

TIMEX COMPUTER FDD3000

Service Manual



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The retro computing magazine

TC TIMEX COMPUTER

FDD3000

SERVICE MANUAL

FOR DOUBLE
&
SINGLE DRIVE SYSTEM

REV 03

CONTENTS

- I- INTRODUCTION
- II- WHAT IS THE FDD 3000
 - 1- HARDWARE
 - 2- OPERATING SYSTEM
 - 3- DISKETTES
- III- OPERATING PROCEDURES
- IV- HOW TO TEST THE FDD
- V- TROUBLESHOOTING

APPENDIX

- I- ERROR MESSAGES
- II- PIN OUT RS232
- III- PARST LIST
- IV- SPARES PARTS LIST
- V- LISTING (MACRO) CBIOS
- VI- LISTING (MACRO) BIOS
- VIII- DATA SHEETS OF COMPONENTS

INTRODUCTION

I) INTRODUCTION

It is not the objective of this manual how to teach how to repair but to give some technical guidelines allowing fault finding and isolation of the defect and whenever possible to solve the fault.

The troubleshooter needs to use its technical knowledge on a rational way. He will need patience, a continuity tester, a multimeter and an oscilloscope. As a very basic rule these are the tools required to identify and troubleshoot the faults.

Special attention is required to the non conformities with the product specification.

This manual was conceived to completely cover the product and the project, and is the most updated one.

The way this manual was written will give a progressive knowledge of the product as you will read through it allowing you to solve all the situations.

WHAT IS THE FDD 3000

FDD MANUAL

II - HARDWARE

II-2 THE OPERATING SYSTEM

The addition of the floppy disc drive system to the zx Spectrum or its compatibles TC2048 and TC2068 creates a very powerful system, the TOS (TIMEX OPERATING SYSTEM). This OPERATING SYSTEM was developed by TIMEX giving the user a capacity from the BASIC that he never thought about.

The secret is the controller that commands the drive operation, another one for external communications that an unimaginable flexibility to TOS.

The controller has 64k Bytes of DINAMIC memory.

The input and output of data is controlled by a Z80A microprocessor at 4 MHZ.

When a TOS command is issued it passes through a parallel bus to the controller that executes the instructions, without overloading the computer memory, since the the controller on its own is a stand alone computer.

The controller and the operating system were developed around the need to communicate. So we can find 2 RS 232 (V24) ports, which can be configured to any type of communication protocol, which means that besides the power to communicate with other users of TOS it is also possible to TALK with users of others computer systems. Other peripherals like telephonic MODEMS, PRINTERS and other devices connectable to a communication port can be driven by the FDD system.

II-3) THE MEDIA (Diskettes or simply discs)

The diskettes (Discs) are manufactured with very thin flexible material coated with a magnetic material, enclosed inside a hard plastic case. A shutter mechanically actuated protects the media when out of the floppy disc drive unit.

This protection opens automatically when the disc is inserted in the drive and when it is completely inside the READ/WRITE head touches the disc.

The disc is of double density type allowing a formatted capacity of 140 K per side (total 320 K Bytes per disc).

Although the discs are very reliable certain basic precautions have to be taken:

- Do not expose the discs to very strong or direct sources of heat or light.
- Do not submit disc to high temperatures.
- Do not expose the disc to any type of magnetic field.
- Do not expose to dust.
- Keep discs away of humide environments.
- Do not open the protection shutter and/or touch the media with the fingers or any other object.

The information stored in the disc can be protected in two possible ways: hardware or software. the Hardware protection is achieved trough the protection tabs, that cover or open a hole near the corners of the disc plastic enclosure, which allows or stops the write operations on the disc.

OPEN HOLE.....WRITE PROTECTED DISC

... About CP/M

CP/M means "Control Program Monitor" and was one of the first Operating Systems written in the beginning of the 70' s. Dr. Gary Kindall is considered as the father of CP/M, he was developing Software for the INTEL microprocessor 8080.

With the development of different types and sizes of floppy disc drives the need for a system that would interconnect or make all of them was created. This is one of the reasons of CP/M flexibility and transportability from one system to another. CP/M Operating System consists off 3 parts, to know:

BIOS (BASIC INPUT/OUTPUT SYSTEM)

BDOS (BASIC DISC OPERATING SYSTEM)

CCP (CONSOLE COMMAND PROCESSOR)

the BIOS is the only part of the Operating System that depends on the Hardware where CP/M is going to run. Is the only part of the Operating System that can be costumised by the Hardware manufacturer to have mind particularities of the Floppy Disc Drives, Discs, Terminals, and Printers that he produces.

BDOS can not be relocated or modified since it is legally protected. It is the part of the Operating System that controls all the Drives and is independent of the Hardware.

The CCP interfaces the user with the software since it translates the keyboard instructions into instructions that the microprocessor can understand. It is also legally protected and can not be relocated or modified.

When CP/M is loaded into computer memory it is done in a well organized way occupying segments of memory. The BIOS is stored in the top of the memory.

The CCP stays immediatly below and CCP occupies the bottom part of the memory pile. The remaining memory space is reserved for the application programs and is called TPA (TRANSIT PROGRAM AREA).

The amount of memory used by the BIOS depends on the Hardware configuration and is typically of 3K Bytes.

The BDOS as a fixed length of 3.5 K Bytes. This happens because when CP/M transfer information from the RAM to the Disc, or Vice-versa does it always in blocks of 128 Bytes up to a maximum of 16 drives. (only for maximum on the case of the TIMEX FDD). The physical operation between the DISCS and the RAM is handled by the BIOS.

Below the BIOS and BDOS location in memory we find the CCP and the TPA, the lowest part of memory is formed by a block of 256 K Bytes the contains the system variables.

When the Computer is Switch-On, the first operation performed is to load the CP/M Operation System, from its location in the Disc, to the RAM of the Computer. This is called "BOOTSTRAPPING" or simply system "BOOT". Depending on the system this can be achieved through a special combination of keystrokes on the keyboard. in the case of the FDD 3000 this happens automatically after the insertion of the disc into the floppy disc drive. We know that this operation is finished when the screen displays the log-on message from the Hardware manufacturer followed by the prompt:

A>

This symbol indicates that the CCP is functioning and is waiting to answer any command line.

