Update for Diagnostic Programs 4.4

Date 89-07-01

This update contains new versions of the programs for:

- **DIOC1 0400 Version 4.5**
- **NIOC 1600-3600 / SIOC2 3600 Version 4.5**
- **CPU 68020 Version 4.5**
- **DIOC3 4000 Version 4.5**
- **DIOC2 Peripheral Units Version 4.5**

In order to update your manual you should replace the following chapters in the old manual:

- **Diagnostic Programs Content**
- **Peripheral Units Content**
- **Peripheral Units Chapter 6**
- **Peripheral Units Chapter 7**
- **Peripheral Units Chapter 8**

Replace the following pages in the old manual:

- **Diagnostic Programs Page 1-1 and 1-2**
- **Diagnostic Programs Page 1-13 and 1-14**
- **Diagnostic Programs Pages 2-11 to 2-13**
- **Diagnostic Programs Page 9-7 and 9-8**
- **Diagnostic Programs Pages 10-5 to 10-7**

Add the following pages in the old manual:

- **Diagnostic Programs Page 1-23**
- **Peripheral Units Pages 10-23 to 10-27**

Diagnostic Programs for the Supermax®

Dansk Data Elektronik A/S

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Non-Operator Diagnostic Programs for the Supermax Card Family

Dansk Data Elektronik A/S

Version 4.3 September 1988

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DIAGNOSTIC PROGRAMS 4.5

DIAGNOSTIC PROGRAMS 4.5

Introduction

All intelligent units in a Supermax computer are supplied with a service port. The service port is an RS 232-C interface modified to support parallel connection between all units.
The Diagnostic Programs run separately in each unit. Consequently it is possible to start programs in all units controlled by one terminal. The main purpose of the Diagnostic Program is to locate a failing unit. If any errors are found the failing unit should be removed from the system and be repaired. It is not the purpose of the Diagnostic Program to specifically point out where on the unit the error was found. An exception from this is the memory test in the CPU Diagnostic Programs, which under certain circumstances are able to point out the failing memory component.
The Diagnostic Programs are delivered on one diskette, 5.25" or 8". The diskette contains Diagnostic Programs for all intelligent units in the Supermax. The Diagnostic Programs are loaded into the different units, when the diskette is inserted in the floppy disk drive, and the computer is booted. If winchester boot is installed on the Supermax, it is possible to load the Diagnostic Programs from the winchester disk, when booting. Depending upon whether the Diagnostic Programs are loaded from the floppy disk drive or from the winchester disk, they will run in two different modes, **Operator Mode** and **Non-Operator Mode**.

Operator Mode

The Diagnostic Programs will, when booted from the floppy disk, enter the **Operator Mode**. All units will be idle until an operator types the select sequence of a unit, on the terminal connected to the service port. The unit will respond to that by writing a prompt on the terminal, indicating that it is ready to take input from the terminal. Now the operator is able to start the tests corresponding to the selected unit.

Non-Operator Mode

The Diagnostic Programs will, when booted from the winchester disk, enter the **Non-Operator Mode**. All units will automatically go through at least one pass of their internal test, and after that at least one pass of the bustest, involving all units in the system. Each unit will stop, when locating any errors and upon completion of the test, the error status will be written on the winchester disk. During this **Non-Operator** test it is possible to select the units from a terminal connected to the service port, and thereby see the test running. If a unit has discovered an error, it will be displayed on the terminal as well as written on the winchester disk.
The time necessary to complete the test for each unit is shown in the table. The total time necessary to complete the whole test is calculated by the master unit in the following manner:

- The maximum value of the columns Internal test + Winchester
- The sum of the values in the column Bustest

When this time is calculated the master unit will control the other units and make sure they will start the bustest at the same time.

Non-Operator Mode default time			
Module type	**Internal test**	**Bustest**	**Winchester**
CPU68000	1 min + 12 min/Mbyte	2 min	
SIOC1	2 min	2 min	
DIOC1	2 min	2 min	
CIOC	2 min	2 min	
DIOC2	2 min	2 min	
NIOC	2 min + 8 min/Mbyte	2 min	
CPU68020	1 min + 4 min/Mbyte	2 min	
SIOC2	2 min + 8 min/Mbyte	2 min	
DIOC3	2 min + 3 min/Mbyte	2 min	(Cyl * head)/1024 min, if 2 or more winchesters then time/2
CPU68030	2 min + 3 min/Mbyte	2 min	

Selecting and deselecting units

To ensure that only one service port sends messages to the terminal, only one unit is selected at a time. All units are deselected upon start of the Diagnostic Programs. To select a specific unit, type one of the two sequences shown below.

<ESC>
#
0 - F (*unit number*)
<CR>

In order to deselect all units in a system, type * instead of the unit number in the select sequence above.
If your terminal has function keys, it is possible to use the keys *F1-F16* to select the 16 units in a system. The function keys must send the following sequence of characters, when activated:

<Ctrl A>
@ - O
<CR>

Unit number 0 is selected by the key *F16* and unit number 1 to F by the keys *F1* to *F15*. It is not possible to deselect all units by using the function keys. You must use the first mentioned sequence in order to deselect all units.

If a unit does not respond to the select sequence the cause of the trouble might be one of the following:

- The unit is not installed in the system.
- The unit is not connected to the service port.

- The Diagnostic Program is not loaded into the unit.
- The unit has failed in a way that makes it unable to run the Diagnostic Program.

Program control

It is possible to control program execution by using some special control characters as mentioned below.

- **Ctrl C.** This is used to cancel a running test. Program execution stops and the prompt will be displayed on the terminal. It only affects the unit currently selected.
- **Ctrl D.** This is used to place the Diagnostic Programs in the **Non-Operator Mode**. It affects all units, whether they are selected or deselected. All units will restart the test. If booted from the floppy disk, the error messages will be displayed on the terminal only. The error message will be shown when a unit is selected. If booted from the winchester disk the programs will run as mentioned under **Non-Operator Mode**.
- **Ctrl S.** This is used to send *XOFF* character to the program, which will stop printing on the terminal. If the unit is selected the program will stop when it tries to print on the terminal and *XON* character must be received to continue. If the unit is deselected, it will remember the *XOFF* character when selected and *XON* character must be received to continue.
- **Ctrl Q.** This is used to send *XON* character to the program, which will start printing again. This affects all units whether selected or not.
- **Ctrl N.** This is used to stop printing on the terminal, but program execution continues.
- **Ctrl P.** This is used to start printing again after a **Ctrl N** has been pressed.

The **<DEL>** or **<RUB>** key will delete all inputs in the current command line and issue a new prompt.

Getting started

The following procedure is recommended when using the Diagnostic Programs. Normally you would start a complete test of the system. That is done by booting the Diagnostic Programs and then pressing **Ctrl D**. This will make the units go through a complete test including the bustest. If the test is OK, then the system does not have any hardware errors and is able to continue normal operation. If the test fails, you should run the tests manually in order to isolate the failing unit(s). The first thing to do is to test each unit with the programs only concerning itself. When you are sure that all units have successfully completed those tests, you can start the bustest. You should start this test *slowly*, which means that you start by letting one unit test the others while watching the printout on the terminal to ensure that it runs OK. Then you can start another unit and watch that this also runs OK and so on until all units are testing all other units. When all units have completed the test the Supermax should be ready to run again.

