

Preliminary Specification

N C R D E C I S I O N M A T E V D I A G N O S T I C S

1.0 GENERAL:

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Level 0 and Level 1 Diagnostics for Decision Mate V

Level 0: -integrated on Main Board
-checking of basic microprocessor and controllers functions
-error messages on LED row on the back rear
-executed after Power On or Reset

Level 1: -pluggable box connected to system bus
-Power Supply function controlled
-tests selectable by switches or keyboard inputs
-Level 1 ROM resitend on the box
-error messages on CRT or two 7-segment displays

1.1 Usage Intention

Installed and used by field engineering and by customer
Easy understandable error messages
Test of modules and boards down to the lowest replaceable part

To perform the diagnostic, the module will be inserted in slot 7 on the rear of the cabinet.

2.0 LEVEL 0 Diagnostics

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Started after each power on or reset with a general test of all components:

- Processor
- ROM check
- RAM test
- Keyboard
- GDC Controller
- DMA Controller
- Flex Disk Controller

2.1 Description of Level 0 Tests

Level 0 Diagnostics

1. Processor Test

2. Firmware Sum Check Test

3. Memory Test

Write/Read test of RAM locations 0000H - FFFFH with pattern 55/AA.

4. Keyboard Processor (8041) Test

Self test of processor and checking of possible country code of keyboard.

5. CRT Controller Test

6. DMA Controller (8237) Test

Write/Read test of registers is performed.

7. Flex Disk Controller (8272) Test

Read Main Status of flex Disk Controller and if status is no 80H test failed

2.2 Level 0 Error Codes

If an error is detected the program stops and the LED row on the rear side shows the error status:

"x" indicates a burning LED

| LED number: | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |
|-------------|---|---|---|---|---|---|---|---|----------------------|
| | x | x | x | x | x | x | x | x | Processor |
| | x | | | | | | | x | ROM Sum Check Error |
| | x | | | | | | x | | CRT Controller |
| | x | | | | | x | | | Flex Disk Controller |
| | x | | | | x | | | | not used |
| | x | | | x | | | | | Keyboard Error |
| | x | | x | | | | | | DMA Controller Error |
| | x | x | | | | | | | Memory Error |

3.0 LEVEL 1 Diagnostics:

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3.1 Hardware Scope

- 8 k ROM
- 2 k RAM
- Timer
- port for switches and 7 segment display
- Memory select logic
- LEDs for display of running
- reset switch

3.1.1 Running LED's

- Voltage indicator
 - 5 Volts over under and correct voltage
 - 12 Volts over under and correct voltage
- MEMR/ Memory Read indicator - when it is "on" something going on
- PCLK Processor Clock - when it is "on" the processor clock runs
it is no indication of right clock frequ
- HOLDA Holdacknowledge indicator - when it is "on" the processor
is not in HOLD, it can work

All these green LED's must burn when the board is running.

3.1.2. Memory Select Logic:

As the entire 64k Memory is occupied by the user Ram, a select logic must share areas which are also used by the diagnostic firmware

Switch logic of shared memory with two
port lines:

PC 1 PC 0

| | | | |
|---|---|------------------|------------------|
| 0 | 0 | disable diag ROM | disable diag RAM |
| 0 | 1 | enable diag ROM | disable diag RAM |
| 1 | 0 | disable diag ROM | enable diag RAM |
| 1 | 1 | enable diag ROM | enable diag RAM |