If by any reason it is necessary re-initialize CP/M after the power-on of the computer, it is possible to execute a "WARN-BOOT" warm reset of the Operating System. This is some times required after a system error and the subsequent Operating System "error message". This procedure loads BDOS and CCP into their memory location meaning that the computer is ready to accept new commands again.

CP/M is a registered trademark of DIGITAL RESEARCH.

Some passages of "USING CP/M" by PETER GOSLING where quoted above.

OPERATING PROCEDURES

III- OPERATION PROCEDURES.

In this chapter we will through the installation procedure of the Floppy Disc Drive unit.

The FDD 3000 supports two different Operating systems:

TOS - TIMEX OPERATING SYSTEM

CP/M - CONTROL PROGRAM MONITOR

The Hardware configuration depends directly of the Operating System to be used. Lets see why:

If we want to use TOS software we need the following Hardware:

- MICROCOMPUTER (Z80 based)
- TV SET OR MONITOR
- INTERFACE FOR COMMUNICATION
- FLOPPY DISC DRIVE SYSTEM FDD 3000
- PRINTER (RS232) (OPTIONAL)

In this configuration the interface changes according to the computer to be used.

If your request is to run Software in CP/M format two approaches can be used, one using a computer as console and the other is to use a TERMINAL 3000, in this case the configuration will be:

- TERMINAL 3000
- MONITOR
- FLOPPY DISC DRIVE SYSTEM FDD 3000
- PRINTER (RS232 SERIE) (OPTIONAL)

III-2) THE CONNECTIONS BY SEQUENCE

- 1- Connect the curly cable from the FDD 3000 to the right communication interface for your computer.
- 2- Carefully engage the interface connector of the interface in the computer edge-connector.
- 3- Connect the RS232 cable for the printer into the chosen channel "A" or "B".
- 4- If you have a ZX SPECTRUM you can use a monitor, just connect the monitor RCA plug from the monitor into the socket at the back of the FDD 3000 system also marked "MONITOR". If you have a ZX SPECTRUM and not a MONITOR you have to use the TV set, connecting the TV cable to the appropriate plug on the computer. If you any other TIMEX computer and a MONITOR you have to plug the RCA jack into your computer, socket marked with MONITOR.
It is completely impossible to connect the tv cable to the video plug at the back of the FDD 3000 since no picture will be produced at all in the TV screen.
If you are using a TERMINAL 3000 to work with this system the monitor cable RCA must be connected to the MONITOR plug at the back of the FDD 3000 system.
- 5- Connect all the power supplies to the mains socket 220 VOLT. If you are usin the ZX SPECTRUM or TC computers connect the plugs from the power supplies to the correct sockets at the back pannels of the computers. Connect the TV set or the MONITOR to the mains.
- 6- Then power-on of:
 - POWER ON TV SET OR MONITOR
 - POWER ON OF THE FDD 3000
 - POWER ON OF THE COMPUTER
 - POWER ON OF THE PRINTER

HOW TO TEST THE FDD 3000

IV- HOW TO TEST THE FDD 3000

Configure the system to operate in the TOS mode:

- 1- POWER ON THE TV SET OR THE MONITOR
- 2- POWER ON THE FDD 3000
- 3- POWER ON THE PRINTER
- 4- POWER ON THE COMPUTER
- 5- PUT THE TOS FORMATTED DISC INTO DRIVE A AND THE CP/M DISC IN DRIVE B
- 6- DO RESET ON THE FDD 3000 CONTROLLER RESET BOTTON
- 7- DO RESET ON THE COMPUTER INTERFACE BY PRESSING RESET BOTTON ON THE INTERFACE

ON THE SCREEN THE FOLLOWING MESSAGE WILL APPEAR AFTER A SECOND

C 1982 SINCLAIR RESEARCH LTD
C 1984 TIMEX - TOS VA.2

- 8- THE SCREEN WILL CLEAR AND THE FOLLOWING MESSAGE WILL BE DISPLAYED

"DAMAGE'S CHANNEL'S" (if there is no RS 232
communicatio between channel
"A" and "B")

If the communication is possible between the two channels the following message is shown:

" TAKE OUT THE PLUG RS 232 &
CONNECT THE PRINTER CORD! "

PRESS C TO CONTINUE

- 9- PRESS KEY C,
THE SCREEN WILL THEN SHOW:

" MONITOR EMULATOR FOR TC2048/TC2068
Copyright TMX PORTUGAL
VERSION V A1.1 11, APRIL 1986

PLEASE PUT THE CP/M DISKETTE IN DRIVE A:
AND PRESS THE CCONTROLLER RESET BOTTON: "

- 10- REMOVE THE DISC IN DRIVE "A". TURN TO SIDE B AND INTRODUCE IT IN DRIVE "A" AGAIN. PRESS THE RESET BUTTON ON THE CONTROLLER: THE SCREEN WILL SHOW:

```
CP/M VERSION 2.2
COPYRIGHT DIGITAL RESEARCH INC!

CBIOS VERSION VAI.1 COPYRIGHT TMX PORTUGAL

3, JUNE 1986
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- 11- TYPE "T" + "RETURN"
THE SCREEN DISPLAYS:

```
TESTE DO FDD 3000
PREPARADO POR F.FARIA & Z.SILVA
C 1986 TMX PORTUGAL
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TESTE DE ACESSO A DRIVE A CONSTITUIDO POR:

- 1- CRIACAO DO FICHEIRO "TEMP.TMP"
- 2- ESCRITA THE 128 K BYTES (ASCII"?) NO FICHEIRO
- 3- FECHO DO FICHEIRO
- 4- ABERTURA DE FICHEIRO
- 5- LEITURA DO FICHEIRO
- 6- APAGAR AO FICHEIRO

TESTE DO CANAL (:CH_A) DO TIMEX FDD 3000

VERIFIQUE SE A SEQUENCIA DE CARACTERES ESTA CORRECTA!

1234567890QWERTYUIOPASDFGHJKLZXCVBNM

TESTE DE MEMORIA DO TIMEX FDD 3000

MEMORIA OK !!!

