nascom

Nascom 2 Microcomputer
DOCUMENTATION

Lucas Logic

Dear Customer,

The Nascom-2 is the culmination of well over 15 months intensive engineering development and, in our opinion, it is the most versatile single board computer that will reach the marketplace in the early 1980's.

We had very little opportunity to let people outside the Company assemble and use Nascom-2s and our experience with the Nascom-1 has been that the documentation required several revisions as we received input from our customers. Should you therefore have any criticism, whether good or bad, of this documentation, we would very much like to hear from you so that we may make appropriate amendments in order to give all customers the opportunity to use this machine to its fullest extent.

If you do write in to us will you please address all communications on this subject to the Nascom-2 Documentation Editor.

Yours sincerely,

David R Wadham
Technical Director

INTERNATIONAL NASCOM MICROCOMPUTER CLUB

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The intention of the NASCOM Club is to promote the use of the computer by
making available software and hardware notes sent in by users. The library
will mostly, I am sure, contain programs but it would add to the projects
expansion if engineers would send in hardware mods and suggestions. NASCOM
Microcomputers will continue to expand along the major lines. Programs will
cost 8p per page plus postage.

There are many ideas we have that the club could pursue and we would like to
hear yours. Immediately we have secured a reduced subscription to the
Personal Computer Workd. This is £6.25 for twelve issues.

The Club will issue a short newsletter monthly with a list of new programs
received that month.

The cost is £1.00 registration plus £5.00 for a year's subscription.

The INMC literature will in the foreseeable future only be published in English
We realise that there are many limitations in adopting this policy but on
the other hand the costs of translation would be prohibitive within the very
limited budget on which the Club functions.

Nascom is very conscious of its export market and actively pursue sales in
Scandinavian countries, western Germany, France, Italy, Austria and Switzerland
and in due course will extend its marketing activities into other European
countries. We do hope that the language barrier will not be insurmountable.

Some European countries still maintain very strict Exchange Control Regulations.
For those of you who live in France, it is not possible for us to accept
ordinary bank cheques as remittances. If you are in a position to pay us with
an international money order, would you please send your subscription and
registration fee to:-

JCS Composants,   35 Rue de la Croix Nivert, Paris 75015, France

who will in turn forward it to us.

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Welcome to the growing band of Nascom users. Your Nascom
computer represents an advanced but well-proven design using
one of the most powerful 8 bit microprocessors available - the
Z80A. The Nascom is also one of the most versatile micro-
computers and can be expanded as your requirements grow so that
it will give you many years of satisfying use.

A wide range of accessories are already available. As well as
the products produced by Nascom Microcomputers a number of
other companies are producing useful add-ons. We like to
encourage this as it will widen the scope for our products, and
to this end we have awarded the classification 'Nascom approv-
ed' to those products which we believe merit this.

No computer will perform any useful work without programs, and
again a range of software is already available for your Nascom,
from games to business management programs.

The range of Nascom accessories will continue to grow, and to
remain aware of these developments we suggest that you should
read one (or more!) of the popular monthly computer magazines.
There is also a club for Nascom users, which is currently run
entirely independent of Nascom itself.

Your local dealer will be pleased to keep you informed of
Nascom developments. Should you have any problems or enquiries
regarding your Nascom we recommend that in the first instance
you should discuss these with your dealer. However we at Nascom
will always do our best to deal with any direct contact which
you may make.

If you develop any generally useful software or hardware
yourself for use with our products we would be delighted to
hear from you - naturally we pay for any new idea which we
subsequently market.

We wish you many years of successful computing.

Mike Hessey
Technical Manager

SECTION 0 - HOW TO GET STARTED

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1. Kit Builders

Those of you who have bought your Nascom 2 in kit form should first assemble the kit in accordance with the instructions given in the Construction Manual, Section 2 of your Owners Handbook, and the Hardware Manual, Section 1 of the Handbook. You will then be in the same position as those who have bought their Nascom 2 in the form of a built board.