Winchester boot

When winchester boot is installed on a system running UNIX System V it is possible to boot the Diagnostic Programs from the winchester also. Refer to the description of the utilities **mkwboot** and **boot** in section 1 of the *Reference Manual*. The example shows the configuration sector, which is located on the physical winchester disk in address 300 to 3FF.

```
     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
300  03 F4 00 00 01 10 00 00 00 A0 00 00 00 A0 00 00  ......... ... ..
310  00 10 00 00 00 04 00 00 00 00 00 00 00 00 00 00  ................
320  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
330  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
340  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
350  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
360  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
370  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
380  00 00 00 00 73 75 62 64 69 73 6B 32 20 70 72 65  ....subdisk2 pre
390  73 65 6E 74 FF FF FF FF FF FF FF FF FF FF FF FF  sent............
3A0  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ................
3B0  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ................
3C0  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ................
3D0  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF  ................
3E0  02 50 00 00 02 60 00 00 FF FF FF FF FF FF FF FF  .P...'..........
3F0  FF FF FF FF FF FF FF FF 02 50 00 00 02 50 00 00  .........P...P..
```

Configuration sector	
Address	Content
300-303	Four bytes containing the hexadecimal value of the physical disk size, in this example a 63 Mb disk.
304-383	32 times four bytes containing the size of each logical disk on the physical disk. The maximum number of logical disks on a physical disk is 32. In this example there are 5 logical disks, 17Mb, 10Mb, 10Mb, 1Mb and 0.25Mb. Please note that a logical disk size set to 00 00 00 00, indicates that the logical disk is not used.
384-393	This text string indicates to the operating system that the sector is valid.
394-3DF	Not used.
3E0-3EF	Four times four bytes used for boot pointers 0 through 3. Each pointer contains the hexadecimal address on the winchester disk, where the boot information is found. Normally pointer 0 points to the operating system and pointer 1 points to the Diagnostic Programs. FF FF FF FF means that the pointer is not used.
3F0-3F7	Not used.
3F8-3FB	This is a temporary pointer used by the Diagnostic Program.
3FC-3FF	This is the actual boot pointer used by the boot prom on the DIOC. This is the address on the winchester disk from where to load the system.

Error buffer

The below example shows the error buffer from the **Non-Operator** Diagnostic Programs. The error buffer is located on the physical winchester disk address 400 to 4FF. The utility **hwstatus** is used to interpret the error buffer. The example shows the error buffer as it will be, when a test was successfully completed. The error buffer contains 16 bytes for each unit. The buffer for unit number 0 starts in address 400, unit number 1 starts in 410, and so on.

```
     0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
400  A1 00 70 00 00 00 00 00 00 00 00 02 00 00 00 0D  ..p.............
410  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
420  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
430  A1 00 70 00 00 00 00 00 00 00 00 02 00 00 00 0D  ..p.............
440  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
450  A1 00 60 00 00 00 00 00 00 00 00 02 00 00 00 06  ..`.............
460  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
470  A1 00 80 00 00 00 00 00 00 00 00 02 00 00 00 0A  ................
480  A1 00 20 00 00 00 00 00 00 00 00 02 00 00 00 02  .. ............
490  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
4A0  A1 00 30 00 00 00 00 00 00 00 00 02 00 00 00 02  ..0.............
4B0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
4C0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
4D0  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
4E0  A1 00 50 00 00 00 00 00 00 00 00 02 00 00 00 02  ..P.............
4F0  A1 00 40 00 00 00 00 00 00 00 00 02 00 00 00 02  ..@.............
```

On the following pages a description of the error buffer is shown for each of the units, that might be in a system.

Error buffer description

Address	Name	Text
0	TSTAT	Test status
1	ERCD	Error code
2	TYPNUM	Module type and test number
3	SCODE	Special status
4-7	ADD3,ADD2,ADD1,ADD0	Error address
8-11	WDT3,WDT2,WDT1,WDT0	Write data
12-15	RDT3,RDT2,RDT1,RDT0	Read data

TSTAT	
Value	**Text**
FF	Fatal error
E4	Error in internal test
E2	Error in bustest
E1	Error in peripheral test
A4	Internal test
A2	Bustest
A1	Test ended OK

TYPNUM for CPU 68000	
Value	Text
10	No tests.
11	Test RAM. High speed.
12	Test RAM. Bit test.
13	Test RAM. Address bit test.
14	Test RAM. Galloping ones and zeroes.
15	Test RAM. Byte write.
16	Test RAM. Read modify write.
17	Test MMU memory.
18	Test MMU adder.
19	Test ASN register.
1A	Test MMU ASN con SEG.
1B	Test MMU comparator.
1C	Test interrupts.
1D	Bustest.

Error codes for CPU 68000

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
01	EAR	SYN(15-0)	-	-	Single bit error in memory
10	-	Address	Write	Read	Error in high speed test
11	-	Address	Write	Read	Error in bit test
12	-	Address	Write	Read	Error in address bit test
13	-	Address	Write	Read	Error in galloping test
14	-	Address	Write	Read	Error in byte write test
15	-	Address	Write	Read	Error in R-M-W test
30	-	-	-	-	Error in ASR test
31	-	Address	Write	Read	Error in MMU init test
32	-	-	-	-	Error in MMU adder test
33	-	-	-	-	Error in ASN - SEG test
34	-	-	-	-	Error in comparator test
40	-	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
42	-	-	-	-	Wrong interrupt level
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
77	Unit no	I/O adr	-	-	TAS did not change byte
78	Unit no	I/O adr	-	-	Byte was set before TAS
79	Unit no	I/O adr	Write	Read	Error in bustest
E0	Unit no	STATUS	-	-	Bus error
F0	-	-	-	-	Address error

TYPNUM for SIOC1

Value	Text
20	No tests.
21	Test memory 4000 to F000.
22	Test memory mapper.
23	Test timer interrupt.
24	Bustest.

Error codes for SIOC1

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
10	-	Address	Write	Read	Memory error
30	-	Map adr	Write	Read	Memory mapper error
40	Int. level	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
79	Unit no	I/O adr	Write	Read	Error in bustest
E0	ESR	Unit no	-	-	Error occurred. ESR = XX

TYPNUM for DIOC1	
Value	Text
30	No tests.
31	Test memory A000 to F000.
32	Test memory mapper.
33	Test timer interrupt.
34	Bustest.
35	Test DMA.
36	Test peripheral interface.

Error codes for DIOC1

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
10	-	Address	Write	Read	Memory error
30	-	Map adr	Write	Read	Memory mapper error
40	Int. level	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
79	Unit no	I/O adr	Write	Read	Error in bustest
7A	Unit no	I/O adr	Write	Read	Error in bustest, BTU access
80	-	-	-	-	Error in SCSI interface
81	-	-	-	-	Error in Streamer interface
82	-	-	-	-	Error in Floppy interface
83	-	-	-	-	Error in DMA
E0	ESR	Unit no	-	-	Error occurred. ESR=XX

TYPNUM for CIOC

Value	Text
40	No tests.
41	Test memory 4000 to F000.
42	Test memory mapper.
43	Test timer interrupt.
44	Bustest.
45	Test DMA and memory move.