A>

- 12- CONNECT THE "RCA" PLUG AND VERIFY IF THE SCREEN IMAGE IS CORRECT.

IF THE ANSWER IS yes THE CONTROLLER IS APPROVED !!!

FDD MANUAL

IMPORTANT ! IMPORTANT ! IMPORTANT ! IMPORTANT !

BEFORE STARTING THE REPAIR SESSION PLEASE MAKE SHURE
THAT YOU HAVE BACKUP COPIES OF THE TEST SOFTWARE

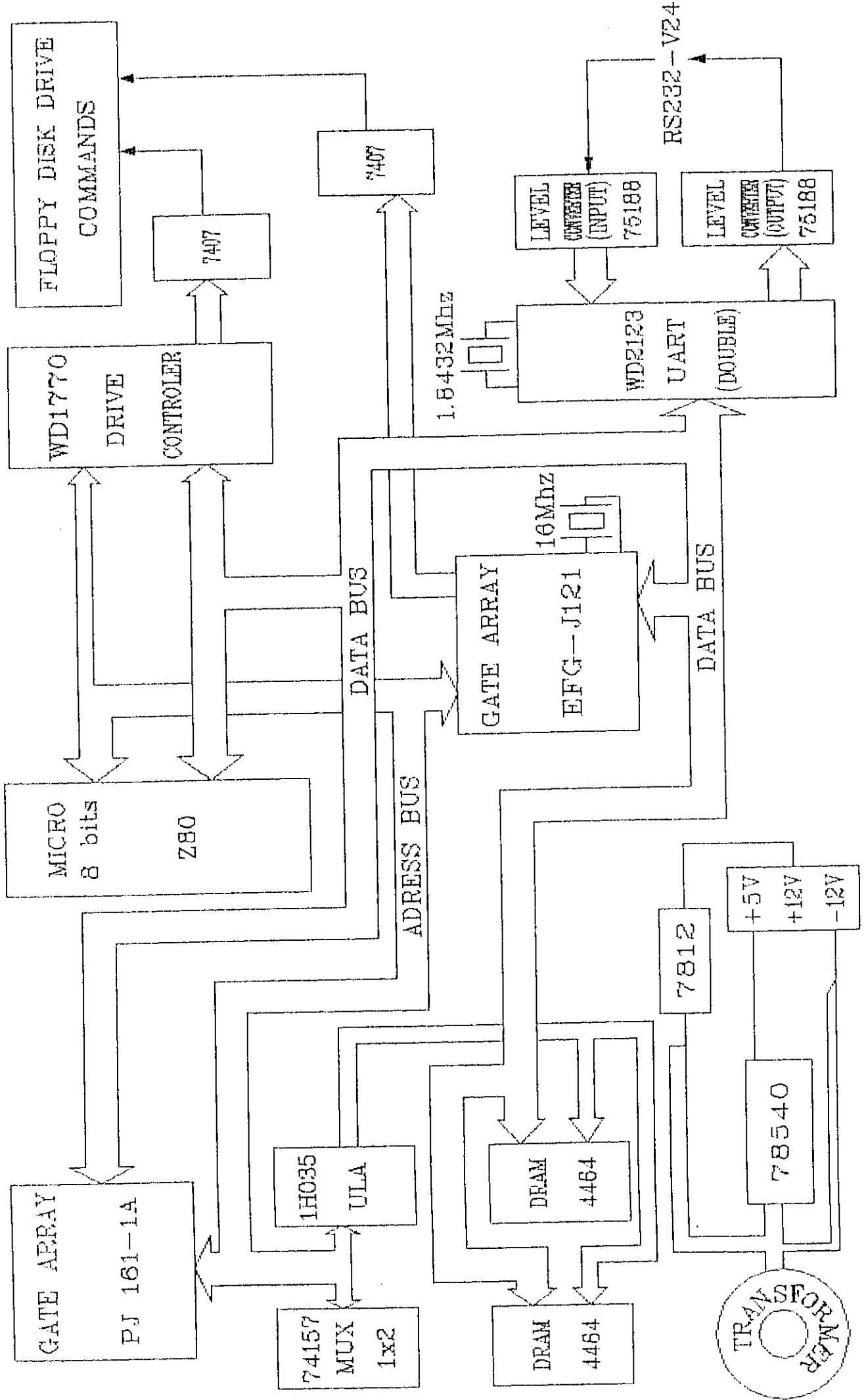
IMPORTANT ! IMPORTANT ! IMPORTANT ! IMPORTANT !

ELECTRICAL SCHEMATICS

V - ELECTRICAL SCHEMATICS

LIST OF SIGNALS:

- 1 - CLOCK 16 MHZ (XIN) (PIN 45 GA121)
- 2 - CLOCK 16 MHZ (XOUT) (PIN 44 GA121)
- 3 - CLOCK 4 MHZ (XOUT) (PIN 42 GA121)
- 4 - CLOCK 8 MHZ (XOUT) (PIN 42 GA121)
- 5 - CLOCK 1.8432 MHZ (X1) (PIN 31 WD2123 - U10)
- 6 - CLOCK 1.8432 MHZ (X2) (PIN 32 WD2123 - U10)
- 7 - D10A/D10K (PIN 15,16 - U17)
- 8 - DRCV/SWC 8 (PIN 15,16 - U17)
- 9 - BASE Q1 (D43C1)
- 10- TIME (PIN 12 - U17)
- 11- C1 (PIN 10 - U17)
- 12- COLLECTOR Q1 (D43C1)
- 13- VOUT (U16)
- 14- VAC



TROUBLESHOOTING

VI - TROUBLESHOOTING

Since the FDD 3000 is composed of several blocks of Hardware and Software, it is necessary to fully identify the origin of the fault if it exists.

A good rule to troubleshoot is to always use a disc that you are absolutely shure that is 100 % working.

Connect all the different parts of the FDD 3000 according to what was described in chapter III as follows:

Power On the TV set or the MONITOR,
switch on the FDD 3000 and computer.

Insert the System Disc into drive "A".

Verify if the power LED is ON:

If the LED in the FDD 3000 is OFF
preform the operations described above in
the reverse order.