3.1.3 ROM/RAM

8k ROM 2 * 2732
2k RAM 1 * 6116

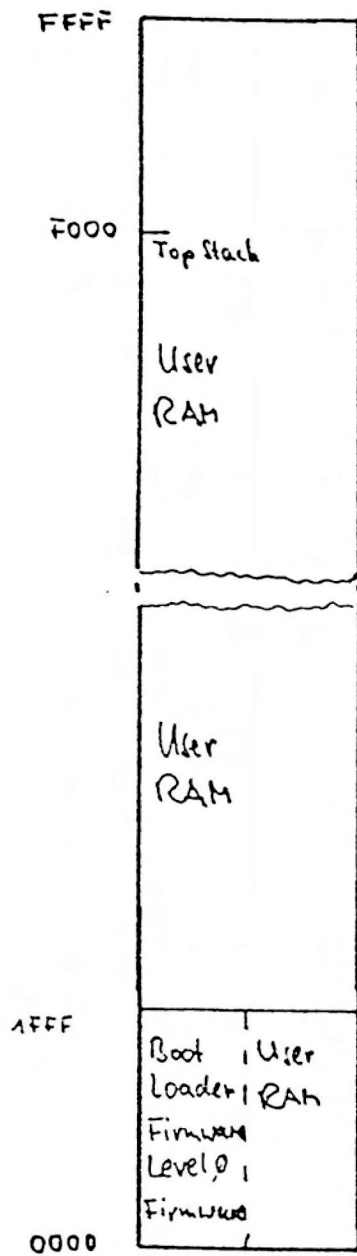
3.1.4. Timer (8253)

For interrupts (running into an endless loop)
Measuring of timing

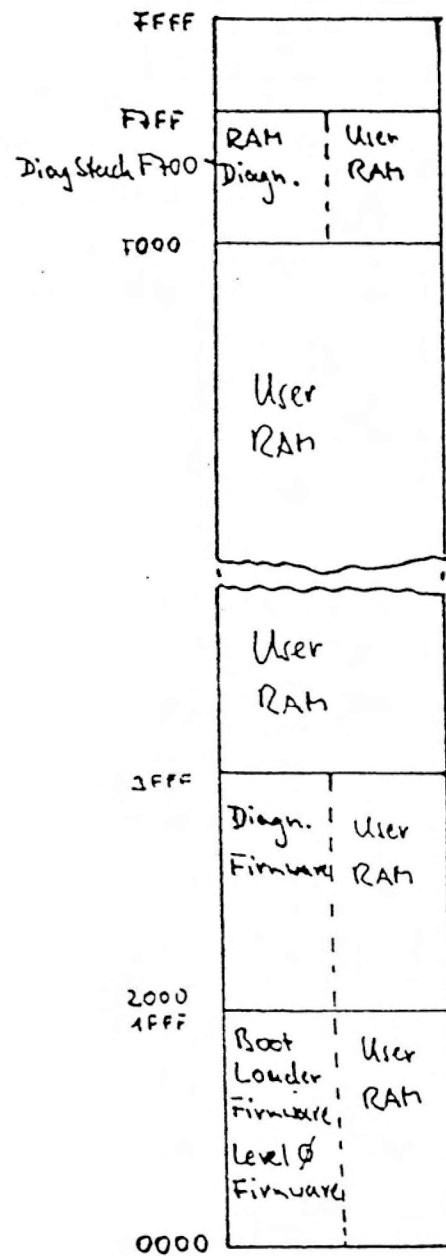
3.1.5. Ports Using (8255)

8 test selection switches
7 segment displays
Memory select logic

3.1.6. Memory Sharing in Diagnostic



Memory Sharing DM V



















Memory Sharing Diagnostic DM V

3.2. Functions of Diagnostic Box

Requirement for a successful test start:

No fault in the Processor and Address-Data bus

3.2.1.1. Function and test switch select

| | OFF | ON | |
|-----------------|---|---|-----------------|
| OFF |  |  | ON Test Start |
| Single Run |  |  | Continuous Run |
| Module Message |  |  | Detail Message |
| Maintenance LED |  |  | Maintenance CRT |
| |  |  | Select 1 |
| |  |  | Select 2 |
| |  |  | Select 3 |
| |  |  | Select 4 |

