 08 CD 20 47 32
4710  C0 4E 06 06 CD CA 46 FD  E1 DD E1 E1 D1 C1 F1 C9
4720  E5 11 76 4E 01 12 00 ED  B0 32 87 4E FD 21 7A 4E
4730  0E 0C FD 7E 00 E6 1C CB  3F 47 CB 3F 80 47 3A 86
4740  4E 80 87 87 47 FD 7E 00  E6 03 80 11 00 00 5F CB
4750  23 CB 12 CB 23 CB 12 CB  23 CB 12 21 33 4C 19 06
4760  08 7E DD 77 00 23 DD 23  10 F7 11 38 00 DD 19 FD
4770  23 0D 28 09 FD 7E 00 E6  03 28 B7 18 E2 3A 87 4E
4780  FE 02 20 1A 3A 86 4E FE  02 20 13 3A 7A 4E E6 03
4790  20 0C 3E 04 32 87 4E 3E  08 32 75 4E 18 5A 3A 87
47A0  4E FE 04 20 17 3A 75 4E  3D 32 75 4E 20 05 32 87
47B0  4E 18 45 FE 01 20 41 32  86 4E 18 3C 3A 86 4E 3C
47C0  32 86 4E FE 03 20 31 AF  32 86 4E 21 84 4E 11 85
47D0  4E 01 0F 00 ED B8 3E FF  32 76 4E 3A 79 4E FE FF
47E0  20 16 CD 05 48 7C E6 0F  21 A5 4B CD 14 48 21 76
47F0  4E 06 04 77 3C 23 10 FB  01 12 00 D1 21 76 4E ED
4800  B0 3A 87 4E C9 2A 73 4E  F5 C5 45 0E 29 09 22 73
4810  4E C1 F1 C9 3C 3D 28 03  23 18 FA 7E C9 DD 21 9F
4820  4B 3E 2F DD 4E 00 DD 46  01 C6 01 ED 42 F2 29 48
4830  09 FD 77 00 FD 23 DD 23  DD 23 0D 20 E4 FD 36 00
4840  30 06 03 FD 7E FD FE 30  C0 FD 36 FD 20 FD 23 10
4850  F2 C9 EF 0C 20 2A 2A 20  46 52 55 49 54 20 4D 41
4860  43 48 49 4E 45 20 2A 2A  20 28 43 6F 70 79 72 69
4870  67 68 74 20 53 2E 43 2E  41 6C 6C 65 6E 20 31 39
4880  38 31 29 0D 0D 20 20 20  59 6F 75 20 68 61 76 65
4890  20 61 6E 20 69 6E 69 74  69 61 6C 20 73 74 61 6B
48A0  65 20 6F 66 20 31 30 30  70 2E 0D 20 20 20 20 20
48B0  20 54 68 65 20 63 6F 73  74 20 6F 66 20 65 61 63
48C0  68 20 67 6F 20 69 73 20  20 31 30 70 2E 0D 0D 20
48D0  20 20 20 20 20 20 20 20  20 20 20 20 20 20 20 57
48D0  49 4E 4E 49 4E 47 53 0D  20 20 20 53 79 6D 62 6F
48F0  6C 20 20 20 20 20 20 20  31 73 74 20 26 20 32 6E
4900  64 20 20 20 20 20 41 6C  6C 20 33 0D 20 20 20 20
4910  42 41 52 20 20 20 20 20  20 20 20 20 20 20 20 32
4920  30 70 20 20 20 20 20 20  20 20 20 20 33 30 70 0D
4930  20 20 20 20 42 45 4C 4C  20 20 20 20 20 20 20 20