Verify if the FUSE located in the rear
panel of the FDD conduits.

Verify if all the plugs are fully
engaged, well inserted, and are in good
conditions.

Verify if all the terminals are well
crimped and inserted in the terminals
and housings.

FDD MANUAL

The LED on the Floppy Disc Drive remains ON but the systems fully operates, i.e. responds correctly to the commands

Verify if the line "IN USE" is not interrupted.

Make shure that the DIODE that connects the "IN USE" signal and ground is good.

Remember that this signal is active LOW meaning a very low voltage level near 0 V (0.4 v).

Verify that the signals in U8 change.

Verify if PIN 11 of the gatte array GA 121 is not short circuited.

Note: Configure the system to work in CP/M mode and load the the Operating System. In good circunstances the LED located in the drive blinks when loading the Operating System, in the end it should stay in the OFF stage. The Led would lit again only in case of a disc access. The "IN USE" signal is set ON or OFF after the drive selection preformed by the Operating System.

The LED remains always ON and the drive can only recognize the TRACK 00.

If the system is still configured to run CP/M verify if the communication cable with the console or computer is in perfect conditions (all the lines warrantying galvanic connection between plugs).

Do a system RESET checking if the system is able to locate other tracks then only TRACK 00. If that happens the problem is located at the CONSOLE/COMPUTER level.

FDD MANUAL

After power on nothing happens:

Verify if the address lines of the controller are not stuck to a fix logic value.

Verify if the DATA lines are active changing logic values.

Verify if the PINS of RD and WR of the processor (Z80) are accessed (PINS 21 and 22 of U1).

FDD MANUAL

The system loads TOS but not the CP/M Operating System:

Verify if the SELECT lines of the different MEMORY banks are correctly selected by the signals "ASEL", "CP/M3", "CP/M2", "CP/M1" (PINS 22, 23, 24, 25, of gatte array GA121).

Note: After POWER ON the bank automatically selected is the one corresponding to "ASEL".

Have in mind that for a correct selection of the MEMORY banks only one can be selected at the time (EXOR).

To check if the MEMORY selects are correct procede as follows: after insering the CP/M disc in drive "A" check, with the help of an Oscilloscope, PIN 22 of gatte array GA 121. If it must go LOW when trying to load the Operating System. Try to load the Operating System by pressing thr RESET button on the controller, all the lines should stay HIGH.

FDD MANUAL

It does not communicate with the interface although it loads TOS.

Verify if PIN 21 of gate array GA121 (MODE) is correctly selected in J1B and J1A. This PIN selects the type of communication to be performed (BYTES or NIBLES).

Verify if all the DATA lines DO (DATA OUT) oscilate within the specified limits.

Verify if the DI lines (DATA IN) oscilate inside the correct values.

FDD MANUAL

After POWER ON nothing happens.

Verify if the system is powered.

Verify if there is no excess power consumption in any of the lines.

Verify the clock signal between PINS 44 and 45 of the GA 121.

Verify the 8 MHz signal at PIN 42 of gate array GA 121.

Verify if the contacts of the RESET button are free from any short-circuit.

Verify if the RESET line (PIN 34) of the gate array GA 121 is at the logic state "1" HIGH.

Press the RESET button and check if the signal across PIN 34 of the same gate array varies inside the correct values.

Verify if the line " INT" is HIGH. Analyse the response of this signal with changes in the RESET.

Verify if the "HALT" command is activated.

Verify if the ON/OFF swicht is operational cutting or conducting when actuated.

Check if the soldered points between the the circuit and the secondary terminals of the transformer are in good conditions.

Check the primary of the transformer.

Measure the DC value of the SPSU output in the open circuit situation.

With the help of resistive loads on the secondary power lines check the voltage drop.

Verify that the power LED is in good conditions and the connecting wires also assure a reliable connection.

FDD MANUAL

Impossible to FORMAT a disc in drive "A".

Verify if the line "WD" is assuring a good connection between the drive and the PCB.

Check if the LOGIC level of PIN 22 of WD 1770 varies during the format operation.

Verify the inverter U-7 (Gatte IN-11, Gatte OUT-10).

Even with the Hardware protection (protection TAB of the disc - open) it is possible to write in the disc.

Verify if the line "WRPT" assures the connection between the drive and PIN 10 of U-11 (GA 121).

Verify the contact of pin of U-11 with the PCB.

The controller outputs to the RS 232 line but does not receive through the same line.

Verify if the +12V and -12V voltages are applied to the BUFFER's CONVERTERS U9 (1489 or 75189).

Check if the decoupling capacitors on the ENABLE pins are correctly inserted and in good working conditions.

Check if the ripple measured in the power lines are inside reasonable limits.

Verify if the clock signal that drives the communication has no other interfering signal in top of it.

Produce an artificial shunt between the input and output pins of the converter, with a very simple software program open a file sending after ASCII characters through the channel. this helps to check the efficiency of the level converters.

FDD MANUAL

After RESET the Controller reads TRACK 00 and the following 3 TRACKS

Verify if any line of U-3 (ULA 1h035) is not stuck LOW.

Check if U-3 do not heat.

Verify the address lines of the microprocessor before and after the multiplex circuit.

Make shure that A0 and A1 change value allowing the execution of the first 4 TOS instructions addressed to the floppy disc drive.

A0	A1		A0	A1	
0	0	DS	0	0	TK00
0	1	MD	0	1	IF
1	0	DIR	1	0	RD
1	1	STEP	1	1	WFTR

TRANSMIT

RECEIPT

Verify if the SELECT lines of the MEMORY banks of the gate array GAL21, after RESET are accessed. Check the status of PIN 9 of U-3 (256CS).

Verify if the Z80 line INT is active.

Verify PIN 28 (WD 1770 - INT).

Verify the oscillations in PIN 27 of Z80 M1 (Machine Code Cycle).

FDD MANUAL

The characters sent to the printer do not to the ones displayed on the screen.

Verify if the printer is configured in the same way as the controller.

BAUD RATE
PARITY
STOP BITS
TEXT/BYTES
BITS/CHARACTER

Check the ripple of the power supply are not out of the specified.