3.2.1.2. Switch Setting of Select 1 to Select 4

| Test # in Maintenance Mode | Select Switch | | | | Test Name |
|-------------------------------|---------------|---|---|---|--------------------------|
| | 4 | 3 | 2 | 1 | |
| - | 0 | 0 | 0 | 0 | Self Configuration Test |
| 1 | 0 | 0 | 0 | 1 | DMA Controller Test |
| 2 | 0 | 0 | 1 | 0 | CRT Controller Test |
| 3 | 0 | 0 | 1 | 1 | Disk Controller Test |
| 4 | 0 | 1 | 0 | 0 | Keyboard Controller Test |
| 5 | 0 | 1 | 0 | 1 | CRT Test |
| 6 | 0 | 1 | 1 | 0 | Disk Drive A Test |
| 7 | 0 | 1 | 1 | 1 | Disk Drive E Test |
| 8 | 1 | 0 | 0 | 0 | Keyboard Test |
| 9 | 1 | 0 | 0 | 1 | Memory Test |
| A | 1 | 0 | 1 | 0 | Main Board Test |
| E | 1 | 0 | 1 | 1 | Disk Drive Alignment |
| C | 1 | 1 | 0 | 0 | not used |
| D | 1 | 1 | 0 | 1 | not used |
| E | 1 | 1 | 1 | 0 | not used |
| F | 1 | 1 | 1 | 1 | not used |

- ON/OFF Switch

OFF - diagnostic box not activ

ON - run diagnostic

- Continous Run

OFF - selected diagnostic test passes only one time then stops and displays the error code or 99 for no errors

ON - the test is running as long as this switch is on or an error is detected

Switch is only activ if Maintenance is OFF

- Detail Message

OFF - the shown error code on the 7 segment display is only a general error code, pointing to a failed module

ON - detailed error code will enable an educated user to isolate the trouble to the lowest field replaceable part

Switch is only activ if Maintenance is OFF.

- Maintenance Switch

OFF - test are selected by switches
error messages shown on 7 segment displays
only the selected test displayed on CRT

ON - a test menu is shown on CRT, and the tests are selectable by keyboard
error messages on CRT the 7 segment display shows 00.

Select switches 1..4

these switches select the specified module test in Maintenance Off
they are binary coded

4.0 Description of Level 1 Tests

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After entering Level 1 diagnostic a Sum Check of Diagnostic ROM's is done.

0. Self Configuration Test

The Self Configuration Test execution enclose several tests:

- Main Board Test
- Keyboard Processor Test
- CRT Test

In a later version it shall also test the entire system configuration with connected interfaces, RAM extensions or 16-Bit extension.

1. DMA Controller Test

A register Read/Write test with different bit pattern is performed and if the bit pattern does not match, an error code is displayed.

2. CRT Controller Test

Write/Read of the Graphic RAM with pattern 55/AA, AA/55, 00/FF and FF/00. The pattern is displayed on the screen.

3. Disk Controller Test

An invalid command is sent to the Disk Controller and the status register is checked.

4. Keyboard Controller Test

A self check command is send to the keyboard controller on the main board and the return status is checked for error.

5. CRT Test

Display some pictures on the screen

- Cursor Movement draws a square on the screen
- Full screen display with character "E"
- Full screen display with the whole character set (00-7F Hex).
each picture is seperated by a key input

6. Disk Drive A Test

To check the drive a scratch disk must be inserted.

- Restore function (position to track #0)
- Format track (last track #27 Hex is formatted)
- Seek function (seek track #27 Hex)
- Write data to disk (track #27 Hex is written)
- Read data from disk and compare (read track #27 Hex)

7. Disk Drive B Test

The same as for Drive A.

8. Keyboard Test

Performs first the Keyboard Controller Test (Test #4)

Next the language code is read and displayed.

In the Maintenance On Mode you can additionally test each key typed in, which is displayed on the CRT (including sound of tone).

9. Memory Test

The Memory is checked with 55/AA,AA/55,00/FF and FF/00.

Directly following a Memory Address Decode Test is performed.

The memory address is written into the addressed memory location.

Processor is set into HALT to wait for automatic refresh from dynamic RAM controller.

After one second, all memory locations are read and verified with the written values.

A. Main Board Test

It runs the entire set of component tests on the Main Board

- Run Level 0 Diagnostic
- Main Board LED Test
- Several Tests described before
 - DMA Controller
 - CRT controller
 - Disk Controller
 - Keyboard Controller
 - Memory Test

E. Disk Alignment

After a Restore on the selected Drive, a continuous Read of Track 16 is performed. Stop the test by entering any key on the keyboard.

A special alignment Disk is necessary for this test.