2. Built Boards

If you have a Nascom 2 in the form of a built and tested board then your first requirement is to provide the board with the necessary power. The power supply requirements are described in Section 1-8 of the Hardware Manual (page 1-8). The Nascom Power Supply Unit is available for this purpose, and we strongly recommend that you use this. If for any reason you intend to use another supply you must ensure that the individual supplies shut down in the order specified on page 1-9, or damage to some components can result. The Nascom Power Supply provides this protection as standard.

Once you have a built board and a power supply it is possible to run your computer system. Many people start using their system in this 'naked' form, without a cabinet. The system will work perfectly like this, but do remember that the primary of the transformer carries potentially lethal mains voltage, even though only low voltages are present on the computer board. At least the transformer should therefore be protected to avoid accidental contact by fragile human beings. While the system will work in this naked form it is much tidier to build the system into a case. This can be home made, or a number of suitable cases are commercially available. The Nascom Approved case is the Kenilworth Case, made by Business and Leisure Microcomputers, and available from most dealers. Remember when constructing any case to observe the usual safety precautions regarding mains connections - fit suitable fuse, screen mains connections from accidental contact, secure the cable mechanically to the case (not just at the electrical connection) and earth metal cabinets.

3. Complete Systems

A Nascom 2 with power supply and, optionally, a case, represents a complete and running computer system. We will now suggest how you can start to become familiar with it.

Lesson 1 - Preparation

Turn the power on!

Connect the TV to the modulated output from the computer, or if you are using a monitor then connect it to the video output. Tune the TV - you will find several points at which a clear display will be obtained. Nascom 2's are usually built so that at power on they execute the NAS-SYS monitor program. It is this which will have produced the display

NAS-SYS 1

which you can probably now see.

People who expect to use the BASIC programming language most of the time can easily adjust the computer so that it will go into BASIC whenever the power is turned on, rather than using NAS-SYS. We will describe how to do this later.

If your Nascom has been constructed to start up in BASIC (you need more than just workspace memory for this to be possible, though) the message displayed will be

Memory size?

Although you may regard this as a retrograde step we suggest that for the moment you join the rest of us in NAS-SYS. You can do this by pressing the <ENTER> key (we shall use the < > symbols to indicate a key on the keyboard). When the message Ok appears type the letters MONITOR and then press <ENTER>. You will now get the NAS-SYS 1 message which indicates that you are in the monitor.

Lesson 2 - Keyboard Input and the Screen Editor

The Nascom 2 is equipped with a very powerful screen editor, which will help when you are typing in data, programs or instructions. The examples below should help you to become familiar with the screen editor. While you are trying these exercises you should avoid the <ENTER> key. The effect of pressing this key is to cause the contents of the current line to be passed to the computer to be processed. As we shall be typing rubbish during these exercises the computer will display the message 'Error' if you should press <ENTER>. Don't worry if this should happen though - you can carry on just as before.

The flashing - symbol near the top of the screen is known as the cursor, and it indicates the position at which the next character you type will be displayed. Try typing

HI THERE - THUS IS EDDI

Now if you typed this as shown here you have two deliberate errors - you may have made more of your own, but don't worry about this at the moment! The cursor should be flashing immediately after the I of EDDI. If you now press the <BACK> key the cursor will move back 1 character and display a space character at the current cursor position. BACK(space) has this effect - it moves the cursor back one position and substitutes a space for the new cursor position. If you now type the <Y> key the cursor moves on one space again, but has left a Y where we originally had an I. You can press the <BACK> key repeatedly to move the cursor back several spaces, replacing characters successively with spaces. We could correct the earlier mistake (THUS instead of THIS) in this way, but of course we should then need to re-type all the remainder of the line, as the <BACK> key had the effect of replacing the intervening characters with spaces. Instead try pressing the left pointing arrow at the bottom left of the keyboard - this is known as cursor left. The effect is to move the cursor 1 position left without affecting any of the characters on the line. Press the key the required number of times to position the cursor over the U of THUS, and then press the <I> key. 'I' is substituted for the 'U'. You can now use the right cursor key (right arrow on the bottom right of the keyboard) to move the cursor to the right if you wish to complete the sentence (YOUR SHIPBOARD COMPUTER). The cursor up and cursor down keys can now be tried (up and down arrows next to the space bar) - yes, they have the effect you would expect. Try taking the cursor on a trip round the screen using the four cursor control keys. You may notice that if you press cursor left when you are at the extreme left of a line the cursor goes to the end of the preceding line, and similarly if you press cursor right when at the extreme right hand

