Lucas Microcomputers

NASCOM FLOPPY DISC CONTROLLER

HARDWARE MANUAL

Lucas

Microcomputers for education, science and business

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NASCOM FLOPPY DISC DRIVE MANUAL

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C O N T E N T S

1. PARTS SUPPLIED

Each disk drive system consists of a disk drive cabinet containing either one or two disk drives (single or dual system). This is a built and tested unit.

The disc drive system is connectd to the computer via the Nascom floppy disc controller (FDC). This consists of an 8 inch by 8 inch NAS-BUS circuit card and a separate ribbon cable with connections at each end.

1.1 Disk drive case

The disk case contains one or two TEAC FD 55E or FD 55F 5 1/4 inch floppy disk drives, with associated power supply. The FD 55E's are double density, single sided, double tracked (80 tracks), giving a capacity of approximately 350K bytes (depending on the software used) of storage space when formated, while the FD 55F is the double sided version with double the capacity. Standard pairs of drives are set up with drive 0 (or A when using the CP/M operating system) on the right.

The ribbon cable (flat grey cable) from the rear of the unit is connected to allow the floppy disk controller to access both drives. This cable is terminated with a 37 way D type plug suitable for connection to the separate cable supplied with the floppy disc controller (FDC) board.

1.2 Ribbon cable

This is a connection cable consisting of 34 way ribbon cable terminated with a 37 way D type socket and a 34 way ribbon cable socket connector.

1.3 Controller card

The Floppy disk card supplied is capable of driving up to four drives i.e. two dual drive systems. If the third and/or fourth drives are required they need to be set up slightly differently to the first and second drives as normally supplied, so ensure that the expansion drives you obtain are set up correctly (see section 4.).

The card has a number of features described in more detail in its hardware manual. Its specification can briefly be described as follows:

1.3.1 Controls up to four floppy disk drives
1.3.2 Single or double density drives
1.3.3 Single or double sided drives
1.3.4 2 or 4 MHz operation
1.3.5 5 1/4 or 8 inch drives
1.3.6 Digital write precomp used
1.3.7 NASBUS card
1.3.8 Seven I/O base addresses possible

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2. INSTALLATION

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WARNING

Before performing any installation work, or making any modifications to the system hardware, make sure that all units are switched off and disconnected from the mains.

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The first step in installing the NASCOM FDC system is to install the Floppy Disk Controller (FDC) board. This requires that your system has a NASBUS backplane arrangement. This is standard with a Nascom 3. In a Nascom 3 the card can be plugged into any spare slot, though the top slot is recommended to make the best use of the card frame space (allowing other cards needing more height to occupy the slot positions with a wider spacing).

Once the FDC has been installed, the separate cable can be fitted. Provision is made for this on the Nascom 3, using the D type cut-out CON 2 on the back panel. The connector should be mounted from the inside. The cable should be routed inside the box so as not to obstruct air flow etc. The 34 way socket connector should be connected to the FDC card making sure that it is connected correctly. i.e. with all 34 pins properly in the socket connector and with the arrow on the connector next to the preset potentiometer. Connecting the cable the wrong way, although not impossible, would be quite difficult due to the raised part on the socket fouling the board.

The board is set up and tested for use with a 4 MHz system, which again is standard on a Nascom 3. If a 2 MHz system is used then refer to the FDC card manual to see how to re-configure the board.

The disk drive unit, although tested, is supplied without a mains plug. The appropriate plug should be fitted using a 3A fuse.

The system can now be connected together.

The disk drives and cable should be placed carefully so that the cables and drives are not exposed to excessive temperature (hot or cold). This will usually be limited by the storage/useable temperature range for the disks, which typically may be from 5 to 30 degrees Centigrade. More accurate figures will be available from individual disk data sheets.

The drives should not be installed or used near equipment likely to produce large electromagnetic fields. This includes items such as televisions, loudspeakers etc. Usually metal cased televisions or monitors will not affect disk operation; however, it is recommended that these items be placed a reasonable distance (normally about 30 cm is sufficient) from the drives (and disks).

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3. USING THE SYSTEM

Before the system can be used a piece of software (a program) needs to be loaded into the computer. Two options are available from Nascom - NAS-DOS and CP/M 2.2.