4940  20 20 20 32 30 70 20 20  20 20 20 20 20 20 20 20
4950  33 30 70 0D 20 20 20 44  4F 4C 4C 41 52 20 20 20
4960  20 20 20 20 20 20 20 33  30 70 20 20 20 20 20 20
4970  20 20 20 20 38 30 70 0D  20 20 20 50 4F 55 4E 44
4980  20 20 20 20 20 20 20 20  20 20 20 33 30 70 20 20
4990  20 20 20 20 20 20 20 20  38 30 70 0D 20 20 43 48
49A0  45 56 52 4F 4E 20 20 20  20 20 20 20 20 20 20 34
49B0  30 70 20 20 20 20 20 20  20 20 20 31 35 30 70 0D
49C0  20 20 20 20 46 41 43 45  20 20 20 20 20 20 20 20
49D0  20 20 31 30 30 70 20 20  20 20 20 20 20 20 20 35
49E0  30 30 70 00 C9 EF 0C 20  20 20 20 20 20 20 20 20
49F0  20 20 20 20 20 20 20 2A  20 20 48 4F 4C 44 20 20
4A00  2A 0D 0D 20 20 20 20 57  68 65 6E 20 48 4F 4C 44
4A10  20 66 6C 61 73 68 65 73  20 72 65 65 6C 73 20 63
4A20  61 6E 20 62 65 20 68 65  6C 64 20 62 79 0D 20 20
4A30  20 20 70 72 65 73 73 69  6E 67 20 6B 65 79 73 20
4A40  31 2C 32 20 61 6E 64 20  33 2E 57 68 65 6E 20 68
4A50  65 6C 64 20 48 4F 4C 44  0D 20 20 20 20 20 20 20
4A60  20 20 20 20 20 20 20 20  63 65 61 73 65 73 20 74
4A70  6F 20 66 6C 61 73 68 2E  0D 0D 20 20 20 20 20 20
4A80  20 20 20 20 20 20 20 20  20 20 2A 20 20 4E 55 44
4A90  47 45 20 20 2A 0D 0D 57  68 65 6E 20 20 4E 55 44
4AA0  47 45 20 20 69 73 20 61  6E 6E 6F 75 6E 63 65 64
4AB0  20 2C 20 70 72 65 73 73  20 61 6E 79 20 20 6B 65
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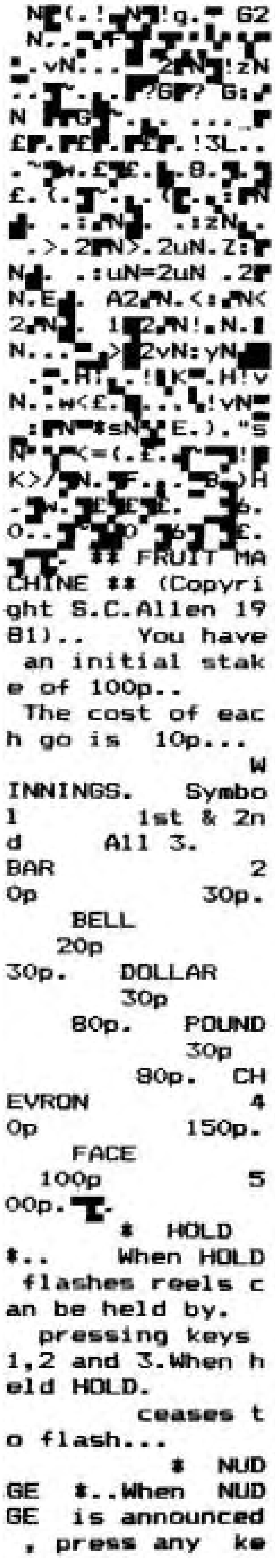

```
    ** FRUIT MA
CHINE ** (Copyri
ght S.C.Allen 19
81)..    You have
 an initial stak
e of 100p..
 The cost of eac
h go is  10p...
               W
INNINGS.   Symbo
l       1st & 2n
d     All 3.
BAR            2
0p          30p.
    BELL
   20p
30p.   DOLLAR
       30p
    80p.   POUND
           30p
        80p.  CH
EVRON          4
0p          150p.
    FACE
  100p         5
00p.
       *  HOLD
*..    When HOLD
 flashes reels c
an be held by.
  pressing keys
1,2 and 3.When h
eld HOLD.
        ceases t
o flash...
