Preliminary Specification

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NCR DECISION MATE V DIAGNOSTICS

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1.0 GENERAL:

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: -plugable 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 enginering 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

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:

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

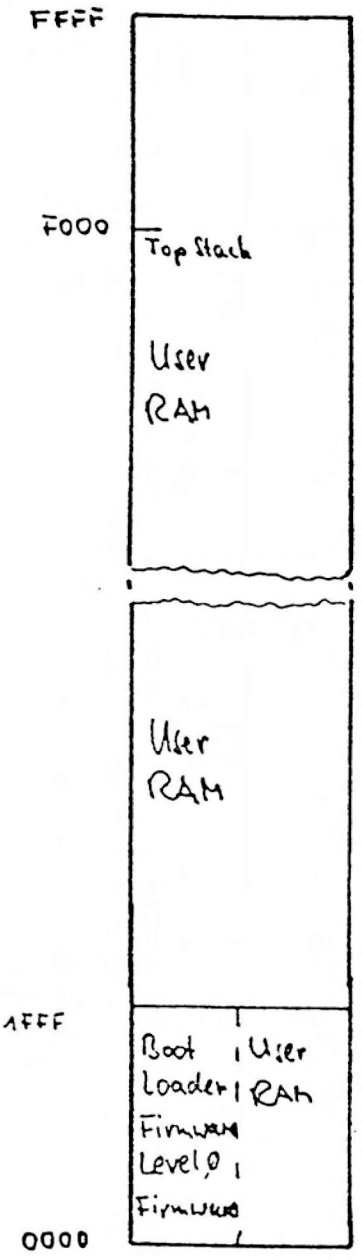
3.1.4. Timer (8253)

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

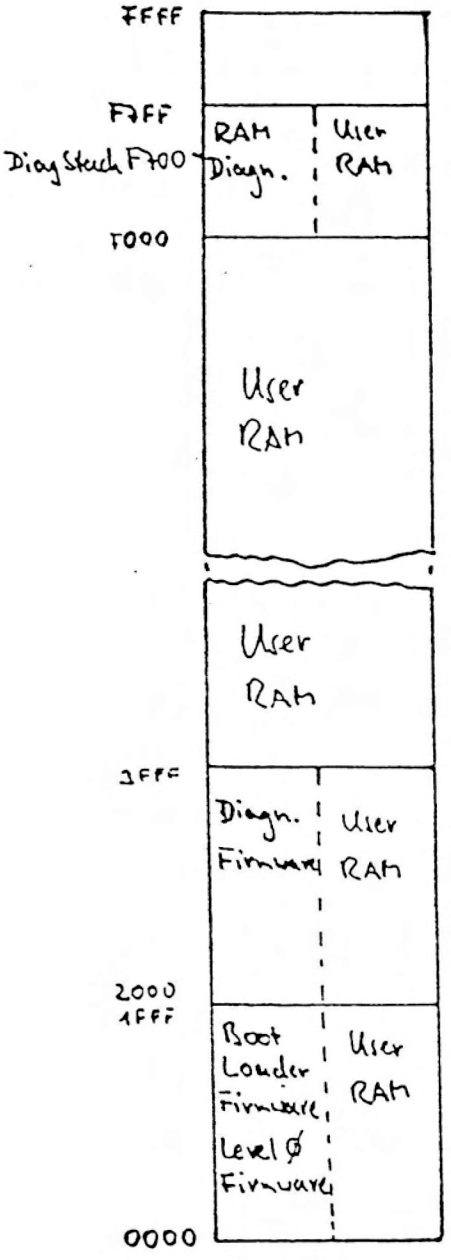
3.1.5.Ports Using (8255)