5.0 Error Codes and Error Messages

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5.1. Error codes

10 - Main Board

- 11 - Level 0 Diagnostic Error
- 12 - DMA Controller Error
- 13 - Disk Controller Error
- 14 - Keyboard Controller Error
- 15 - CRT Controller Error (GDC Graphic Display Controller)

20 - Memory Address Error

21 - Memory Bit 1 Error

to

28 - Memory Bit 8 Error

30 - Disk Drive Error

- 31 - Recalibrate Error
- 32 - Disk Format Error
- 33 - Read ID Error
- 34 - Write Data Error
- 35 - Read Data Error
- 36 - Write/Read Data Compare Error

50 - Keyboard Error

51 - Keyboard not connected

52 - Keyboard Processor Error

90 - Diagnostic Box Sum Check Error

99 - Test passed OK Processor stops

5.2. Error Messages on CRT Screen

In the Maintenance On Mode all error messages and codes are displayed on the screen. This is a listing and short description of these messages.

0. General Messages

Level 0 failed

ERROR CODE = 11
LEVEL 0 DIAGNOSTICS ERROR STATUS = x x x x x x x x

x = 0 or 1 bit pattern of Level 0 LED's (see 2.2.)

Level 1 ROM check error

ERROR CODE = 90
ROM SUM CHECK = xx

xx = Another Sumcheck than 00 is a error

1. DMA Controller Test

ERROR CODE = 12
DMA CONTROLLER ERROR ON CHANNEL n
PORT EXP OBS
ADDR VALUE
ii xx xx

n = 0..3

ii = Portaddress 20...27

xx = Data

2. CRT Controller Test

ERROR CODE = 18
GDC RAM WRITE/READ ERROR
Graph. RAM ADDR. = iiii
EXP. VALUE = xx
OBS. VALUE = xx

iiii = Graphic RAM address 0...3840 Hex

xx = Data

3. Disk Controller Test

ERROR CODE = 13
FLEX DISK CONTROLLER ERROR
STATUS 0 = xx

xx = Another Status 0 than 80H are errors

4. Keyboard Controller Test

ERROR CODE = 14
KEYBOARD CONTROLLER ERROR
SELF CHECK STATUS = xx

xx = Another status than 55H is an error

5. CRT Test

This phase has no messages. You see only the drawn pictures.

6. Disk Drive A Test

1. Recalibrate Test

ERROR CODE = 31
RECALIBRATE ERROR
STATUS 0 = aa
PRESENT CYL.(HEX) = nn

aa =

nn = Present Track

2. Format Error

ERROR CODE = 32
FORMAT ERROR
DISK STATUS VALUES
ST0 ST1 ST2 C H R N
xx xx xx xx xx xx xx

ST0 = Status Register 0

ST1 = Status Register 1

ST2 = Status Register 2

C = Current selected track number 0-27 Hex

H = Head number 0 or 1

R = Sector number which is read or written

N = Number of data byte written on a sector

3. Read ID Error

ERROR CODE = 33
READ ID ERROR
DISK STATUS VALUES:
ST0 ST1 ST2 C H R N
xx xx xx xx xx xx xx

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ERROR CODE = 34
WRITE ERROR
DISK STATUS VALUES:
ST0 ST1 ST2 C   H   R   N
xx  xx  xx  xx  xx  xx  xx

```

5. Read Data and Compare Error

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ERROR CODE = 35
READ ERROR
DISK STATUS VALUES:
ST0 ST1 ST2 C   H   R   N
xx  xx  xx  xx  xx  xx  xx

```

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ERROR CODE = 36
READ DATA COMPARE ERROR

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7. Disk Drive B Test

The error messages are the same as for drive A.

8. Keyboard Test

At this time can also appear an error from Keyboard Controller

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ERROR CODE = 51
KEYBOARD NOT CONNECTED

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ERROR CODE = 52
KEYBOARD PROCESSOR ERROR

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9. Memory Test

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ERROR CODE = 20
MEMORY ADDRESS ERROR
EXP. ADDR. = iiii
OBS. ADDR. = iiii

```

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ERROR CODE = aa
MEMORY ERROR ON BIT n
ADDR.      EXP/OBS VALUE
iiii      xx  xx

```

aa = 21...28 corresponds with the error bit position
n = Bit position 1..8
iiii = RAM Address from 0 to FFFFH
xx = Data