Error codes for CIOC

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
10	-	Address	Write	Read	Memory error
30	-	Map adr	Write	Read	Memory mapper error
40	Int. level	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
79	Unit no	I/O adr	Write	Read	Error in bustest
7A	Unit no	I/O adr	Write	Read	Error in bustest, BTU access
E0	ESR	Unit no	-	-	Error occurred. ESR = XX

TYPNUM for DIOC2	
Value	Text
50	No tests.
51	Test memory.
52	Test memory mapper.
53	Test DMA memory.
54	Test bus interrupt, and timer interrupt.
55	Test peripheral interface.
56	Bustest.

Error codes for DIOC2

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
10	X (ASCII)	Address	Write	Read	Memory error bank X
11	X (ASCII)	Address	Write	Read	DMA memory error bank X
30	-	Map adr	Write	Read	Memory mapper error
40	Int. level	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
42	-	-	-	-	Error in bus interrupt
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
79	Unit no	I/O adr	Write	Read	Error in bustest
7A	Unit no	I/O adr	Write	Read	Error in bustest, BTU bank 0
7B	Unit no	I/O adr	Write	Read	Error in bustest, BTU bank 1
7C	Unit no	I/O adr	Write	Read	Error in bustest, BTU bank 2
7D	Unit no	I/O adr	Write	Read	Error in bustest, BTU bank 3
80	-	-	-	-	Error in BTU interface
81	-	-	-	-	Error in Tape interface
82	-	-	-	-	Error in Floppy interface
E0	ESR	Unit no	-	-	Error occurred. ESR = XX

TYPNUM for NIOC	
Value	Text
60	No tests.
61	Test main memory.
62	Test buffer memory.
63	Test MMU memory.
65	Test LAN controller without transceiver.
66	Test MMU ASN - SEG
67	Test MMU size field check.
68	Test interrupt.
69	Bustest.

Error codes for NIOC

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
10	-	Address	Write	Read	Error in high speed test
11	-	Address	Write	Read	Error in bit test
12	-	Address	Write	Read	Error in address bit test
13	-	Address	Write	Read	Error in galloping test
15	-	Address	Write	Read	Error in R-M-W test
16	-	-	-	-	Parity error in buffer memory
31	-	Address	Write	Read	Error in MMU init test
33	-	-	-	-	Error in ASN - SEG test
34	-	-	-	-	Error in size field check
40	-	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
42	-	-	-	-	Wrong interrupt level
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
77	Unit no	I/O adr	-	-	TAS did not change byte
78	Unit no	I/O adr	-	-	Byte was set before TAS
79	Unit no	I/O adr	Write	Read	Error in bustest
B0	-	-	-	-	Data error in LAN test
B1	-	-	-	-	Diagnose error in LAN test
B2	-	-	-	-	RU error in LAN test
B3	-	-	-	-	Time out in LAN command
B4	-	-	-	-	Transmit error
B5	-	-	-	-	Receive error
B6	-	-	-	-	Reset error
E0	Unit no	STATUS	-	-	Bus error
F0	-	-	-	-	Address error

TYPNUM for CPU 68020	
Value	Text
70	No tests.
71	Test RAM. High speed.
72	Test RAM. Bit test.
73	Test RAM. Address bit test.
74	Test RAM. Galloping ones and zeroes.
75	Test RAM. Byte write.
76	Test RAM. Read modify write.
77	Test MMU memory.
78	Test MMU adder.
79	Test ASN register.
7A	Test MMU ASN con SEG.
7B	Test MMU comparator.
7C	Test interrupts.
7D	Bustest.
7E	Cache test.

Error codes for CPU 68020

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
01	SYN(7-0)	EAR	-	-	Single bit error in memory
10	-	Address	Write	Read	Error in high speed test
11	-	Address	Write	Read	Error in bit test
12	-	Address	Write	Read	Error in address bit test
13	-	Address	Write	Read	Error in galloping test
14	-	Address	Write	Read	Error in byte write test
15	-	Address	Write	Read	Error in R-M-W test
20	-	Address	Write	Read	Error in cache memory
21	-	Address	Write	Read	Error in cache test
22	-	Address	Write	Read	Error in physical cache test
30	-	-	-	-	Error in ASR test
31	-	Address	Write	Read	Error in MMU init test
32	-	-	-	-	Error in MMU adder test
33	-	-	-	-	Error in ASN - SEG test
34	-	-	-	-	Error in comparator test
40	-	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
42	-	-	-	-	Wrong interrupt level
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
77	Unit no	I/O adr	-	-	TAS did not change byte
78	Unit no	I/O adr	-	-	Byte was set before TAS
79	Unit no	I/O adr	Write	Read	Error in bustest, short access
7A	Unit no	I/O adr	Write	Read	Error in bustest, long access
E0	Unit no	STATUS	-	-	Bus error
F0	-	-	-	-	Address error
F1	-	-	-	-	Exception error
F2	-	-	-	-	Fatal error during boot PROM self test

TYPNUM for SIOC2	
Value	Text
80	No tests.
81	Test main memory.
82	Test buffer memory.
83	Test MMU memory.
86	Test MMU ASN - SEG
87	Test MMU size field check.
88	Test interrupt.
89	Bustest.

Error codes for SIOC2

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
10	-	Address	Write	Read	Error in high speed test
11	-	Address	Write	Read	Error in bit test
12	-	Address	Write	Read	Error in address bit test
13	-	Address	Write	Read	Error in galloping test
15	-	Address	Write	Read	Error in R-M-W test
16	-	-	-	-	Parity error in buffer memory
31	-	Address	Write	Read	Error in MMU init test
33	-	-	-	-	Error in ASN - SEG test
34	-	-	-	-	Error in size field check
40	-	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
42	-	-	-	-	Wrong interrupt level
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
77	Unit no	I/O adr	-	-	TAS did not change byte
78	Unit no	I/O adr	-	-	Byte was set before TAS
79	Unit no	I/O adr	Write	Read	Error in bustest
E0	Unit no	STATUS	-	-	Bus error
F0	-	-	-	-	Address error

TYPNUM for DIOC3	
Value	Text
90	No tests.
91	Test program memory.
92	Test cache memory.
93	Test SRAM memory.
94	Test SRAM mapping.
95	Test BTU transport.
96	Test interrupts.
97	Bustest.
98	Winchester test.
99	SCSI test.