8 test selection switches
7 segment displays
Memory select logic

3.1.6. Memory Sharing in Diagnostic



Memory Sharing DMV

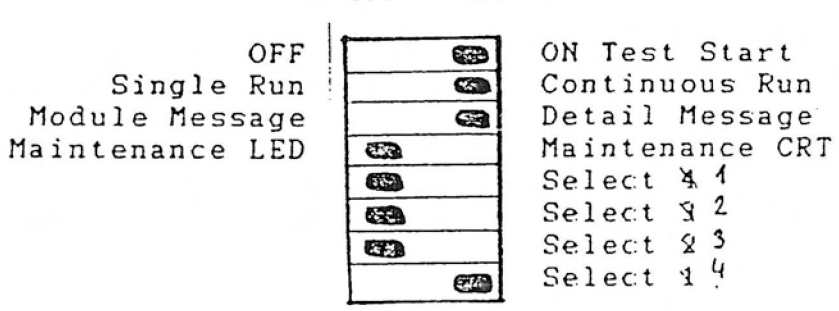


Memory Sharing Diagnostic DMV

3.2. Functions of Diagnostic Box

Requirement for a sucessful test start:
No fault in the Processor and Address-Data bus

3.2.1.1. Function and test switch select



3.2.1.2. Switch Setting of Select 1 to Select 4

Test # in Maintenance Mode	Select Switch 4	3	2	1	Test Name
-	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 B Test
8	1	0	0	0	Keyboard Test
9	1	0	0	1	Memory Test
A	1	0	1	0	Main Board Test
B	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 menue 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

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 folowing 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

B. 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

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 ERRROR
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
KEYBORD CONTROLLER ERROR
SELFCHECK 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 nummber 0-27 Hex
    = 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
```

```
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

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


ERROR CODE = 36
 READ DATA COMPARE ERROR
```

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