          *  NUD
GE  *..When  NUD
GE  is announced
 , press any  ke
```

```
4AC0 79 20 20 74 6F 0D 73 74 6F  70 20 20 74 68 65 20
4AD0 20 6E 75 64 67 65 20 20 63  6F 75 6E 74 20 2E 20
4AE0 55 73 65 20 6B 65 79 73 20  31 20 2C 20 32 20 61
4AF0 6E 64 20 33 0D 74 6F 20 6E  75 64 67 65 20 72 65
4B00 65 6C 73 20 64 6F 77 6E 20  2E 20 4F 6E 63 65 20
4B10 73 74 61 72 74 65 64 20 6E  75 64 67 65 73 20 77
4B20 69 6C 6C 0D 61 75 74 6F 6D  61 74 69 63 61 6C 6C
4B30 79 20 63 6F 75 6E 74 20 64  6F 77 6E 20 74 6F 20
4B40 30 2E 20 54 6F 20 6E 75 64  67 65 20 61 20 72 65
4B50 65 6C 0D 6D 6F 72 65 20 74  68 61 6E 20 6F 6E 63
4B60 65 20 70 72 65 73 73 20 6B  65 79 20 61 67 61 69
4B70 6E 2E 00 C9 EF 0D 20 20 20  20 20 20 20 20 20 20
4B80 50 72 65 73 73 20 27 43 27  20 74 6F 20 63 6F 6E
4B90 74 69 6E 75 65 2E 2E 2E 00  CF FE 43 20 FB C9 64
4BA0 00 0A 00 01 00 00 04 08 08  0C 0C 0C 10 10 10 10
4BB0 04 14 14 14 14 0A 04 03 03  02 02 32 0F 08 08 04
4BC0 04 48 4F 4C 44 20 20 20 20  20 48 4F 4C 44 20 20
4BD0 20 20 20 48 4F 4C 44 57 49  4E 20 4C 49 4E 45 59
4BE0 4F 55 20 57 49 4E 20 20 20  20 30 20 20 59 4F 55