Check if there are no spurious signals on top of the clock signal of the communication IC.

Verify if the UART clock signal is stable.

Check if the decoupling capacitors of the level converters are in good conditions.

Check all the supply voltages at the communication converters.

FDD MANUAL

Loads TOS incompletely

Verify if the address lines multiplexed in U4 and U5 are stuck and do not oscillate.

Does not load TOS and does not select the drive.

Check if the multiplexer MUX U2 (74157) is commutating the address A4 and A15.

Verify if the control signal HPX PIN 14 of U3 (1H035) is not stuck LOW by GA121 or U3.

No VIDE0 output

Check if the pins of the RCA plug are well soldered.

Assure that the grounding of the cable is good.

Verify the connections of the curly cable.

Does not execute RESET because the RESET line is hold LOW.

Verify if C16 is not LOW.

Check if the PINS of the RESET Button are not short-circuited.

FDD MANUAL

MECHANICAL FAULTS

APPENDIX

APPENDIX I-1

The Operating System when invoked by mistake will produce an error message, which could be:

HARDWARE FAULT ON DISK

This message will be display whenever a READ or WRITE error occur during access to the disc.

The error can be located in the disc drive Hardware or by the disc itself. If the disc in drive A is not present this error may in some circumstances be generated. Note that the system can not operate without a disc in drive A.

A faulty disc can also generate this message.

DISC CORRUPTED

This message may be displayed if a disc is partially destroid due to magnetic fields, heat etc.

The Operating System loaded in the controller memory is corrupted by noise generated by electrical interference in the power line.

The new disc inserted in drive A has a new version of the Operating System or no Operating System was previuosly saved in the disc. In any of those re-BOOT the system.

If the message remains after checking al the above is because the disc is fault. try to FORMAT it again but before try to transfer the files to another disc which will work in the majority of the cases.

----- IS WRITE PROTECTED

Appears after a trial to erase a file or directory that is protected via the instruction "ATTR * " (software protection).

This error may also be generated by "SAVE *", "ERASE *", "MOVE *" and "OPEN *".

APPENDIX I-2

DISK-----IS SOFTWARE W/P

It is not possible to create, update, erase, rename or even write protect a file or directory in a software protected disc with the instruction "ATTR *" this error may be generated by the following instructions: "SAVE *", "OPE *", "CLOSE* ", "DIM *", "ERASE *", "LET* ", "MOVE*", "PRINT*", or "ATTR *". Note that the instruction FORMAT does not produce this error since it formats the disc even if the same is software write protected.

DISC-----IS HARDWARE W/P

The disc is Hardware protected by the use of the protection TABS.

The instruction FORMAT * (DISC) does not format a Hardware write protected disc but generates the error message "HARDWARE FAULT ON DISC -----".

DIRECTORY FULL ON DISC----

Generated whenever the systems tries to update a file however there is no space in the disc or directory. This error may occur with the following instructions "DIM *", "CLOSE *", "MOVE *" and "SAVE *".

A drive directory accepts up to 128 files entry. The disc itself uses one entry for its own name. Any other directory uses one entry. The files occupy one entry for each 16k length. This means that a file with 7k uses only one entry and a file with 50k uses 4 .

FDD MANUAL

ILLEGAL USE OF A ROOT NAME

it is impossible to specify a name for the root or from the root. This error may be generated by the instructions that have a PATHNAME as argument; "GOTO *", "GOSUB *" AND "CAT *" (AT THE ROOT LEVEL), also "DIM *", "ERASE *", "SAVE *", (FROM THE ROOT).

CHANNEL BUSY

The instruction "OPEN *" generates this an error message when trying to specify this channel. Change channel or firts close the OPEN file.

CHANNEL NOT OPEN

The instructions that generate this error message are "CLOSE *", "LIST *", "PRINT *", "INPUT *" or "RESTORE *" when trying to use a channel not previously OPEN.

ILLEGAL DRIVE NAME

The instruction FORMAT * generates this error if the specified drive is wrong.

ILLEGAL DISC NAME

The instruction FORMAT * generates this error message when a non valid name is specified for the drive in the second ALFANUMERIC entry. It is necessary to specify a disc name or directory and not a PATHNAME.

DISC -----FULL

The disc as no free space, this error is generated by the instructions "SAVE *", "MOVE *" OR "PRINT *".

THIS ARE THE TOS ERROR MESSAGES

APPENDIX III

PARTS LIST

APPENDIX IV

SPARE PARTS LIST

ITEM	PART NAME	P/NUMBER	%
0035	DISKETTE, TOS VA.2	398-917020	5%
0040	DISKETTE, CP/VH VA.2	398-909464	5
0170	DRIVE, HITACHI HFD350SX	394-970100	1
0180	FUSE, SLOW BLOW 250V/0A5	396-920033	10
0275	ASSY, CONN. CENTER END 21 WAYS	301-970110	5
0285	CORD, WITH MOULD'D" PLUG FEM 15WAYS	395-930035	2
0295	SUB. ASSY, PUSH BOTTOM	301-975110	8
0405	CONN.34 POSITIONS EDGE CARD	395-930055	1
0415	CABLE, FLAT 34 COND. 28AWG, GRAY	395-930040	2
0440	PLUG, HOUSING, 4 POS	396-920050	3
0460	CONN. IN PIN HEADER 2x17 PINS DBL ROW	301-945004	2
0465	PLUG, PCB MOUNTING, 4 WAYS	395-930069	5
0470	PLUG, RGT. ANG. PCB MOUNTING 4 WAYS	395-930070	5
0490	CONN. "D" TYPE 9 PINS SOCKET DGR MALE	301-940200	5
0505	CONN. LOCK HD. STRAIGHT POS 21 WAYS	395-930084	5
0510	XTAL. 16MHZ, HC-18/U	395-930060	2
0515	XTAL. 1.8432MHZ, HC-18U	395-930066	2
0520	IC, CPU HK3880-280	330-910201	5
0530	IC, WD1170	395-930010	5
0535	IC, WD2123	395-930015	5
0600	IC, 75188	395-930085	3
0605	IC, 75189	395-930090	3
0635	IC, 74LS273	395-930025	3
0645	IC, DRAW 4454-150NS	335-912115	5
0650	IC, ULA 311035	334-812014	3
0811	HUB ASSY-PCB	301-975130	
0812	IC, EFGJ121	395-930105	5
0813	IC, EFGJ151	395-930065	5