```
ERROR CODE = 51
KEYBOARD NOT CONNECTED

ERROR CODE = 52
KEYBOARD PROCESSOR ERROR
```

9. Memory Test

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


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

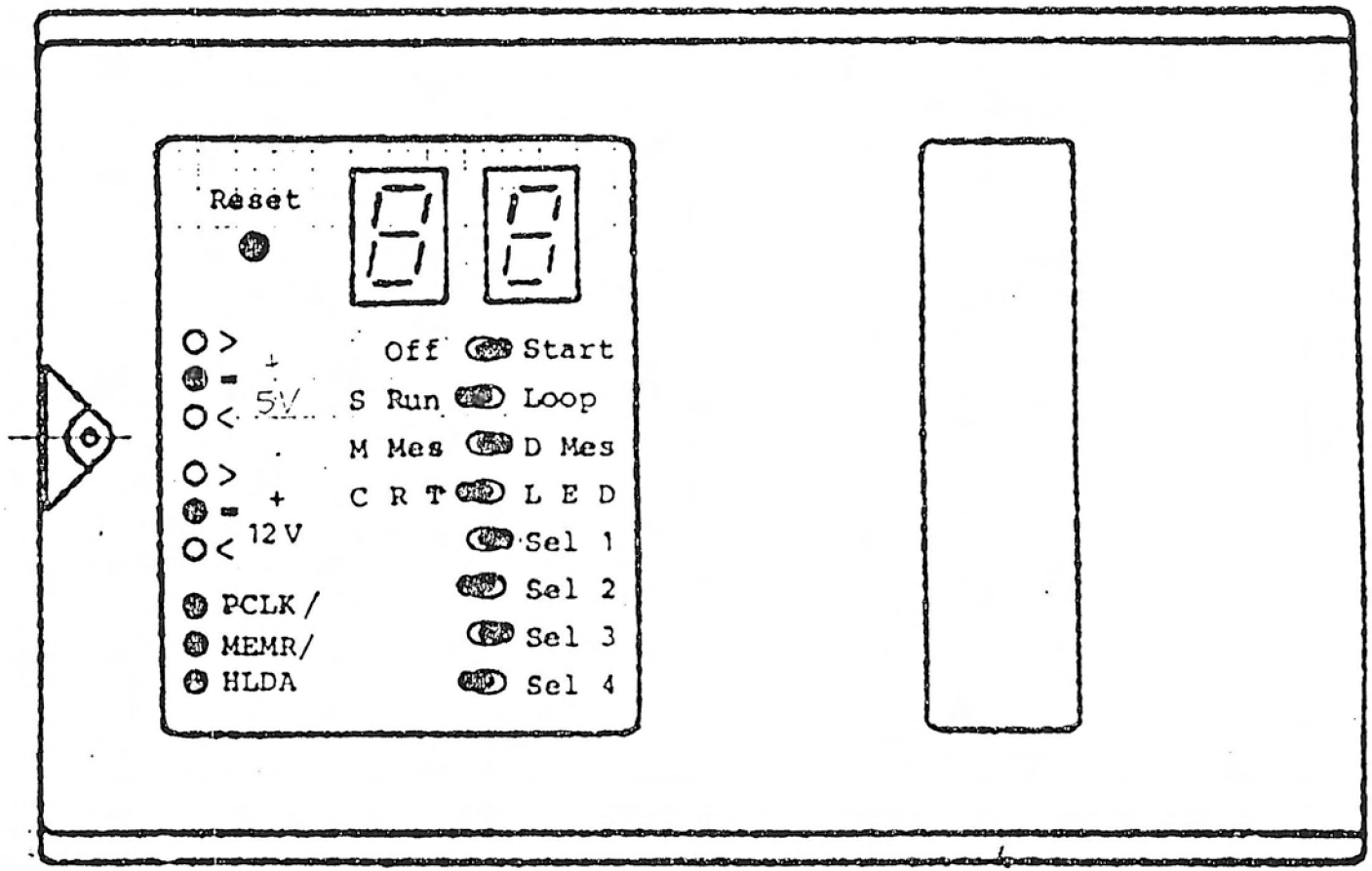
In this phase can appear all messages from
- Level 0
- Memory
- DMA controller
- Disk Controller
- Keyboard
- GDC RAM Test

additionally a Lamp Test of the level 0 LED's is performed
- all Lamps on
- all Lamps off
- each Lamp seperately on

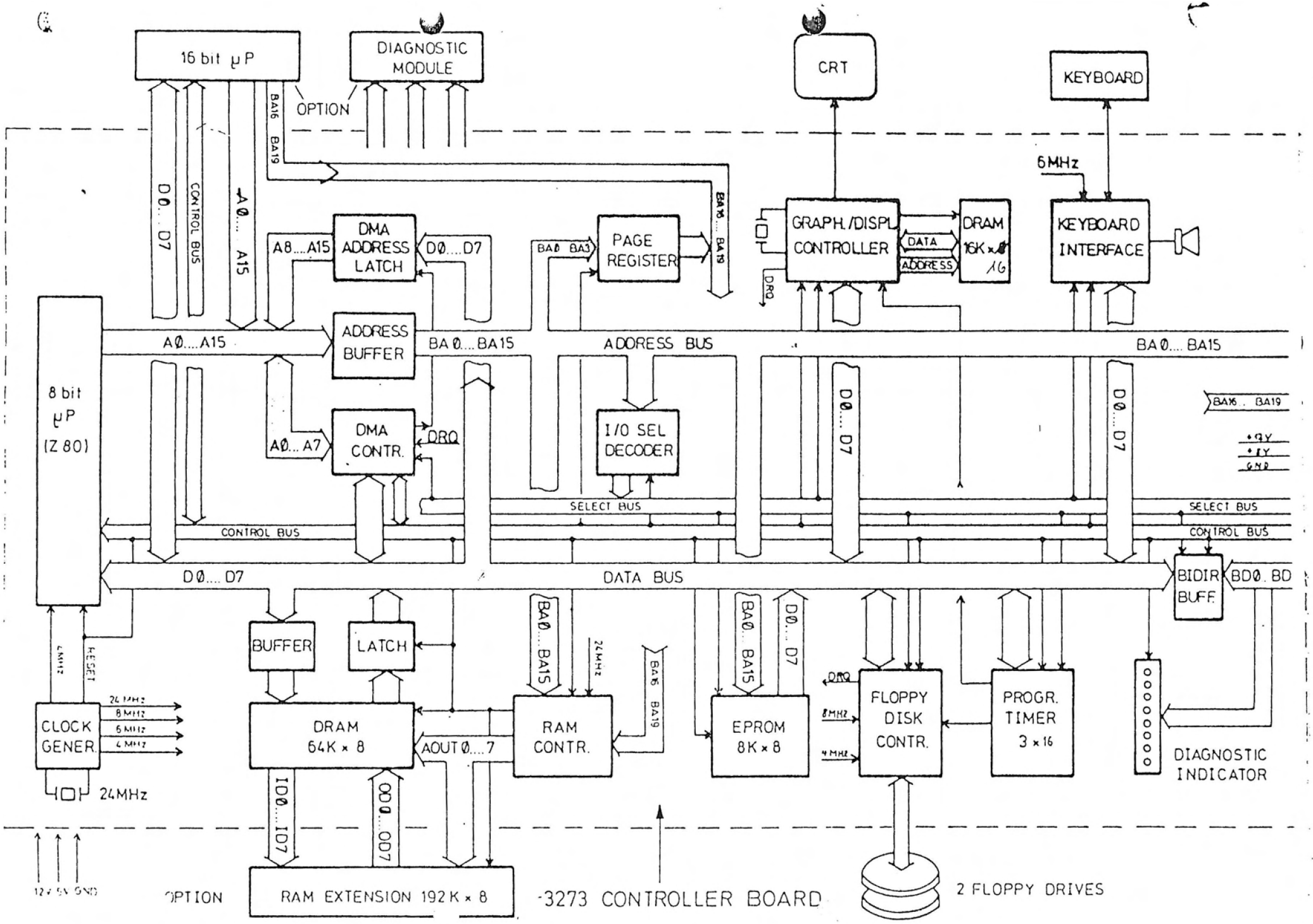