4BF0 20 4C 4F 53 45 20 20 20 20  55 4E 4C 55 43 4B 59
4C00 20 20 20 20 20 20 4E 45 41  52 4C 59 20 20 20 57
4C10 48 41 54 20 41 20 50 49 54  59 20 20 20 20 4E 55
4C20 44 47 45 20 20 20 20 20 20  20 20 20 20 20 20 20
4C30 20 20 20 C0 C0 E0 F6 F6 C4  C0 C0 C0 F0 FF FE F7
4C40 FF C6 C0 C0 C0 D9 F6 F6 CB  C0 C0 C0 C0 C0 C0 C0
4C50 C0 C0 C0 C0 C0 C0 E4 E4 C0  C0 C0 C0 E0 FE FD EF
4C60 F7 C4 C0 C0 C8 FB ED ED DF  C1 C0 C0 C0 C0 C9 C9
4C70 C0 C0 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 C0 F4 FB DF
4C80 E6 C0 C0 C0 D8 FF DB DB FF  C3 C0 C0 C0 C8 DB DB
4C90 C1 C0 C0 C0 C0 C0 D4 E2 C0  C0 C0 C0 E0 CA E0 C4
4CA0 D1 C4 C0 C0 C0 D4 C1 C8 E2  C0 C0 C0 C8 C0 C0 C0
4CB0 C0 C1 C0 C0 C0 C0 E0 C4 C0  C0 C0 C0 C0 D4 C1 C8
4CC0 E2 C0 C0 C0 C8 E0 CA D1 C4  C1 C0 C0 D0 C1 C0 C0
4CD0 C8 C2 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 C0 E0 CA D1
4CE0 C4 C0 C0 C0 D0 C1 D4 E2 C8  C2 C0 C0 E0 CA C0 C0
4CF0 D1 C4 C0 C0 C0 C0 D4 D2 C4  C0 C0 C0 C0 FC E4 C0
4D00 C0 C0 C0 C0 C0 F8 C0 C0 E0  C0 C0 C0 C0 C9 C9 C9
4D10 C1 C0 C0 C0 C0 C0 E0 E4 C0  C0 C0 C0 C0 F0 C1 C0