Error codes for DIOC3

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
10	-	Address	Write	Read	Error in high speed test
11	-	Address	Write	Read	Error in bit test
12	-	Address	Write	Read	Error in address bit test
13	-	Address	Write	Read	Error in galloping test
14	-	Address	Write	Read	Error in byte write test
15	-	Address	Write	Read	Error in R-M-W test
16	SR1	-	-	-	Parity error in cache memory
30	-	-	-	-	Error when mapping
31	-	Address	Write	Read	Error in SRAM init test
40	-	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
42	-	-	-	-	Wrong interrupt level
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
77	Unit no	I/O adr	-	-	TAS did not change byte
78	Unit no	I/O adr	-	-	Byte was set before TAS
79	Unit no	I/O adr	Write	Read	Error in bustest
7A	Unit no	I/O adr	Write	Read	Error in bustest, BTU access
D0	SCSI/ID no	-	-	-	Timeout in reset SCSI
D1	SCSI/ID no	Timeout code	-	-	Timeout on SCSI interface
D2	SCSI/ID no	-	-	-	Invalid disk parameters
D3	SCSI/ID no	Address	Error code	-	Disk drive error
E0	Unit no	SR0	-	-	Bus error
E1	Unit no	SR1	-	-	BTU bus error
F0	-	-	-	-	Address error
F1	-	-	-	-	Exception error

TYPNUM for CPU 68030	
Value	Text
A0	No tests.
A1	Test RAM. High speed.
A2	Test RAM. Bit test.
A3	Test RAM. Address bit test.
A4	Test RAM. Galloping ones and zeroes.
A5	Test RAM. Byte write.
A6	Test RAM. Read modify write.
A7	Test AMMU memory.
A8	Test PMMU memory.
A9	Test AMMU mapping.
AA	Test PMMU mapping.
AB	Test interrupts.
AC	Cache test.
AD	Bustest.

Error codes for CPU 68030

ERCD	SCODE	ADD(3-0)	WDT(3-0)	RDT(3-0)	Text
01	SYN(7-0)	EAR	-	-	Single bit error in memory
10	-	Address	Write	Read	Error in high speed test
11	-	Address	Write	Read	Error in bit test
12	-	Address	Write	Read	Error in address bit test
13	-	Address	Write	Read	Error in galloping test
14	-	Address	Write	Read	Error in byte write test
15	-	Address	Write	Read	Error in R-M-W test
20	-	Address	Write	Read	Error in cache memory
21	-	Address	Write	Read	Error in cache test
35	-	Index	-	-	Error when testing AMMU mapping
36	-	Index	-	-	Error when testing PMMU mapping
40	-	-	-	-	Interrupt error
41	-	-	-	-	Missing timer interrupt
42	-	-	-	-	Wrong interrupt level
70	Unit no	-	-	-	Unit not present
71	Unit no	-	-	-	Unit illegal test table
72	Unit no	-	-	-	Bustest not completed
73	Unit no	-	-	-	Overrun in test table
74	Unit no	-	-	-	Sum check error in test table
75	Unit no	I/O adr	Write	Read	Error in request byte
76	Unit no	I/O adr	Write	Read	Error in acknowledge byte
77	Unit no	I/O adr	-	-	TAS did not change byte
78	Unit no	I/O adr	-	-	Byte was set before TAS
79	Unit no	I/O adr	Write	Read	Error in bustest
7A	Unit no	I/O adr	Write	Read	Error in bustest, Write Bus
E0	Unit no	STATUS	-	-	Bus error
F0	-	-	-	-	Address error
F1	-	-	-	-	Exception error
F2	-	-	-	-	Fatal error during boot PROM self test

Mirrored disks.

When using mirrored disks on the DIOC3 the configuration sector on the winchester disks must contain information about the validity of the disk systems used for mirroring. This information is located in address 0x1000 of both the physical winchester disks. The two disks used for mirroring must have the same ID and must be installed with one on each SCSI interface. The following example shows a valid mirrored disk system.

```
      0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
1000  4D 49 52 4F 7F 32 61 4F 00 00 00 01 00 00 00 00  MIRO 2aO........
```

Mirrored disks	
Address	Content
1000-1003	Four bytes containing the ascii equivalent of "MIRO", 0x4D49524F.
1004-1007	Contains a magic number, which must be the same on the two mirrored disks.
1008-100B	This is the status field for the mirrored disk. Note that more than one bit can be set. 0x00000010 The disk is new. 0x00000008 The partner disk has failed. 0x00000004 This disk has failed. 0x00000002 Write not completed. 0x00000001 Disk is OK.

DIAGNOSTIC PROGRAMS 4.3

Bustest

This is a common part of all Diagnostic Programs and is used to test the communication between units connected to the common I/O bus on the mother board in a Supermax system. A unit which is running a bustest will access another unit and perform a memory test in the memory of the other unit. You should have in mind that a unit is not allowed to perform any other test when it is participating in a bustest.

X - Bustest. Passive unit

The first time you select this test the unit will initialize itself to take part in a bustest as a passive unit. This means that it will allow other units to test its memory and it will take care of the arbitration between units who want to test its memory. When selecting this test again the unit will remove itself from the passive state, and it cannot be accessed from the I/O bus any more. Whenever a unit is passive the letter **X** appears in the prompt:

cpu20 3 X > _

Y - Bustest. Active unit

This test will make the unit the active part in a bustest. When selecting this test the program will ask for the unit numbers of the units, that are going to be tested, and then the unit will perform a memory test on those units. Before making a unit active be sure that all units that are going to be tested are placed in the passive state. A unit can be both passive and active at the same time, which makes it possible for you to let all units in a system test all the other units. Most units are not able to test themselves but some are. This will be told in the paragraph concerning the different units. Whenever a unit is active the letter **Y** appears in the prompt:

cpu20 3 Y> _

Instead of typing in all unit numbers, it is possible to type the character *. In that case the unit will use the unit numbers of all units recognized, when the Diagnostic Programs were loaded. That information can be read in a configuration table located in the master unit, which is the DIOC that loaded the system, and all units in the system will be tested. An example is shown:

```
cpu20 0 X > Y
cpu20 0 X >
Unit numbers to be tested: *
cpu20 0 XY>
Unit numbers to be tested: 3 5 8 E
cpu20 0 XY>
Now testing unit number: 3 5 8 E
```

Concept of testing

In order to perform a complete test of the I/O bus it is necessary to test every address line in the 34 bit address bus and every data line in the 32 bit data bus. In order to reduce the amount of memory necessary to do that the relocating capabilities of the modules are used. On all modules up to and including the CPU 68020, the 34 bit I/O bus address is interpreted in the following manner:

34 Bit I/O Bus Address			
Unit	ASN	SEG	Address
UUUU	NNNNNN	SSSS	AAAA AAAA AAAA AAAA AAAA

On all modules starting with the DIOC3 and the CPU 68030, the 34 bit I/O bus address is interpreted in the following manner:

34 Bit I/O Bus Address	
Unit	Address
UUUU	AA AAAA AAAA AAAA AAAA AAAA AAAA AAAA

By testing one unit you can verify that it is possible to drive the bits concerning the unit number for that unit. This leaves us with 30 address bits. It would take 1 Gb of memory in order to test that completely. But *(un)fortunately* there is not that much memory available, so there must be another way to do it.