edge of a line the cursor will move to the start of the next line. You will also find that cursor up is ignored when you are at the top of the screen, and cursor down is ignored when you are at the bottom.

When you have finished experimenting with moving the cursor, return it to the position of the - character in our sample line. Suppose we wished to eliminate this - and the succeeding space. We can do this by holding down either of the <SHIFT> keys and pressing the left cursor key twice. The shifted left cursor has the effect of maintaining the cursor position and pulling the remainder of the line to the left. Now if we want to insert text - replace the '- ' characters we can hold down the <SHIFT> key and press right cursor. Shifted right cursor has the effect of opening up a space in the current line at the position of the cursor. You can then type in text at that position.

Another function is provided if you make a real hash of typing in a line and want to start again. This is the <ESC> key (shifted ENTER), which deletes the current line and re-posotions the cursor at the start of the line. Finally you can clear the complete screen by means of the <CS> (shifted BACK) key.

Now that you have tried out the keyboard input and screen editing functions you are ready to start using the computer in earnest. You will find that you will very quickly become familiar with the screen editor as you use the system.

The screen editor is described further on pages 4.3 and 4.4

Lesson 3 - Use of the NAS-SYS Monitor

Many of you would probably prefer to go into BASIC now, and there is really no reason why you should not skip this lesson in order to do so. However, for those of you who are more ambitious, or have only workspace memory, here are a couple of things to try in the monitor.

Type

TOC80 OCA0

and press <ENTER>. T is the command to NAS-SYS which specifies that we wish to tabulate the contents of memory on the screen. OC80 is the starting address and OCA0 is the finishing address of the memory that we want displayed, expressed in hexadecimal form. Note that commands to NAS-SYS must appear in the first column of the entry. The memory contents displayed will be arbitrary at this stage, but will quite possibly consist of alternate 00 and FF values.

If we now type

MOC80

and press <ENTER> (remember that the command M must be in the first column) then we are specifying that we want to modify the contents of memory location OC80. The computer responds by displaying the memory address and its present contents. If you type

01

and press <ENTER> the monitor accepts this value and changes the memory contents accordingly. It then prompts you with the address and memory contents of the next location - OC81 in this case. Try entering one or two more memory data changes in this

way, and then type a _ followed by the <ENTER> key in order to terminate the modify command. If you now repeat the earlier T command on this same block of memory you will see that you have modified the memory contents.

These and all the other NAS-SYS monitor commands are described fully in Section 4 of this Manual.

Now you can try entering another monitor command in order to go into BASIC, that is unless you have a system with no user memory, which will not permit operation of BASIC.

Lesson 4 - BASIC

If you are in the NAS-SYS monitor and you wish to go into BASIC you can type J followed by the <ENTER> key. Note that the J must appear in the right hand column. The J command causes a cold start of BASIC, and all BASIC's counters are initialised. This is the only way you can enter BASIC from the monitor after power on, or after you have used any program which uses the BASIC workspace or program area. However, if you have already been into BASIC, and have merely gone into the monitor for something like a change of the keyboard functions using the K command then you can safely carry out a warm start of BASIC. Indeed it is much better to warm start in these circumstances, otherwise you will need to re-load any program which had been used in BASIC since the cold start clears BASIC's memory. A warm start of BASIC from the NAS-SYS monitor is performed using the Z command.