4D20 C1 C0 C0 C0 C0 F9 C9 C0 C0  C0 C0 C0 C0 DA D2 D2
4D30 CA C0 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 C0 E0 CA C9
4D40 C2 C0 C0 C0 C0 FA D2 C0 C0  C0 C0 C0 C0 FC E4 E4
4D50 D4 C0 C0 C0 C0 C0 F4 F4 C4  C0 C0 C0 C0 D8 FC FC
4D60 CC C0 C0 C0 C0 D0 FC FC DC  C0 C0 C0 C0 C0 C8 C8
4D70 C0 C0 C0 C0 C0 C0 E0 E0 C0  C0 C0 C0 C0 F0 F9 F9
4D80 D1 C0 C0 C0 C0 E0 F9 F9 F1  C0 C0 C0 C0 C0 D9 D9
4D90 C1 C0 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 C0 E0 FA FA
4DA0 E2 C0 C0 C0 C0 C8 FA FA E2  C0 C0 C0 C0 C8 FA FA
4DB0 CA C0 C0 C0 C0 C0 F4 E6 C0  C0 C0 C0 C0 F8 FF FF
4DC0 C7 C0 C0 C0 E0 FE FF FF F7  C4 C0 C0 C0 C0 C8 C1
4DD0 C0 C0 C0 C0 C0 C0 E0 C4 C0  C0 C0 C0 C0 F0 FF FF
4DE0 C6 C0 C0 C0 C0 FC FF FF E7  C0 C0 C0 C8 C9 D9 CB
4DF0 C9 C1 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 C0 E0 FE F7
4E00 C4 C0 C0 C0 C0 F8 FF FF C7  C0 C0 C0 D0 DB FB DF
4E10 DB C2 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 F6 F6 F6 F6
4E20 F6 F6 C0 C0 C9 C9 C9 C9 C9  C9 C0 C0 C0 C0 C0 C0
4E30 C0 C0 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 E4 E4 E4 E4