Each unit will not use all of the 30 address bits, when they are accessed from the I/O bus. Some will only use the 16 least significant bits, like the SIOC1, and some will use all 30 bits, like the CPU 68020. The least significant bits are tested using a linear block of memory, approximately of the size given by the number of address bits. Whenever a unit uses more than 20 bits of the address, it has some kind of a mapping facility in order to translate the I/O bus address into local memory addresses. When testing the most significant bits, this is done by isolating one bit at a time, testing a linear block of memory with that bit set to both 0 and 1 and then continue with isolating the next bit. By doing that, the amount of memory needed to test a unit is reduced to a size equaling the size of the linear block used to test each bit, because the relocating facilities of the units will use the same physical memory block during each test.

Request/Acknowledge table

When one unit is testing another unit we must be sure that no other units are testing the same unit at the same time. This is done in a way, that the passive unit manages its own memory, and grants permission to an active unit, when the memory is free to be tested by that unit. The passive unit makes sure that only one active unit at a time gets an acknowledge. An active unit requests a passive unit for permission to test it. This is done by writing in the Request byte and then interrupting the passive unit by writing in the interrupt address. When the request is asked, the active unit will wait until permission is granted, and then the test will be performed. All this is done using a 32 bytes table in each passive unit. The table looks like this:

Request and Acknowledge Table

Address	Byte	Byte	Text
0x00	REQ0	ACK0	Request and acknowledge for unit 0
0x02	REQ1	ACK1	Request and acknowledge for unit 1
0x04	REQ2	ACK2	Request and acknowledge for unit 2
0x06	REQ3	ACK3	Request and acknowledge for unit 3
0x08	REQ4	ACK4	Request and acknowledge for unit 4
0x0A	REQ5	ACK5	Request and acknowledge for unit 5
0x0C	REQ6	ACK6	Request and acknowledge for unit 6
0x0E	REQ7	ACK7	Request and acknowledge for unit 7
0x10	REQ8	ACK8	Request and acknowledge for unit 8
0x12	REQ9	ACK9	Request and acknowledge for unit 9
0x14	REQA	ACKA	Request and acknowledge for unit 10
0x16	REQB	ACKB	Request and acknowledge for unit 11
0x18	REQC	ACKC	Request and acknowledge for unit 12
0x1A	REQD	ACKD	Request and acknowledge for unit 13
0x1C	REQE	ACKE	Request and acknowledge for unit 14
0x1E	REQF	ACKF	Request and acknowledge for unit 15

REQ(0-F) must contain 0x00 when not active.

REQ(0-F) must contain 0x50 + (unit number) when active.

ACK(0-F) must contain 0x00 when not active.

ACK(0-F) must contain 0xA0 + (unit number) when active.

Error messages will be displayed if the values are not correct.

Test table

The bustest concept is built in a way, that each unit has a test table containing all necessary information to the active units about how it should be tested. All units have this test table on I/O bus address 0x01003c00, which is the only fixed address, specified to the units. Prior to testing a unit the active unit will read this table and initialize the bustest to run with the parameters from the test table. The table contains the following information:

Test table

Name	Content	Size	Description
Table	Valid	long	Table valid = 'BUST'
	Count	word	Number of bytes to read Including Valid and Check
	Config	word	0x0001 = Byte 0x0002 = Word 0x0004 = Long 0x0008 = RMW (Read-Modify-Write) 0x0010 = WB (Write Bus) 0x0100 = BURST (BTU burst mode)
	Req/Ack	long	Request/Acknowledge Start Address
	BINTADR	long	Bus Interrupt Address
	WBtab1	word	Offset to Write Bus Table (Write)
	WBtab2	word	Offset to Write Bus Table (Read)
	NUMTAB	word	Number of tables below
	Tab1	word	Offset to Table 1 (Test 1, Write)
	Tab2	word	Offset to Table 2 (Test 1, Read)
	Tab3	word	Offset to Table 3 (Test 2, Write)
	...	...	...
	TabN	word	Offset to Table N (Test N, Read)

The size and content of the next part of the table depends very much on which unit it concerns. The second part of the table contains the following:

Name	Content	Size	Description
Table 1	Size1	long	Block size of addresses in Table 1
	Count1	word	Number of addresses in Table 1
	Addr11	long	Table 1 Address 1
	Addr12	long	Table 1 Address 2
	Addr13	long	Table 1 Address 3
	Addr14	long	Table 1 Address 4
	...	...	...
	Addr1N	long	Table 1 Address N
Table 2	Size2	long	Block size of addresses in Table 2
	Count2	word	Number of addresses in Table 2
	Addr21	long	Table 2 Address 1
	Addr22	long	Table 2 Address 2
	Addr23	long	Table 2 Address 3
	Addr24	long	Table 2 Address 4
	...	...	...
	Addr2N	long	Table 2 Address N
Table 3	Size3	long	Block size of addresses in Table 3
	Count3	word	Number of addresses in Table 3
	Addr31	long	Table 3 Address 1
	Addr32	long	Table 3 Address 2
	Addr33	long	Table 3 Address 3
	Addr34	long	Table 3 Address 4
	...	...	...
	Addr3N	long	Table 3 Address N
...	...	...	...
Table N	SizeN	long	Block size of addresses in Table N
	CountN	word	Number of addresses in Table N
	AddrN1	long	Table N Address 1
	AddrN2	long	Table N Address 2
	AddrN3	long	Table N Address 3
	AddrN4	long	Table N Address 4
	...	...	...
	AddrNN	long	Table N Address N
	Check	word	Checksum of table.

In order to understand the function of the test table we will go through an example concerning the SIOC1. The test table of a SIOC1 looks like this:

Test table for SIOC1			
Name	**Content**	**Value**	**Description**
Table	Valid	0x42555354	Table valid = 'BUST'
	Count	0x0026	Number of bytes to read
	Config	0x000B	0x0001 = Byte 0x0002 = Word 0x0008 = RMW (Read-Modify-Write)
	Req/Ack	0x00003FD0	Request/Acknowledge Start Address
	BINTADR	0x000000A4	Bus Interrupt Address
	WBtab1	0x0000	Offset to Write Bus Table (Write)
	WBtab2	0x0000	Offset to Write Bus Table (Read)
	NUMTAB	0x0002	Number of tables below
	Tab1	0x001A	Offset to Table 1 (Test 1, Write)
	Tab2	0x001A	Offset to Table 2 (Test 1, Read)
Table 1	Size1	0x0000b000	Block size of address in Table 1
	Count1	0x0001	Number of addresses in Table 1
	Addr11	0x00005000	Table 1 Address 1
	Check	0x297B	Checksum of table.

Valid — This text string, 'BUST' indicates to the active unit that the table is initialized and valid.

Count — This number indicates that the total length of the table is 0x26 bytes.

Config — The value 0x000B, which contains 3 bits set to **One**, indicates that the unit will accept the following accesses.
- Byte access.
- Word access.
- Read-Modify-Write access.

If the active unit can perform these accesses to the I/O bus, it should test the passive unit using these accesses.

Req/Ack — 0x00003FD0 is the I/O bus start address in the SIOC1 of the Request/Acknowledge table. That is the table used to arbitrate between active units, who wants to test the SIOC1.