3.1 NAS-DOS

This is a 4K operating system available in EPROM ready to fit into a Nascom 2 or 3. It complements NAS-SYS (1 or 3), and allows the use of disks for operations such as :

1. Saving BASIC programs
2. Formatting new disks
3. Loading (with or without automatic execute) BASIC and assembler programs
4. Saving and loading NASPEN (word processor) files.
5. Saving and loading ZEAP (assembler) source files
6. Displaying directory of disk programs
7. Writing and reading direct from disk (addressing sector and track).
8. Verifying program readability on disk
9. Erasing program from disk
10. Saving and reading sequential and random files
11. Opening and closing files

The above functions can be accessed from BASIC or assembler programs, as well as by means of interactive keyboard commands.

3.2 CP/M 2.2

This is an operating system originating from Digital Research. It is available for use on many different computers and because of this a lot of software packages are available for use on a CP/M system. This software can be obtained from several sources details of which can be found from the adverts in computer magazines.

Briefly the operating system allows functions similar to that of NAS-DOS, though in general the system is more comprehensive in terms of functions available. For more information about CP/M it is best to refer to one of the many books written describing the operating system.

3.3 Operating the disk drives

Once the required hardware and software has been assembled and connected together the system can be switched on. This should be carried out in the following order:

1. Turn on the disk drives
2. Turn on computer and associated monitor on TV

To insert a disk, follow this procedure:

1. First ensure the door locking lever is in the horizontal position pointing to the right. If it is not (ie it is pointing vertically downwards), turn it through 90 degrees anticlockwise so that the disc slot is exposed. Remove transit cards if these are fitted.

2. Take the relevant disk from its storage envelope.

3. Insert disc fully into the drive with the head window facing inwards and the write enable notch (which may be covered by a write protect tab) on the left side. **DO NOT APPLY EXCESSIVE FORCE!**

4. Rotate the lever clockwise to point vertically downwards. If there is any problem in closing the door it is probably due to incorrect insertion of the disc.

4. ADDING A SECOND DISC DRIVE TO A SINGLE DISC UNIT

To add a second disc drive to a single disc unit proceed as follows:

1. Release the screws on each of the side panels which hold the top in place.

2. Remove the top.

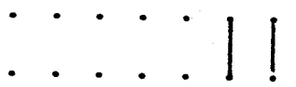
3. Undo the screws in the base which hold the blanking plate in position and remove the plate.

4. Release the screws holding the existing drive in position.

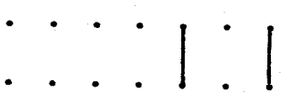
5. Fit the connections to the edge of the new drive, following the arrangement on the existing drive. The marked wire of the ribbon cable should be connected to the end of the connector marked 1.

6. Note the position of the link pack at the rear of the PCB on each disc unit. This PCB is mounted below the disc unit, which is why it is necessary to remove the disk unit before setting the links. The links should be set as follows:

Drive 0



Drive 2



Drive 4

Drive 6

7. Remove the resistor packs at the rear of this PCB (usually a white 14 pin 'chip') on all except the last disc unit.

8. Refit the drives and cabinet top. The disc system is now ready for use.

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5. INSTALLATION OF A SECOND PAIR OF DRIVE UNITS

If more than two drives are required, then a second pair of drives can be added to give up to four drives running off one FDC card. The second drive unit is set up internally different to the first, (see Section 4) and is supplied with a special cable to enable the two drive units to be connected up to the one socket installed on the computer. The procedure for installing the second unit is as follows:

1. Check that the drive addresses on the second unit are set correctly as described in Section 4 of this manual.

2. Remove the 37 way D type plug of the first unit from the back of the computer.

3. Plug this into the 37 way socket mounted on the cable of the second unit (positioned near to the drive unit).

4. Plug the 37 way plug of the second unit into the now vacant socket on the computer.

5. Refer to section 4 and the illustration to set the links which determine the disc drive numbers.

6. The drives should now be ready for use. The way in which these drives are accessed will depend on the operating system used on the existing drive.

NASCOM Floppy Disk Controller Card Hardware Manual

Contents

1 Links

1.1 Solder links

There are four links on the board labelled LK1-4. These should be configured as below:

LK1	open (no link).
LK2	made from A to C when 1793 chip used (standard)
LK3	open (Spare i/p 1).
LK4	open (Spare i/p 2).