8. Main Board Test

In this phase can appear all messages from

- Level 0
- Memory
- DMA controller
- Disk Controller
- Keyboard
- GDC RAM Test

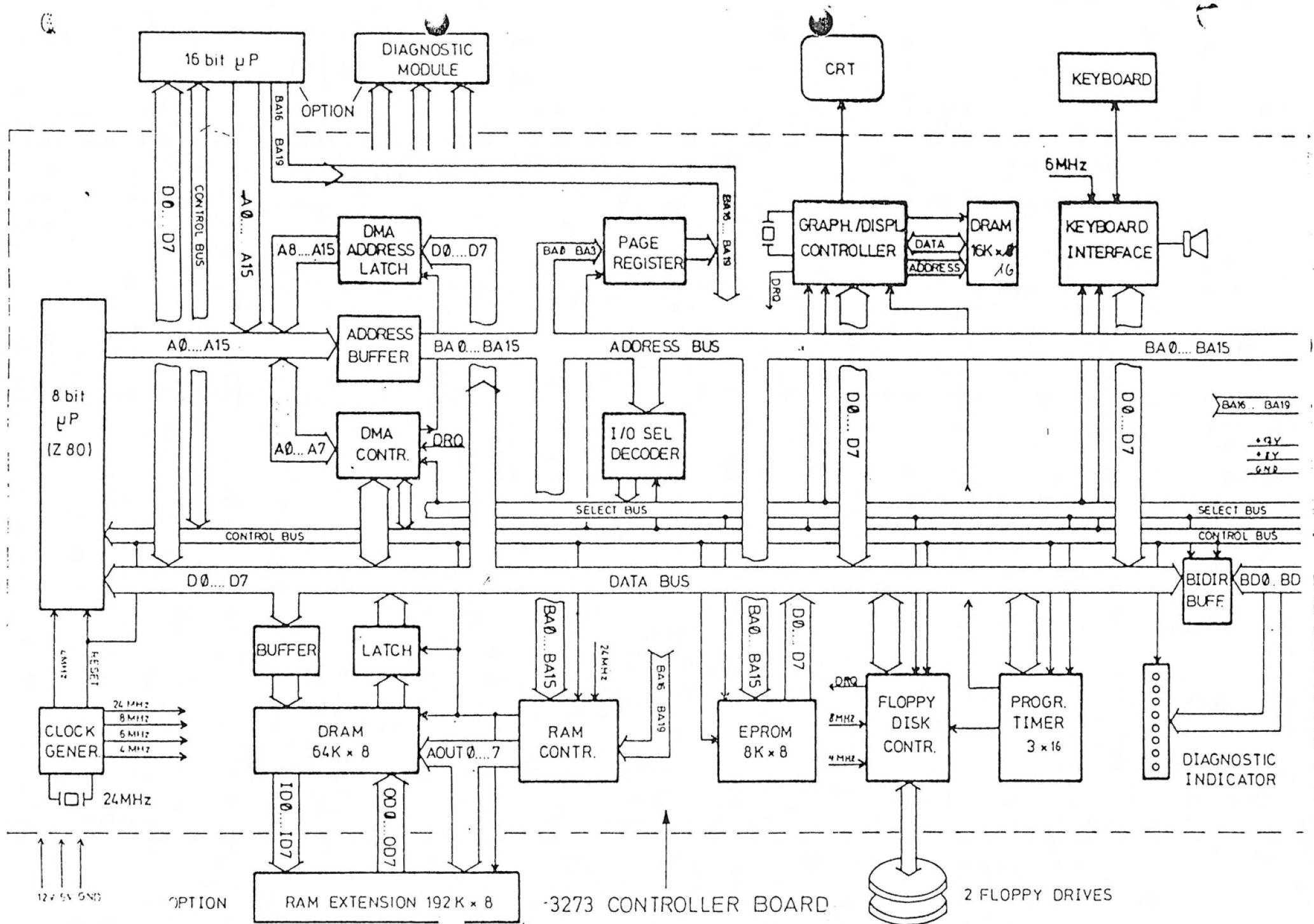
additionally a Lamp Test of the level 0 LED's is performed