APPENDIX V

LISTING (BASIC)UBIOS

BIOS

Versao para densidade dupla

VERSAD FINAL EM : 85/10/29

ACTUALIZACAO : 3/6/86

BY : Antonio Nobrega

Esta versao substitui a versao de 20/1/83. O novo BIOS tem processamento de erro para recuperacao de problemas de hardware. Emendado a nao detecao de erro de read a segunda tentativa

CP/M REFERENCE CONSTANTS

IMAG	EQU	100H	;offset para a REL -1 ou 0
MSIZE	EQU	20	;Capacidade da memoria em K bytes
IAS	EQU	(MSIZE-20)*1024+IMAG	;Deslocamento em relacao aos
CCP	EQU	BIAS	;20 K bytes
BDOS	EQU	CCP+806H	
CBIOS	EQU	CCP+1600H	
IOBYTE	EQU	0003H	;Estrutura do IOBYTE nao implementado
CDISK	EQU	0004H	;Drive corrente
NDRIVE	EQU	4	;Numero de drives previsto
NTENT	EQU	10	;Numero de tentativas em caso de erro
			;no acesso a disco
SECLDG	EQU	128	;Sector logico
SECFIS	EQU	256	;Sector fisico
SECI	EQU	0	;Sector fisico representado em 1 byte

Caracteres ASCII

LF	EQU	0AH	;Line feed
CR	EQU	0DH	;Carriage return
FFFEED	EQU	0CH	;Form feed
EOF	EQU	1AH	;End of file
ESCAPE	EQU	1BH	

Protocolo comunicacoes CONIN CONOUT

ASTAT	EQU	0	
BSTAT	EQU	40H	
CSTAT	EQU	10H	
DSTAT	EQU	50H	
STMSK	EQU	DSTAT	
COM	EQU	2FH	;Endereco do porto de comunicacoes
SERVICO	EQU	0FH	
MASK	EQU	5FH	
BYTEON	EQU	0AH	
STANDBY	EQU	05H	
WSTA	EQU	06H	;Flag indica conin esta espera caractere

* Descricao do Hardware *

comunicacao serie
=====

Chip WD 2123

=====

Enderecos:

```
CANALA EQU 80H ;Endereco do porto A
SI0ASTS EQU CANALA + 1 ;Endereco do registo de status
SI0ACHD EQU CANALA + 1 ;Endereco do registo de comando
SI0ADAT EQU CANALA ;Endereco do registo de data
SI0ABR EQU 10H ;Endereco do registo de baud/rate
```

```
CANALB EQU 40H ;Endereco do porto B
SI0BSTS EQU CANALB+1 ;Endereco do registo de status
SI0BCMD EQU CANALB+1 ;Endereco do registo de comando
SI0BDAT EQU CANALB ;Endereco do registo de data
SI0BBER EQU 11H ;Endereco do registo de baud/rate
```

Comandos de programacao

```
ACDH EQU 00000111B ;input e output enable
```

Flags do registo de status

```
RXRDY EQU 00000001B ;Receiver READY
RR EQU 01111000B ;Erro na recepcao ou na emissao
IDERR EQU 37H ;Palavra de comando com reset flag
SI0WORD EQU 27H ;palavra de comando com RQT="0"
PTS EQU 20H
IOMASK EQU 81H
```

Controlador de disco

=====

Chip FD1770

=====

Enderecos:

```
FDC EQU 000H
FDCSTS EQU FDC ;Reg de stat
FDCMD EQU FDC ;Reg de comando
FDCTRK EQU FDC + 1 ;Reg da pista
FDCSEC EQU FDC + 2 ;Reg de sector
FDCDAT EQU FDC + 3 ;Reg de dados
```

Comandos de programacao

```
STCHD EQU 05H ;Restore
ERCHD EQU 15H ;Seek c/ verify
STICHD EQU 55H ;Step in
PTOCHD EQU 75H ;Step out
RSCHD EQU 80H ;Read sector
RDMCHD EQU 98H ;Read multiple sectors
WRSCHD EQU 0A0H ;Write sector c/ precompensacao
RACHD EQU 0C0H ;Read address
RICHD EQU 0D0H ;Force interrupt
```

Flags do status

```
BUSY EQU 0 ;Busy
DLOST EQU 2 ;Data lost
FOUND EQU 4 ;Record not found
PROTE EQU 6 ;Write protect
```

```

;
; Outros registos
; =====
DRQ EQU 02FH ;Registo de comunicacoes
; bit 0-6 usados comunicacao em nibbles
; bit 7 DRQ
HRD EQU 0EOH ;Registo de controle
; bit 0 - drive sel 0
; bit 1 - drive sel 1
; bit 2 - drive sel 2
; bit 3 - drive sel 3
; bit 4 - side select
; bit 5 - /EDEN ( densidade)
; bit 6 - /BOOT
; bit 7 - IN USE

```

```

;
; Programacao
;
DENSID EQU 01011111B ;Programacao do porto de controle
INTPRG EQU 11011111B
MSKDRV EQU 00001111B ;Mascara para os drives
LUZ EQU 7 ;Acende luz no drive seleccionado

```

```

;
; *****
; * Tabela de JUMPs do BIOS *
; *****

```

```

JP BOOT
JP WBOOT
JP CONST
JP CONIN
JP CONOUT
JP IHPR
JP PUNCH
JP READER
JP HOME
JP SELDSK
JP SELTRK
JP SETSEC
JP SETDMA
JP READ
JP WRITE
JP IMPRST
JP SECTRAN

```

```

;
; LOGO inicial da versao do bios
;

```

```

SIGNON:: DB ESCAPE
DEFM "H"
DB ESCAPE
DEFM "J"
DEFM "CP/M Version 2.2"
DB CR,LF
DEFM "Copyright by DIGITAL RESEARCH, Inc."
DB CR,LF,LF
DEFM "Cbios Version A1.1 Copyright by THX PORTUGAL"
DB CR,LF,LF
DEFM "3, June 1986"
DB CR,LF,LF
DEFM "$"