1.2. Header

LBK1 is used to set up the base address of the board. Only one short (either by switch pack or links) should be made on each board, indicating a board base address as follows:

1-16	No connection
2-15	Base = 20H
3-14	" = 40H
4-13	" = 60H
5-12	" = 80H
6-11	" = A0H
7-10	" = C0H
8-9	" = E0H - Standard address

Standard software (NASDOS & CP/M) is written using a base address of E0H.

1.3 Switch pack

The switch pack (LKB2) settings have the following meanings:

SW1-3 & SW 0

Only one of SW1-3 should be set at any one time. They control the write precomp operation, along with SW0 which, when on, disables write precomp altogether (regardless of setting of SW1-3). The function of each switch depends on the system operating frequency (i.e. 2 or 4 MHz). For 2MHz only 500ns or zero write precomp is possible - this is with SW1 only on. With 4 MHz operation SW3 enables 500ns and SW2 250ns write precomp. It should be noted that if all of SW1 to 3 are off, then SW0 should be on.

SW 4-5

These two switches control the clock to the FDC chip (1793). This clock is required to be 1 MHz for mini-floppies, or 2 MHz for 8 inch drives.

4-17 (SW 4) Divide by 2 from system clock (use for 2 MHz system)
5-16 (SW 5) Divide by 4 from system clock (use for 4 MHz system)

SW 6-7

Used for setting the voltage controlled oscillator (VCO) frequency This needs to be 500KHz for 5 1/4 drives or 1 MHz for 8 inch.

6-15 (SW 6) Divide by 4 from system clock (2MHz system)

7-14 (SW 7) Divide by 8 from system clock (4 MHz system)

This means that for a 2MHz 5 1/4 inch system or a 4 MHz 8 inch system, switches 4 and 6 are on. For a 4 MHz 5 1/4 inch system, switches 5 & 7 should be on. A special case exists when using a 2 MHz 8 inch system, when a link must be made between pins 4 and 19 on the underside of the board, and only SW6 in the on position.

SW 8

8-13 (SW 8) On sets FDC to auto single/double density. (dependent on relevant i/p bit)

SW 9

9-12 (SW 9) 'on' enables write precomp with tracks greater than 43 when double density. It is usual to use this on 8 inch disks, but is also recommended with the NASCOM supplied TEAC drives.

Recommended settings of LKB2 for use with double desity TEAC drives (single or double sided).

SWITCH No.	Settings 2MHz	4MHz
1 (1-20)	off	off
2 (2-19)	off	on
3 (3-18)	off	off
4 (4-17)	on	off
5 (5-16)	off	on
6 (6-15)	on	off
7 (7-14)	off	on
8 (8-13)	on	on
9 (9-12)	on	on
0 (10-11)	on	off

These provide the following features:

4 MHZ : 1) 250ns write precomp on tracks >43
2) Auto double/single density

2 MHz : Auto single/double density

1.4 Component values

NOTE: Although the floppy disk card has been designed for use with 5 1/4 or 8 inch drive , NASCOM will only support its use with the NASCOM floppy disk drive unit (5 1/4 inch TEAC FD50E or FD50F).

There are two components which need to be altered from the standard board as supplied when using 8 inch drives; these are:

1.4.1 C3 should be a 2% 68pF 63V Sub min ceramic instead of 150pF.

1.4.2 A 50 way connector needs to be inserted in plug position 2.

Note also that C1 should be omitted when using drives without a head solenoid.

2. FDC Ports assignments

The board uses 5 read/write IO ports addr

2. FDC Ports assignments

The board uses 5 read/write IO ports addresses. The base address is set up by LKB.1 as described in section 1.2. In the following X is used as the base address, in use this will be 20H, 40H etc. In particular for CP/M 2.2 and NAS-DOS this will be E0H, i.e. X3 means port E3H in these cases.

2.1 FDC chip (1793) registers

Ports X0 to X3 are the four read/write registers as used by the floppy disk controller chip:

Port	Read function	Write function
X0	Status register	Command register
X1	Track register	Track register
X2	Sector register	Sector register
X3	Data register	Data register

If more details of these registers is required, these should be obtained from the relevant Western digital FD1793 data sheet.

2.2 Other I/O ports

The above described registers control the operation of the 1793, however, several other functions (such as drive select) are needed in a disk drive system. These are provided by another two ports, X4 and X5.