Now that we have typed J and <ENTER> BASIC is initialised, and the question

Memory size?

will appear. Unless you wish to reserve some space at the top of memory for machine code routines you can simply press the <ENTER> key again, and BASIC will assume that it has the use of all the memory.

BASIC now displays the amount of memory available, and indicates that it is ready by prompting Ok. As well as using BASIC to write programs you can use it in 'immediate' mode, where the command you type in is executed immediately.

An example of immediate mode would be to type

PRINT "HELLO"

and press <ENTER>. The computer executes this command immediately, and displays the message HELLO as commanded. Similarly we could type

PRINT 5*8+2

and the computer will display the answer 42.

You can experiment in this way as much as you like, but note that any command to be executed in immediate mode must fit on one line of the display.

In program mode each line entered is preceded by a line number, and the computer will not execute any of the instructions until it receives the command RUN. For example if we now type

```
10 PRINT "HELLO"
```

and press <ENTER> nothing visible happens. The computer in fact remembers the instruction, and now awaits further instructions.

You could now type

```
20 PRINT "END OF MY FIRST PROGRAM"
```

followed by <ENTER>. Again the computer remembers this instruction, but does not yet perform it. If you now type RUN and <ENTER> the computer executes all the instructions (both of them!) entered so far, and responds

```
HELLO
END OF MY FIRST PROGRAM
```

Note that the line number, rather than the order in which you type the statements, determines in what order BASIC will execute them.

As we have said the screen editor facility is available in BASIC, and you have probably been using it to correct typing mistakes as you went through this exercise. There is one condition under which it is necessary to inhibit the normal screen editor, and that is when a BASIC program is running and requests input from the keyboard. You will find in this condition that only the <BACK> key can be used to edit the keyboard input. The screen editor will be activated again immediately after the input statement is completed.

For example, enter the instruction

```
15 INPUT "WHAT IS YOUR NAME ";NAME$
```

which is an instruction causing a prompt message to be displayed, and await a keyboard input terminated by the <ENTER> key. Now type RUN to see the result, and when answering the question you will see that only the <BACK> edit function is active during this INPUT statement. Note that as we explained before it is the line numbers, rather than the order of entry of the statements, which governs the order of execution of the statements in BASIC. If you type LIST then you can see that BASIC has re-arranged the statements into numerical order.

If you wish to edit a line already entered in BASIC you can use the screen editor. To get the line displayed you simply type LIST 10 (substitute for 10 whatever line number you want). BASIC displays the line specified and 4 subsequent lines. If there are more than 4 lines after the line specified you press <ESC> to terminate the listing. You can now move the cursor to the line and use the screen editor. When the line is right you press <ENTER> to fix the modified version in memory - you can press <ENTER> even if the cursor is in the middle of the line.

You can replace a line completely by typing the line number and the new statement - this will overwrite the old one.

You can delete a line by typing the line number immediately followed by the <ENTER> key.

You can clear a program out of memory, ready for entry of a new one, by typing NEW followed by <ENTER>.

For further information on the BASIC language you should read the BASIC reference manual in SECTION 5, or one of the many introductory texts. We particularly recommend ' Illustrating BASIC' by Donald Allcock (Cambridge University Press).

Before you attempt serious programming, however, you will need to have a cassette recorder available in order to save and load your valuable programs. You should check out your recorder and determine the correct volume level using the procedure described below.

Cassette Adjustment

Three connections are required between the Nascom 2 and the tape recorder. These are the ground connection to TP 8 on the Nascom and the screened record and replay leads, the connection from the recorder earphone output to TP9 and the connection from microphone input to TP7 (or possibly TP6, see comments below). These connections are described in more detail on pages 1-9 and 1-10 of the Hardware Manual. If you have bought a cased version of the Nascom, you may already have been supplied with the necessary connecting lead.