BINTADR — 0x000000A4 is the I/O bus address in the SIOC1, where the active unit must write in order to interrupt the SIOC1.

WBtab1 — This entry is not used on the SIOC1, because it does not have the Write Bus facility.

WBtab2 — This entry is not used on the SIOC1, because it does not have the Write Bus facility.

NUMTAB — Indicates that the total number of tables to be used, when testing a SIOC1 is 2.

Tab1 — Indicates that the offset from **Table**, where **Table 1** is found is 0x001a.

Tab2 — Indicates that the offset from **Table**, where **Table 2** is found is 0x001a. **Note** that Tab1 and Tab2 points to the same table. This means that **Table 1** and **Table 2** are the same.

Size1 — 0x0000b000 is the number of bytes to be tested, when using the address in this table.

Count1 — This is the number of addresses in **Table 1**. In this case there is only one address.

Addr11 0x00005000 is the I/O bus start address used when testing the SIOC1.

Check 0x297B is the check sum of the test table in a SIOC1.The value is calculated in such a way that the sum of all words in the table, including the check sum, must be 0.

Accesses

A unit is able to make certain kind of accesses to the I/O bus and the I/O bus is able to make certain kind of accesses to a unit. The following kinds of accesses are possible on the I/O bus. Note that not all units are able to perform all kinds of accesses.

Byte

The active unit is able to perform a Byte access on the I/O bus or the passive unit is able to answer to a Byte access from the I/O bus. During the test of Byte accesses a byte counter is written in the passive unit and then checked.

Word

The active unit is able to perform a Word access on the I/O bus or the passive unit is able to answer to a Word access from the I/O bus. During the test of Word accesses a word counter is written in the passive unit and then checked.

Long Word

The active unit is able to perform a Long Word access on the I/O bus or the passive unit is able to answer to a Long Word access from the I/O bus. During the test of Long Word accesses a long word counter is written in the passive unit and then checked.

Read-Modify-Write

The active unit is able to perform a Read-Modify-Write access on the I/O bus or the passive unit is able to answer to a Read-Modify-Write access from the I/O bus. During the test of RMW accesses, bytes are initialized and the *Test and Set* instruction is performed on all bytes, checking for correct function.

Write Bus

The active unit is able to perform a Write Bus access on the I/O bus and the passive unit is able to answer to a Write Bus access from the I/O bus. The Write Bus test is performed using all kinds of accesses, that is understood by the passive unit. A counter is written to the Write Bus and goes into all units, that are able to do Write Bus accesses. An address range, that depends on the unit number of the passive unit, is then checked.

BTU

The active unit is equipped with a BTU (*Block Transport Unit*), and will test other units using the BTU. The BTU is a high speed DMA channel. When using the BTU to transfer data, all 32 bits of the data bus are used, and the passive unit must be able to answer to long word accesses. The BTU test operates as follows:

- The active unit writes a counter in its own memory.
- The BTU transfers this counter to the passive unit.
- The active unit clears its own memory.
- The BTU transfers the counter from the passive unit to the active unit.

- The active unit checks the counter.
- The active unit clears the memory.

While this operation is in progress the active unit will do a programmed read operation in the passive unit.

BTU burst

The active unit is able to perform a BTU burst access to the I/O bus or the passive unit is able to answer to a BTU burst access from the I/O bus. During this test the BTU will transfer data in bursts, which means that more than one data transfer is made in one I/O bus access.

CPU 68000

When a CPU 68000 is the active unit in a bustest, it will access the passive unit through Address Space Number 0 Segment 2 in the MMU.
The following accesses can be made from the CPU 68000:

Active accesses
Byte
Word
Read-Modify-Write

The following accesses can be made to the CPU 68000:

Passive accesses
Byte
Word
Long Word
Read-Modify-Write

SIOC1

When a SIOC1 is the active unit in a bustest, it will use the first entry to the memory mapper. One entry is able to address 1 Kb of memory on the I/O bus.
The following accesses can be made from the SIOC1:

Active accesses
Byte

The following accesses can be made to the SIOC1:

Passive accesses
Byte Word Read-Modify-Write

DIOC1

When a DIOC1 is the active unit in a bustest, it will use the first entry to the memory mapper. One entry is able to address 1 Kb of memory on the I/O bus.
The following accesses can be made from the DIOC1:

Active accesses
Byte BTU

The following accesses can be made to the DIOC1:

Passive accesses
Byte Word Read-Modify-Write

CIOC

When a CIOC is the active unit in a bustest, it will use the first entry to the memory mapper. One entry is able to address 1 Kb of memory on the I/O bus.
The following accesses can be made from the CIOC:

Active accesses
Byte BTU

The following accesses can be made to the CIOC:

Passive accesses
Byte Word Read-Modify-Write

DIOC2

When a DIOC2 is the active unit in a bustest, it will use entry number 12 to the memory mapper. Each entry is able to address 4 Kb of memory on the I/O bus.
The following accesses can be made from the DIOC2:

Active accesses
Byte
BTU

The following accesses can be made to the DIOC2:

Passive accesses
Byte
Word
Read-Modify-Write

NIOC/SIOC2

When a NIOC/SIOC2 is the active unit in a bustest, it will access the passive unit through Address Space Number 0 Segment 2 in the MMU.
The following accesses can be made from the NIOC/SIOC2:

Active accesses
Byte
Word
Read-Modify-Write

The following accesses can be made to the NIOC/SIOC2:

Passive accesses
Byte
Word
Long Word
Read-Modify-Write

CPU 68020

When a CPU 68020 is the active unit in a bustest, it will access the passive unit using the so called *short bus accesses* and then using the so called *long bus accesses* through Address Space Number 0 Segment 2 in the MMU.
The following accesses can be made from the CPU 68020:

Active accesses
Byte
Word
Long Word
Read-Modify-Write

The following accesses can be made to the CPU 68020:

Passive accesses
Byte
Word
Long Word
Read-Modify-Write
BTU burst

DIOC3

When a DIOC3 is the active unit in a bustest, it will access the passive unit using direct addresses to the I/O bus.
The following accesses can be made from the DIOC3:

Active accesses
Byte
Word
Long Word
Read-Modify-Write
Write Bus
BTU
BTU burst

The following accesses can be made to the DIOC3:

Passive accesses
Byte
Word
Long Word
Read-Modify-Write
BTU burst

CPU 68030

When a CPU 68030 is the active unit in a bustest, it will access the passive unit using different entries in the AMMU.
The CPU 68030 is able to test itself using the I/O bus.
The following accesses can be made from the CPU 68030:

Active accesses
Byte
Word
Long Word
Read-Modify-Write
Write Bus

The following accesses can be made to the CPU 68030:

Passive accesses
Byte
Word
Long Word
Read-Modify-Write
Write Bus
BTU burst

Short form access table

The following table gives you an overview of the accesses from and to the different units.