```

```

;
; *****
; * Subrotinas do BIOS *
; *****

```

* BOOT *

; Procedimento a ser executado depois do LOADER
; em que inicializa o IOBYTE o disco corrente a
; zero, e afixa a mensagem inicial. Por fim ini-
; cializa a page 0 do CP/M com os valores conve-
; nientes passando em seguida o comando ao CCP.
;

```
BOOT:: XOR A
LD (IOBYTE),A ;Reset IOBYTE
LD (CDISK),A ;Inicializa o drive selecionado
LD (UNIT),A
CALL INIT
CALL INITRS ;inicializa canais rs_232
LD HL,SIGNON
CALL PMSG ;Imprimir a mensagem inicial
JP GOCPM
```

* WBOOT *

; Inicializa o hardware, carrega o CCP e o BDOS
; e inicializa a pagina 0 do CP/M passando em se-
; guida o comando ao CCP.

```
WBOOT:: LD SP,STACK
DI
CALL INIT
XOR A
CALL LIGHT
LD HL,CCP ;Endereco de base do CP/M
LD C,FDCDAT
LD B,0
LD D,1
WBLOP:: LD A,D
CALL RDLOOP
JR NZ,WBOOT
LD A,(0H
INC D
CP D
JR NZ,WBLOP
CALL STEPIN ;pista 1
XOR A
CALL RDLOOP ;Sector 0 pista 1
CALL LIGHTOF
```

```
GOCPM:: LD A,0C3H
LD (00H),A
LD HL,CBIOS+3
LD (01H),HL
LD (05H),A
LD HL,BDOS
LD (06H),HL
XOR A
LD (BLREAD),A ;Nada no BUFFER de blocagem
LD (BLALT),A
LD BC,0080H
CALL SETDHA
LD A,(CDISK)
LD C,A
```



```

*****
*                               Subrotinas de I/O de caracteres                               *
*****

```

```

*****
*                               CONST                               *
*****

```

```

; Indica o status da consola
; .parametros de saida
;     reg. A - FF se existe caracter
;             - 00 se nao existe caractere
; .altera o registo A

```

```

CONST:: IN      A,(COM)
        AND     MASK
        CP      04
        JR      Z,CONSON
        XOR     A
        RET

```

```

CONSON:: LD      A,OFFH
        RET

```

```

*****
*                               CONIN                               *
*****

```

```

CONIN:: LD      (SVSTK),SP
        LD      SP,STACK
        CALL    RXBYTE ;Recebe byte do terminal
        LD      C,A
        LD      SP,(SVSTK)
        RET

```

```

*****
*                               CONOUT                              *
*****

```

```

CONOUT:: LD      (SVSTK),SP
        LD      SP,STACK
        LD      A,C
        CALL    TXBYTE ;Transmite byte
        LD      SP,(SVSTK)
        RET

```

```

*****
*                               IMPR                               *
*****

```

```

IMPR:: LD      (SVSTK),SP
        LD      SP,STACK
        CALL    PRINTER
        LD      SP,(SVSTK)
        RET

```



```
LD      (TRACK), A
RET
```

```
*****
*                               SETSEC                               *
*****
```

```
SETSEC:: LD      A, C
DEC      A
LD      (SECTOR), A
RET
```

```
*****
*                               SETDMA                               *
*****
```

```
SETDMA:: LD      (POINTR), BC
RET
```

```
*****
*                               SELDSK                               *
*****
```

```
SELDISK:: LD      HL, 0
LD      A, C
CP      NDRIVE
RET     NC
LD      (UNITDR), A
LD      L, A
ADD     HL, HL
ADD     HL, HL
ADD     HL, HL
ADD     HL, HL
LD      DE, DPHTAB
ADD     HL, DE
RET
```

```
*****
*                               HOME                                *
*****
```

```
HOME:: LD      A, (UNITDR)
LD      C, A
CALL   LIGHT
LD      A, RSTCMD
OUT    (FDCMD), A
CALL   TEMP
```

```
HOMLP:: IN     A, (FDCSTS)
BIT    BUSY, A
JR     NZ, HOMLP
CALL   LIGHTOF
XOR    A
RET
```

```
*****
*                               READ                                *
*****
```

```
ZAD:: LD      (SVSTK),SP
      LD      SP,STACK
      CALL   SAVJMP ;guarda salto de int e coloca novo jmp
      LD      A,(BLREAD) ;Testar se o BUFFER ja foi
      AND     A ;lido alguma vez
      JR      Z,RDCONT
      CALL   IGUAL ;Testa se os sectores no BUFFER
                  ;e para ser lido sao iguais
                  ;se SIM
                  ;          entao A = 0
                  ;          senao A = FF

      AND     A
      JR      Z,REXISTE
      LD      A,(BLALT) ;Testa se o sector no BUFFER
                  ;foi alterado
                  ;se SIM
                  ;          entao "blalt" = FF
                  ;          senao "blalt" = 0

      AND     A
      JR      Z,RDCONT
      CALL   WR256
      AND     A
      JR      NZ,RDFIM
CONT:: LD      HL,BLDRIV
      LD      A,(UNITDR)
      LD      (HL),A ;Bl driv ← UNITdr
      INC     HL
      LD      A,(TRACK)
      LD      (HL),A ;Bl pist ← track
      INC     HL
      LD      A,(SECTOR)
      LD      (HL),A ;Bl sect ← sector
      INC     HL
      XOR     A
      LD      (HL),A ;Bl alt ← 0 (* nao alterado *)
      DEC     A
      LD      (BLREAD),A
      CALL   RD256
      AND     A
      JR      NZ,RDFIM ;Erro
      LD      (BLALT),A
REXISTE:: CALL   RTRANSF
          XOR     A
DFIM:: LD      (ERRORD),A ;flag de erro de leitura
      CALL   PUTJMP ;repoi salto
      LD      SP,(SVSTK)
      RET
```

```
*****
*                               *
*                               *
*****
```

```
WRITE:: LD      (SVSTK),SP
        LD      SP,STACK
        CALL   SAVJMP ;guarda 32h
        PUSH   BC ;Salvar se e acesso a directoria
                  ;se e o primeiro ou se e um acesso
                  ;normal
        LD      A,(BLREAD) ;Testa se o BUFFER ja foi
        AND     A ;lido alguma vez
        JR      Z,WRCONT
```

```

CALL    IGUAL    ;Testa se os sectores no BUFFER
                ;e para ser lido sao iguais
                ;se SIM
                ;
                ;      entao A = 0
                ;      senao A = FF