A detailed technical discussion of the adjustment procedure required for use of a cassette unit is contained on page 1-10 of the Hardware Manual. However, this procedure should only be required when the Nascom 2 is first built. For a built and tested Nascom 2 it is only necessary to determine the correct record and replay levels for the recorder. If your recorder has manual record level control you will find it advantageous to record at a much higher level than for audio use - probably well into the 'red' will produce the best results. Machines with automatic level control should be used in the normal way. It has been noted that some recorders give better results if the high output from the Nascom is supplied direct to the microphone input.

We suggest that you go into the NAS-SYS monitor to check tape operation - if you are still in BASIC you can do this by typing MONITOR and <ENTER>.

Now turn on the recorder, set to record, and type

W1000 5000

This will cause memory locations 1000 to 5000 to be written to the recorder. The display will indicate progress of the dumping operation.

When this operation is complete rewind the tape, type R and <ENTER> and start the tape replaying. The computer should display each block of data as it is read in the form

1000 4F00

After each block is read a . should be displayed - if instead a ? appears a tape misread has occurred. You should adjust the replay volume to give reliable reading of the tape.

If tape misreads occur in normal operation the tape may be rewound a short distance and replay restarted, when the block should read again.

After saving programs or data it is always advisable to verify them before proceeding. The V command in NAS-SYS and CLOAD? in BASIC are available for this purpose.

Some Useful Facts
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1. Power-on Start-up in BASIC

If you rarely use the NAS-SYS monitor you may prefer that your system starts up in BASIC rather than NAS-SYS. This can be done by a simple adjustment to your Nascom 2, and of course you can still get to NAS-SYS by entering the MONITOR command.

First disconnect the power to the Nascom.

Now examine the corner of the circuit board at the top near the 77-way edge connector. You will find either a pack containing 10 small switches or a set of wire links, marked in both cases LSW1. These can be used to select the restart address as described on page 1-2 of the Hardware Manual. If you set switches 2, 3 and 4 down, or cut the links in these positions, then the computer will re-start in BASIC whenever the power is turned on, or the RESTART button is pushed. The switches/links are numbered such that switch/link 1 is the furthest of the 10 from the 77-way edge connector.

If you wish to revert to start-up in NAS-SYS then you need only restore the original switch settings, or re-join the links.

2. Upper/Lower Case Letters

Normally your Nascom will operate so that all letters appear as capitals unless the <SHIFT> key is pressed, in which case lower case letters appear instead. The effect of the <SHIFT> key can be reversed, so that the keyboard behaves like an ordinary typewriter, simply by going in to NAS-SYS and entering the command K1. Typing K0 restores the normal shift function. The same effect can be achieved in BASIC by the commands POKE3111,1 and POKE3111,0 respectively. See pages 4.8 and 5.26 for further details.

Note that reversing the effect of the shift key only affects the letters, so that it does provide a true emulation of a typewriter.

3. Keyboard Repeat

You may find it tiresome to have to keep pressing a key several times to repeat it, particularly when moving the cursor. An automatic keyboard repeat is included in the more advanced NAS-SYS3 monitor, but the same effect can be achieved as follows:

Enter NAS-SYS.

Use the M command to enter the following code (underlined characters are Nascom responses)

M0C90

```
0C90 21 F3 0C DF 72 21 80 0C
0C98 22 7B 0C 21 80 02 22 2E
0CA0 0C 21 50 00 22 30 0C DF
0CA8 5B 00 00 00 00 00 00 00
0CB0 DF 61 30 07 2A 2E 0C 22
0CB8 2C 0C C9 2A 2C 0C 2B 22
0CC0 2C 0C 7C B5 C0 21 02 0C
0CC8 01 00 08 16 FF 7D FE 06
0CD0 20 02 16 BF FE 09 20 02
0CD8 16 C7 7E A2 28 06 0E 01
0CE0 7A 2F A6 77 23 10 E4 79
0CE8 B7 C8 2A 30 0C 22 2C 0C
0CF0 DF 61 C9 76 70 00 00 00
```

Now type E0C90 and <ENTER>. You now have a repeat keyboard function. The delay before repeat starts can be altered by modifying locations 0C2E and 0C2F, and the repeat speed can be modified via locations 0C30 and 0C31.