Active accesses							
Unit	**Byte**	**Word**	**Long**	**RMW**	**WB**	**BTU**	**BTU burst**
CPU 68000	x	x		x			
SIOC1	x						
DIOC1	x					x	
CIOC	x					x	
DIOC2	x					x	
NIOC/SIOC2	x	x		x			
CPU 68020	x	x	x	x			
DIOC3	x	x	x	x	x	x	x
CPU 68030	x	x	x	x	x		

Passive accesses						
Unit	**Byte**	**Word**	**Long**	**RMW**	**WB**	**BTU burst**
CPU 68000	x	x	x	x		
SIOC1	x	x		x		
DIOC1	x	x		x		
CIOC	x	x		x		
DIOC2	x	x		x		
NIOC/SIOC2	x	x	x	x		
CPU 68020	x	x	x	x		x
DIOC3	x	x	x	x		x
CPU 68030	x	x	x	x	x	x

DIAGNOSTIC PROGRAMS 4.3

CPU 68000

The purpose of this program is to evaluate the basic functions of the CPU 68000 module and the dynamic memory connected to it. The following functions can be tested with this program:

- The dynamic RAM connected to the CPU.
- The Memory Management Unit (MMU).
- All interrupts.
- All R/W registers.
- The Error Detection and Correction unit.

The Diagnostic Program is able to run on a CPU with standard mounted straps.

Initialization

After pressing reset you will see **'bO'** in the display. When the Diagnostic Program is loaded into the CPU, the front panel display will count 00, 04, 08, 0C, 10, ..., indicating that an initialization of memory is performed. The CPU is ready to be selected when the display is turned off. If an error occurs the display will change depending upon the error.

- **bE** in the display indicates a bus error.
- **AE** in the display indicates an address error.
- **Er** in the display indicates any other error.

If one of the error messages has been displayed it might be possible to get some more information about the error, by typing the select sequence on the terminal.

Running the Diagnostic Program

When the initialization is successfully completed, the CPU is ready to proceed with the more sophisticated parts of the test. After typing the select sequence for the CPU, that is going to be tested it should respond with the following message on the terminal:

cpu u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the CPU is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the CPU. The example shows the menu from a CPU with unit number 3:

```
cpu   3   > M
 2.00 Mb memory
A - Test RAM High Speed
B - Test RAM Bit Test
C - Test RAM Address Bit Test
D - Test RAM Galloping Ones And Zeroes
E - Test RAM Byte Write
F - Test RAM Read Modify Write
G - Test MMU Memory
J - Test MMU Adder
K - Test MMU ASN con SEG
L - Test MMU Comparator
I - Test Interrupts
O - Repeat test(s)
S - Test All
X - Bustest. Passive unit
Y - Bustest. Active unit
P - Set test parameters
M - Menu
V - Version
Q - Debugger
Z - Boot
cpu   3   >
```

Whenever the prompt is displayed on the terminal, tests can be selected by typing in the corresponding letter.

A - Test RAM. High Speed

This routine performs a fast test of the main memory connected to the CPU module. It takes the low order word of the current address and shifts it one bit to the right and writes that value in the memory. Then the memory content is read and compared to the value written and errors are indicated. All of this is repeated using the high order word of the current address. The high order word is not shifted as the low order word. The Error Detection and Correction circuitry is switched **ON** during this test.

B - Test RAM Bit Test

During this test every single bit in the main memory will be written with both *true* and *inverted* values. This is done using long word operations, but on a word basis which means that during pass one the value written is 00010001, during pass 2 it is FFFEFFFE, during pass 3 it is 00020002, during pass 4 it is FFFDFFFD etc. All in all 32 passes. A plus (+) is written on the terminal for each pass. The Error Detection and Correction circuitry is switched **OFF** during this test.

C - Test RAM. Address Bit Test

During this test every single address bit is tested. This is done by writing one value in the current address if the selected address bit is zero and another value if the address bit is one. The test is performed for address bits in the range 1-19 and the test runs four times, each time with two new write values.

Address bit	Pass 1	Pass 2	Pass 3	Pass 4
0	0000	FFFF	0000	8001
1	FFFF	0000	8001	0000

The reason for the value 8001 during pass 3 and 4 is to be sure that the bits concerning the Error Detection and Correction circuitry, which during this test is switched **ON**, also will be tested.

D - Test RAM. Galloping Ones And Zeroes

This test is also performed 4 times. First of all the memory is initialized with a default value. Then a galloping value is written in a certain address. Then all addresses which are neighbours to that first address are tested. They must still contain the default value. A neighbour is an address, which only differs in one bit from the original address. When all neighbours are tested the default value is written back in the original address. This is repeated for all addresses. The Error Detection and Correction circuitry is switched **ON** during this test.

Value	Pass 1	Pass 2	Pass 3	Pass 4
Default	0000	FFFF	0000	8001
Galloping	FFFF	0000	8001	0000

E - Test RAM. Byte Write

Because of the error correcting code it is much more difficult to write a byte in memory than it is to write a word. 16 bits are used to contain data and 6 bits contain the ECC code belonging to that data. If one byte (8 bits) is to be written you have to read the whole 16 bit word into a register, then write the new byte into the register and then write the whole word back in memory. During this test memory is initialized by writing a byte counter. Then the value 55 is written in all even memory locations and the whole memory is tested for correct content. The memory is then initialized again and the value 55 is written in all odd bytes. The whole memory is again tested for correct content. All write functions use byte write operations.

F - Test RAM. Read Modify Write

The MC68000 microprocessor has a feature which makes it possible in one operation to read a byte in memory, test the byte, set one bit in the byte and to write it back again. This is called *Read-Modify-Write* and this test will initialize memory with a default value and then perform the *Test And Set (TAS)* instruction on all memory locations and then check for correct memory content.

G - Test MMU Memory

The MMU memory consists of eight 1024x4 static RAMs. This memory can be tested using the same routines as those for the dynamic RAM, except the two using byte write operations. When selecting this test the above mentioned tests A, B, C and D will be performed on the MMU memory.

J - Test MMU Adder

The 16 bit adder is built from four 4 bit adders, which can be tested separately. This routine tests each 4 bit section of the adder in the MMU. The main memory is initialized in such a way that each double word in memory contains its own physical address. The memory is accessed using the relocating capabilities of the MMU. The physical address is calculated by adding the offset stored in the MMU to the logical address used when accessing the main memory. The calculated physical address is compared to the real physical address as read in the main memory.

K - Test MMU ASN con SEG

This routine tests that the MMU is addressed correctly by Address Space Number and Segment Number. The content of the main memory is initialized with physical addresses. The MMU memory is initialized with increasing offsets. For all Address Space Numbers and Segment Numbers the main memory is accessed using the relocating capabilities of the MMU. The calculated physical address is compared to the real physical address as read in the main memory.

L - Test MMU Comparator

This routine tests the 12 bit comparator used in the MMU. The routine accesses main memory using different Block Numbers (**BN**) and different **Sizes** in the MMU while the checking facilities of the MMU are enabled. Whenever **BN > Size** the memory access is illegal and a bus error should occur and if **BN <= Size** the memory access is legal and no bus error should occur.