2.2.1 Port X4

Bit	Read	Write
D0	Drive select 0 (DS0)	DS0
D1	DS1	DS1
D2	DS2	DS2
D3	DS3	DS3
D4	Side select (SSL)	SSL - only if LK.2 is A to C
D5	Spare 1 -high if no LK3	Low stops motor, high triggers for 10s.
D6	LOW gives single den.	Density- as read
D7	Spare 2 -high if no LK4	Connected to P4 on board.

2.2.2 Port X5

NOTE - Write port is not used

Bit	Function
D0	INTRQ from 1793 FDC chip
D1	NOT READY - For this to be low motor must be on, and in the case of 8" drives when LK.1 is present, READY i/p must be true.
D2	0
D3	0
D4	0
D5	0
D6	0
D7	DRQ from 1793

3. Input/output connections to FDC

3.1 PL1 - 5 1/4 drive connector

All odd pins on this connector are taken to ground. The even pins are connected as follows:

Pin	Function
2	spare (pad 2)
4	spare (pad 4)
6	Drive select 3
8	Index hole
10	Drive select 0
12	Drive select 1
14	Drive select 2
16	Motor on
18	Direction select (for head step)
20	Step
22	Write data
24	Write gate
26	Track 00
28	Write protect
30	Read data
32	Side select
34	spare (pad 34)

3.2 PL2 - 8 inch drive connector

Pin	Function
2	Track greater than 43
4	pad 4
6	pad 6
8	pad 8
10	pad 10
12	pad 12
14	pad 14
16	pad 16
18	pad 18
20	Index hole
22	Ready
24	pad 24
26	Drive select 1
28	Drive select 2
30	Drive select 3
32	Drive select 4
34	Direction
36	Step
38	Write data
40	Write gate
42	Track 00
44	Write protect
46	Read data
48	pad 48
50	pad 50

3.3 PL3 - NASBUS

Pin	Function
1-4	Gnd
5	System clock
6 7	No connection
8	P3 on board
9-11	No connection
12	$\overline{\text{NASIO}}$
13	$\overline{\text{DBDR}}$
14	$\overline{\text{RESET}}$
15	No connection
16	$\overline{\text{BAI}}$
17	$\overline{\text{BAO}}$
18	No connection
19	$\overline{\text{IEI}}$
20	$\overline{\text{IEO}}$
21-25	No connection
26	$\overline{\text{IORQ}}$
27	No connection
28	$\overline{\text{WR}}$
29	$\overline{\text{RD}}$
30	A0
31	A1
32	A2
33	A3
34	A4
35	A5
36	A6
37	A7
38-48	No connection
49	Gnd
50	D0
51	D1
52	D2
53	D3
54	D4
55	D5
56	D6
57	D7
58-71	No connection
72	Key
73-74	+12V
75-78	+5V

4. Setting up

4.1. Before the FDC board can be used in a system, this system must be set up so that it can use external ports. On a NASCOM 2, this means that LSW2/8 needs to be set for External Ports (switch or link up, as viewed with switch at the top of board). Once this and the FDC board switches and links have been set as required, there is one other adjustment which may need to be made ; that is to the preset potentiometer. This is set up in manufacture for operation with a 4 MHz system, but may need adjusting for different systems. This potentiomer sets up the centre frequency of the VCO. When set up properly the LED will just be on the point of turning on/off (Turning the pot clockwise turns the LED off). Set up as follows:

4.1.1 Ensure that no disk access is being made (e.g. disconnect the drives!)

4.1.2 Turn pot anti-clockwise, until the LED comes on.

4.1.3 Now turn pot clockwise a quarter of a turn.

The VCO is now set up.

It should be noted that the actual status of the LED (i.e. on, off or flashing) during operation of the floppy disks is virtually meaningless at any time other than when setting up.

4.2. If more than one FDC card is used in a system then the following should be bourne in mind:

4.2.1 Only one FDC board should contain the pull up resistor on the NASIO line : i.e. R31. This should be removed if necessary.

4.2.2 The FDC cards must be set up with different addresses as descibed in section 2.

Component changes on Floppy Disk Board

Please note that the following component values on the Floppy disk controller card may be different to those shown on the circuit diagram:

R 28 is now 220k
R 29 is now 150k

C6 is now 100µF
C7 is now 22µF