4E40 E4 E4 C0 C0 DB DB DB DB DB  DB C0 C0 C0 C0 C0 C0
4E50 C0 C0 C0 C0 C0 C0 C0 C0 C0  C0 C0 C0 C0 C0 C0 C0
4E60 C0 C0 C0 C0 FF FF FF FF FF  FF C0 C0 C0 C0 C0 C0
4E70 C0 C0 C0 DA BD 00 0C 0D 0E  0F 04 05 06 07 14 15
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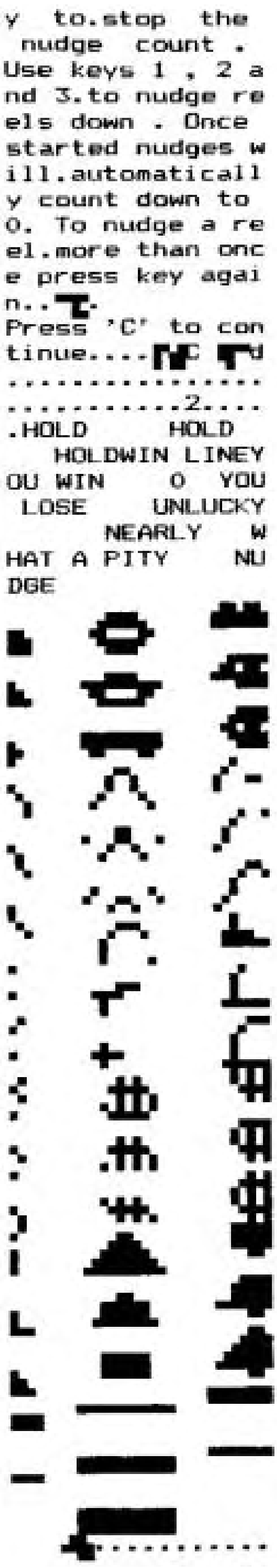
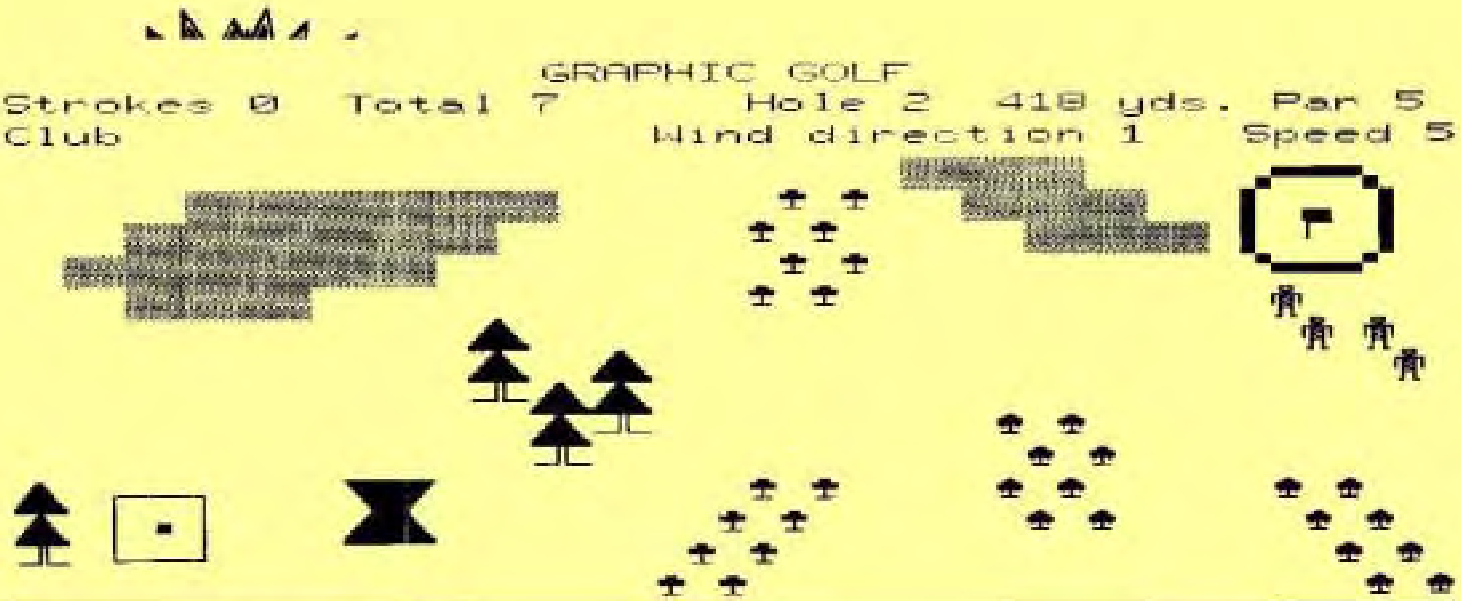
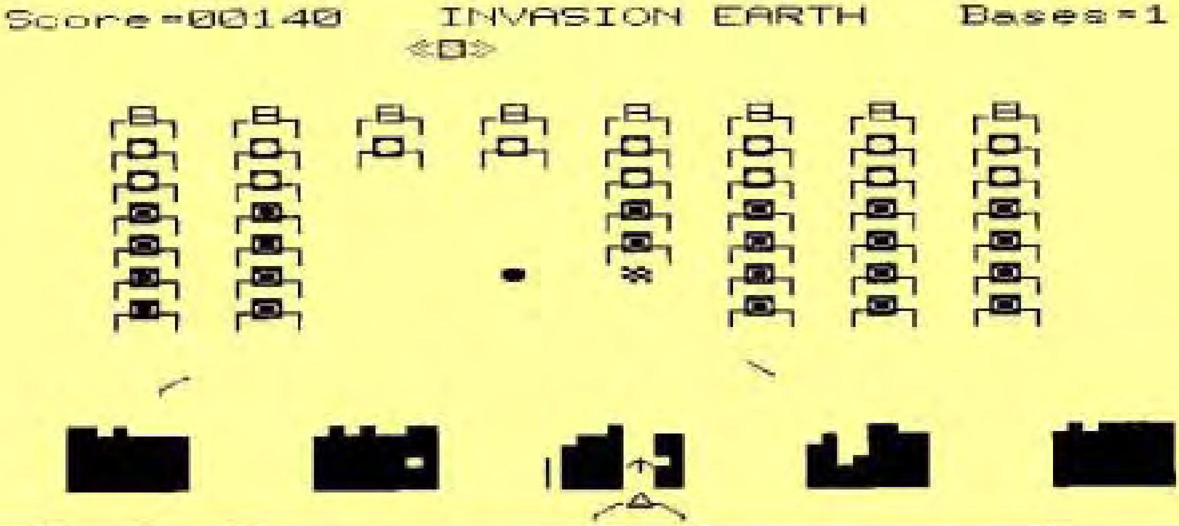


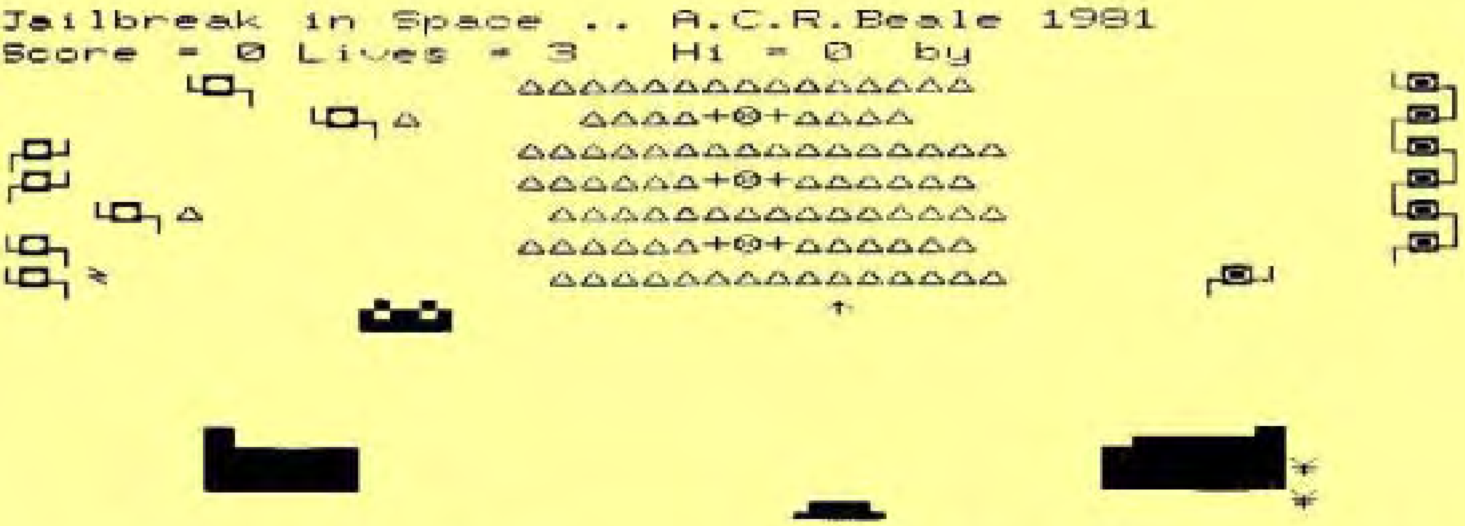
```
y  to.stop  the
 nudge  count .
Use keys 1 , 2 a
nd 3.to nudge re
els down . Once
started nudges w
ill.automaticall
y count down to
0. To nudge a re
el.more than onc
e press key agai
n..
Press 'C' to con
tinue....
................
............2....
.HOLD     HOLD
   HOLDWIN LINEY
OU WIN     0  YOU
 LOSE     UNLUCKY
      NEARLY   W
HAT A PITY     NU
DGE
```



```
                    GRAPHIC GOLF
Strokes Ø  Total 7      Hole 2  41Ø yds.  Par 5
Club                  Wind direction 1   Speed 5
```



```
Score=ØØ14Ø    INVASION EARTH    Bases=1
```



```
Jailbreak in Space .. A.C.R.Beale 1981
Score = Ø Lives = 3   Hi = Ø  by
```