```

```

AND     A
JR      Z,WEXISTE
LD      A,(BLALT) ;Testa se o sector no BUFFER
                ;foi alterado se SIM
                ;      entao "blalt" = FF
                ;      senao "blalt" = 0

```

```

AND     A
JR      Z,WRCONT
CALL    WR256
AND     A
JR      NZ,WRFIM

```

```

WRCONT:: LD      HL,BLDRIV
LD      A,(UNITDR)
LD      (HL),A      ;Bl driv <-- UNITdr
INC     HL
LD      A,(TRACK)
LD      (HL),A      ;Bl pist <-- track
INC     HL
LD      A,(SECTOR)
LD      (HL),A      ;Bl sect <-- sector
INC     HL
XOR     A
LD      (HL),A      ;Blalt <-- 0 (* nao alterado *)
DEC     A
LD      (BLREAD),A
CALL    RD256
AND     A
JR      NZ,WRFIM    ;Erro

```

```

WEXISTE:: CALL    WTRANSF
POP     BC
LD      A,C
CP      1
JR      NZ,WRNDIR
CALL    WR256
AND     A
JR      NZ,WRFIM
LD      (BLREAD),A

```

```

WRNDIR:: XOR     A
JR      WRFIM
WRFIM:: POP     BC
WRFIM:: CALL    PUTJMP
LD      SP,(SVSTK)
RET

```

```

;
; *****
;                               OUTRAS
; *****
;

```

```

;      *** init ***
;

```

```

; Inicializa todo o hardware
; .controlador de disco
;

```

```

INIT:: LD      A,INTPRG
OUT     (HRD),A
LD      B,NDRIVE
LD      A,OFEH
INTLP:: OUT     (HRD),A

```

```

RLC      A
DJNZ    INTLP
LD      A,DENSID
OUT     (HRD),A
AND     OFEH
OUT     (HRD),A
LD      (IMAGSEL),A
LD      A,RSTCMD
OUT     (FDCMD),A
CALL    TEMP
INITLP:: IN      A,(FDCSTS)
        BIT     BUSY,A
        JR      NZ,INITLP
        XOR     A
        LD      (BLREAD),A
        LD      (BLALT),A
        LD      (UNIT),A
        DEC     A
        LD      B,NDRIVE
        LD      HL,DRVTBL
INLP::  LD      (HL),A
        INC     HL
        DJNZ   INLP
        CALL   LIGHTOF
        RET

;
;
;      *** RD256 ***
;
;Le 256 bytes para o BUFFER
;
RD256:: LD      A,(BLDRIV)
        LD      C,A
        CALL   LIGHT
        LD      A,NTENT
        LD      (RETRY),A
        CALL   PREPARA ;tenta dez vezes o seek
        AND     A
        JR      NZ,RDERR
RTRY::  LD      HL,BLBUFF ;endereco buffer
        CALL   RDDSK  ;tenta leitura
        AND     A
        JR      Z,RFIM  ;se o ok sai
        LD      A,(RETRY)
        DEC     A
        LD      (RETRY),A
        JR      NZ,RTRY
RDERR:: LD      B,255
RDOOUT:: CALL   LIGHTOF
        LD      A,B
        RET
RFIM::  LD      B,00
        JR      RDOOUT
RDDSK:: IM      1
        EI
        LD      A,RDSCMD
        OUT    (FDCMD),A
RLP::  IN      A,(DRQ)
        RLA
        JR      NC,RLP
        INI
        JR      RLP
;
;
;      *** WR256 ***

```

```

;
;
WR256:: LD      A,(BLDRIV)      ;Acesso ao drive do buffer
        LD      C,A
        CALL    LIGHT
        LD      A,NTENT
        LD      (RETRY),A      ;10 tentativas
        CALL    PREPARA ;tenta escrita
        AND     A      ;erro?
        JR      NZ,WRERR      ;sim jump sai
WRTRY:: LD      HL,BLBUFF
        CALL    WRDSK      ;tenta escrita
        AND     A      ;erro?
        JR      Z,WFIM
        BIT     6,A      ;disco protegido?
        CALL    NZ,DSKPRT      ;sim logo para consola
        CP     "R"      ;retry?
        JR      Z,WRTRY ;sim tenta nova escrita
        LD      A,(RETRY)      ;tenta dez vezes
        DEC     A
        LD      (RETRY),A
        JR      NZ,WRTRY
WRERR:: LD      B,255      ;flag erro
WRQUT:: CALL    LIGHTOF ;desliga led
        LD      A,B
        RET
WFIM::  LD      B,0      ;flag write ok
        JR      WRQUT
WRDSK:: EI
        LD      C,FDCDAT      ;endereço porto data
        LD      A,WRSCMD
        OUT     (FDCMD),A
WRLP::  IN      A,(DRQ)
        RLA
        JR      NC,WRLP
        OUTI
        JR      WRLP
;
;

```

```

;      *** PRINTER ***
;
;

```

```

;Transmite byte recebido registo C
;para canal serie seleccionado
;

```

```

PRINTER:: LD      A,SIOWORD
        OUT     (SIDACMD),A
        CALL    ERROA
IMPHR::  IN      A,(SIDASTS)
        BIT     7,A      ;cts low ?
        JR      Z,IMPHR ;nao espera
        BIT     0,A      ;registo de tx. esta ready?
        JR      Z,IMPHR ;nao espera
IMPTX::  LD      A,C
        OUT     (SIDADAT),A
        RET
;
;

```

```

;      *** PRINSTS ***
;
;

```

```

;Da o estado do periferico (rs232)
;associado com o canal seleccionado
;

```

```

PRINSTS:: CALL    ERROA

```