If you now save this routine on tape using the NAS-SYS W command (and of course verify it) you can re-load the code using the R command before each session.

You can achieve the same result without going in to NAS-SYS by means of the following BASIC program.


```
50000 REM KEYBOARD REPEAT
50010 FORI=3248TO3316STEP2:READJ:DOKEI,J:NEXT
50020 DOKE3195,3248:DOKE3189,3315
50030 DOKE3118,640:DOKE3120,80:END
50040 DATA25055,1840,11818,8716,3116,10953
50050 DATA3116,8747,3116,-19076,8640,3074,1
50060 DATA5640,32255,1790,544,-16618,2558,544
50070 DATA-14570,-23938,1576,270,12154,30630
50080 DATA4131,31204,-14153,12330,8716,3116
50090 DATA25055,30409,112
```

This program should be executed by means of the RUN50000 statement. The initial delay can be modified by a DOKE in location 3118, and the repeat speed can be changed by a DOKE to location 3120.

4.Display Scrolling

When you are typing in entries at the keyboard and the screen is full you will notice that scrolling occurs - that is the first line is discarded and the next 14 lines move up 1 line each, leaving the bottom line, line 15, empty. In fact, there is a sixteenth line, which is displayed at the very TOP of the screen. This apparent anomaly is a deliberate feature, which allows the top line to be used as a continuously displayed title, which is not subject to the normal scrolling operation. This line 16 will however, be cleared if a 'clear screen' character is output to the screen (eg CLS in BASIC), or when the CS key is pressed.

There is one slight peculiarity (not deliberate!) of this sixteenth line when using the NAS-SYS (but not NAS-SYS3) monitor, and this is that characters must be sent to it singly, rather than as a string. This is discussed in more detail on page 4.47.

The screen display is 'memory mapped', so that individual screen locations can be changed by addressing them as memory, or using POKE in BASIC. The addresses of the screen memory are described on page 1-7.

5. Get Single Characters in BASIC

It is sometimes useful in BASIC to be able to input characters one at a time - either to allow special editing or to allow a program to perform some action as soon as the user presses one particular key, rather than wait for the <ENTER> key. Nascom BASIC does not provide commands which provide these operations as part of the language (sometimes known as INKEY and GET), but they can be added simply as described below.

Enter NAS-SYS.

Make sure the keyboard repeat routine, described earlier, has been loaded. (Actually this is not essential, but we think you will find it useful.)

Type

M0CF8

Now enter the memory locations shown below - underlined characters represent computer output:

OCF8 2A 0B E0 11 00 0D D5 E9
0D00 7B FE 01 20 04 DF 7B 18
0D08 09 FE 02 20 0A DF 62 38
0D10 01 AF 47 AF 2A 0D E0 E9
0D18 AF 18 F8 00 00 00 00 00

You can now save these routines, and the repeat keyboard, by typing

W0C90 0D20

If you load this tape and type E0C90 each time you turn your Nascom on then you will automatically enable the repeat keyboard and load the GET and INKEY operations.

To call up these operations you should proceed as follows. Place the statement

DOKE 4100,3320

at the beginning of your program, to enable the routines.

Now the statement

0=USR(1)

will display a flashing cursor and wait for a key to be pressed. When the key is pressed the variable 0 will contain the ASCII value of the key pressed. This can be converted to a character by the subsequent statement

O$=CHR$(0)

The INKEY operation - look at the keyboard and return a zero if no key has been pressed, or the ASCII value of the key pressed - is activated by the statement

O=USR(2)

0 contains 0 if no key was pressed, or the ASCII value of any key pressed.