- all Lamps on
- all Lamps off
- each Lamp seperately on

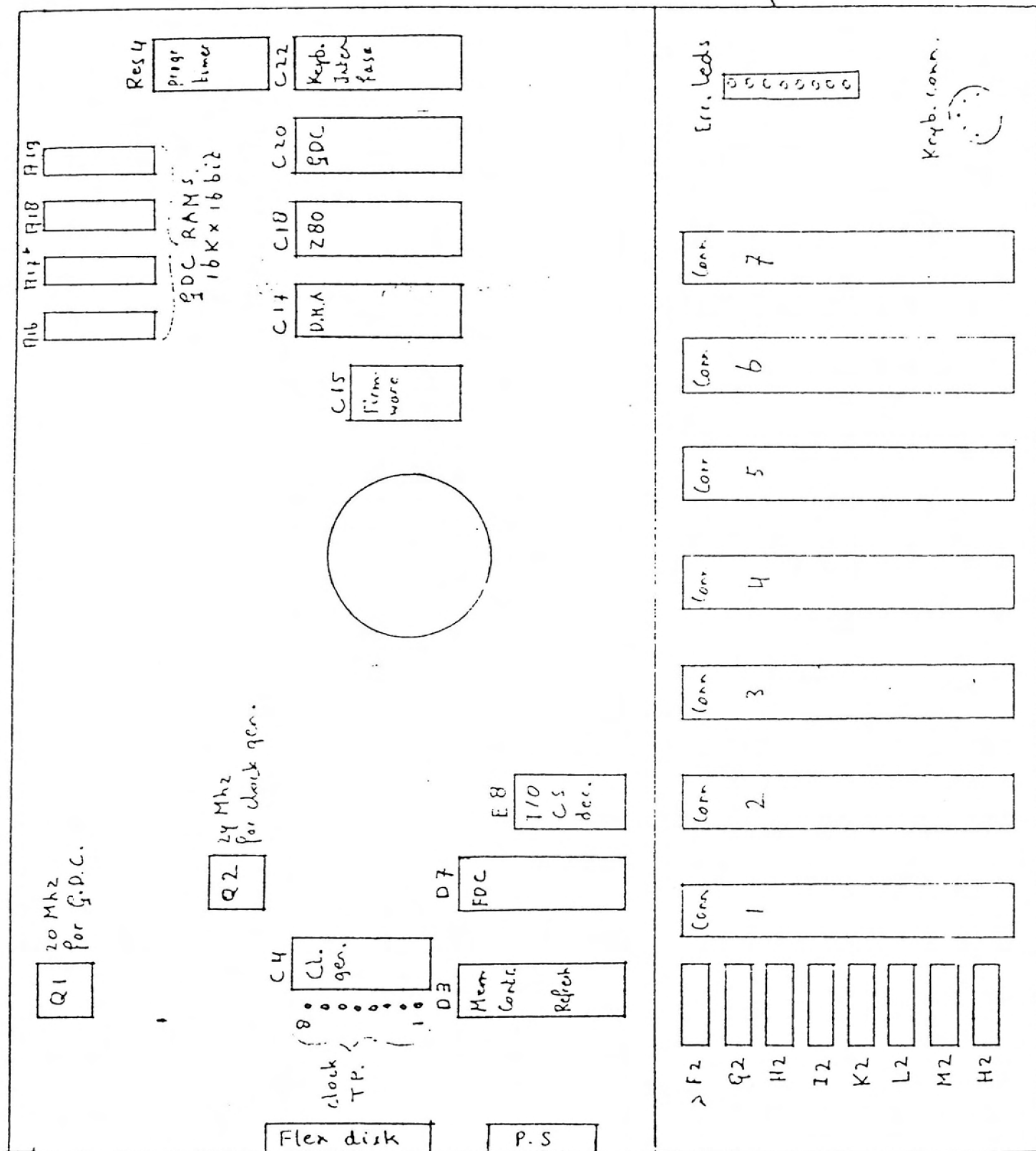
between these phases is always 0.5 second delay

9. Disk Alignment Test

No Error Message is displayed.



CONTROLLER BOARD.


$$\begin{array}{r} 1.91x \\ 1.62x \\ \hline 3.53x \end{array}$$

byte.