between these phases is always 0.5 second delay

9. Disk Alignment Test

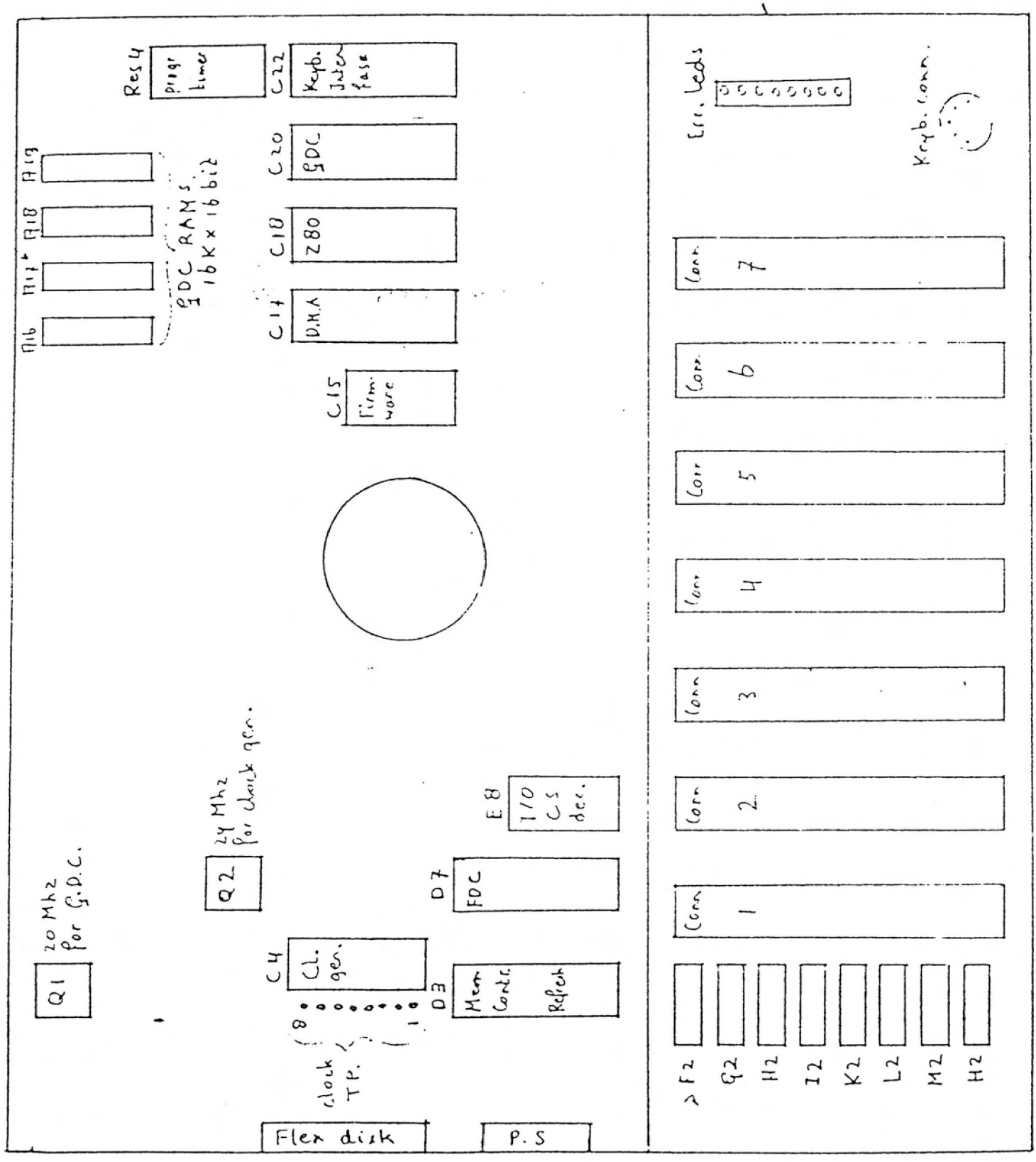
No Error Message is displayed.


Reset
Off
Start
S Run
Loop
M Mes
D Mes
C R T
L E D
Sel 1
Sel 2
Sel 3
Sel 4
5V
12V
PCLK /
MEMR/
HLDA

13.10.82


16 bit µP
DIAGNOSTIC MODULE
OPTION
CRT
KEYBOARD
6MHz
D0.... D7
CONTROL BUS
A0.... A15
BA16 BA19
DMA ADDRESS LATCH
A8....A15
D0....D7
BA0 BA3
PAGE REGISTER
BA16.... BA19
GRAPH./DISPL. CONTROLLER
DATA
ADDRESS
DRQ
DRAM 16K x 8
16
KEYBOARD INTERFACE
8 bit µP (Z 80)
A0....A15
ADDRESS BUFFER
BA0....BA15
ADDRESS BUS
BA0.... BA15
A0... A7
DMA CONTR.
DRQ
I/O SEL DECODER
SELECT BUS
CONTROL BUS
DATA BUS
D0.... D7
BA16.. BA19
+5V
+12V
GND
BIDIR BUFF.
BD0. BD
BUFFER
LATCH
RESET
CLOCK GENER.
24MHz
8MHz
6MHz
4MHz
DRAM 64K x 8
AOUT0....7
RAM CONTR.
EPROM 8K x 8
FLOPPY DISK CONTR.
PROGR. TIMER 3 x 16
DIAGNOSTIC INDICATOR
ID0....ID7
OD0....OD7
RAM EXTENSION 192K x 8
OPTION
3273 CONTROLLER BOARD
2 FLOPPY DRIVES

CONTROLLER BOARD.



1 Kom. 16 K x 4 bit.

16K x 1 bit

1 K byte.