I - Test Interrupts

This routine tests the interrupt circuit by setting all eight levels of external interrupts and checking that they activate the bits in the Interrupt Status Register. The timer interrupt is also tested and you can calculate the time between timer interrupts by measuring the time between two writings of **Timer Interrupt** on the terminal and then divide that time by 100. Normally you should end up with 40 ms.

O - Repeat test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (*O*) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled. It is not possible to select *X* and *Y* together with *O*.

S - Test All

This test will run one time through test A, B, C, D, E, F, G, J, K, L and I. It is possible to add the *Repeat test* option *(O)* to this one. This test does not include the bustest *X* or *Y*.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

P - Set test parameters

This entry is used to set start address and end address for the memory tests. The start and end address has to be on hexadecimal form. If nothing is entered, the program will use the default values shown on the terminal. Entering illegal addresses will not be allowed.

M - Menu

Display the menu on the terminal. The first line contains the actual memory size.

V - Version

Display version, date and elapsed time from last reset, on the form hh:mm:ss.

Q - Debugger

Go to debugging program. Return to Diagnostic Program by entering **RT <CR>**.

Z - Boot

Give master reset to the system.

Status register on the CPU 68000

STATUS(15:0), Status register	
STATUS(0)	Illegal user
STATUS(1)	Illegal bus
STATUS(2)	Illegal write
STATUS(3)	Segment too long
STATUS(4)	Time out
STATUS(5)	No memory
STATUS(6)	Error from bus
STATUS(7)	Double fault in memory
STATUS(8)	Single fault in memory
STATUS(9)	Timer interrupt
STATUS(10)	Error in unit
STATUS(11)	Power fail
STATUS(12)	RxRdy
STATUS(13)	TxRdy
STATUS(15:14)	Not used

DIAGNOSTIC PROGRAMS 4.3

SIOC1 0300

The purpose of this program is to evaluate the basic functions of the SIOC1 module 0300, which is the Serial Input Output Controller in the Supermax card family. The following functions can be tested using this program:

- Baud rate generators
- USART channels
- RS-232C interface
- RS-422 interface
- USART interrupts
- Timer interrupt
- Memory mapper
- Memory

The program is able to run on a SIOC1 with standard mounted straps. However, if the serial lines are to be tested, the 60 pin flat cable between the SIOC1 back panel and the SIOC1 module must be connected. If the RS-422 interface is to be tested, also the 50 pin flat cable must be connected. 8 special plugs must be placed in the SIOC1 back panel 25 pin connectors in order to test the RS-232C serial lines, and two special plugs must be placed in the 15 pin connectors in order to test the RS-422 serial lines. The plugs are described at the end of this chapter.

Running the Diagnostic Program

After pressing reset LED no. 4 will light. When the Diagnostic Program is loaded into the SIOC1, the LED will turn off and the SIOC1 is ready to be selected, and to start execution of the tests. After typing the select sequence for the SIOC1, that is going to be tested it should respond with the following message on the terminal:

sioc1 u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the SIOC1 is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the SIOC1. The example shows the menu from a SIOC1 with unit number 8:

```
siocl 8   > M
Hard test of SIOC1

A - Test baudrate generators
B - Test USART channels
C - Test USART interrupts
D - Test timer interrupt
E - Test memory mapper
F - Test RS-422
G - Test all
H - Test memory from 4000 to F000
O - Repeat test(s)
Q - Call DEBUG
S - Select USART channels to be tested
X - Bustest. Passive unit
Y - Bustest. Active unit
M - Menu
V - Version

siocl 8   >
```

A - Test Baud Rate Generators

This test works in conjunction with the one mentioned in B. It checks the 8 baud rate generators and the USART channels with baud rates from 19200 to 300 baud. For every baud rate it transmits and receives all possible characters on the channels, which were selected in *S*.

B - Test USART channels

This test transmits and receives all possible characters ranging from 00 to FF, on the USART's, which you select. It receives on the same channel as it transmits. The baud rate during this test is 9600 baud.

C - Test USART interrupts

During this test all RxRDY interrupts from the eight USART's are tested. At the same time the Interrupt Mask Register and the Receiver Mask Register are checked for correct function.

D - Test Timer Interrupt

The internally generated timer interrupt is checked for correct function. You can calculate the timer interrupt interval by measuring the time between two writings of **Timer Interrupt** on the terminal and then divide that time by 100. The SIOC1 should be strapped to 20 ms.

E - Memory mapper

The memory mapper consists of six 16x4 static RAMS which are organized as 48 map registers each 8 bits wide. During test of the mapper all registers are initialized with 00, and each bit is set separately. When a bit is set all registers are read back and checked.

F - Test RS-422

The serial RS-422 lines are checked for correct function running at a baud rate of 9600 baud. Channel 6 and 7 are the RS-422 USART's. The routines from test B are used to test this interface.

G - Test All

This test will run one time through test H, E, and D.

H - Test Memory

Memory area from 4000 to F000 is tested as described below. A 16-bit counter (start value 0000) is written in the RAM area which is to be tested. Then the RAM area is read back and the content is checked against the written value in order to locate any errors. After this test a counter with start value FFFF (count down) is written and read back.

O - Repeat Test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (*O*) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled. It is not possible to select *X* and *Y* together with *O*.

Q - Call Debug

Go to debugging program. Return to Diagnostic Program by entering **<CR>1XG**.

S - Select USART channels to be tested

When the USART's are going to be tested the program will need information about which channels are to be tested. If not going through this **S** command the default is all channels. It is possible to select the channels by typing numbers from 0-7 or type A for all.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

M - Menu.

Display the menu on the terminal.

V - Version

Display version, date and elapsed time from last reset, on the form hh:mm.

Special plugs needed to test the SIOC1.

Special plugs	
RS-232C plug 25 pin	RS-422 plug 15 pin
2 ←→ 3 4 ←→ 5 6 ←→ 20	2 ←→ 4 3 ←→ 5 9 ←→ 11 10 ←→ 12

In order to test the USART's you must use eight 25 pin Cannon connectors strapped as shown to the left. Place them in the SIOC1 back panel. If you are going to test the RS-422 lines you must use two 15 pin Cannon connectors strapped as shown to the right, and place them in the SIOC1 back panel.

Status register on the SIOC1 0300

ESR(7:0), Error Status Register	
ESR(0)	Time out
ESR(1)	Bus error out
ESR(2)	Bus error in
ESR(3)	Parity error
ESR(4)	ERROR signal in I/O bus
ESR(5)	Internal error signal
ESR(6)	Not used
ESR(7)	BUSY signal from parallel printer

DIAGNOSTIC PROGRAMS 4.3

DIOC1 0400

The purpose of this program is to evaluate the basic functions of the DIOC1 module 0400, which is the Disk Input Output Controller in the Supermax card family. The following functions can be tested using this program:

- DMA channels
- Peripheral interface
- Timer interrupt
- Memory mapper
- Memory
- Peripheral units

The program is able to run on a DIOC1 with standard mounted straps.

Running the Diagnostic Program

After pressing reset LED no. 4 will light. When the Diagnostic Program is loaded into the DIOC1, the LED will turn off and the DIOC1 is ready to be selected, and to start execution of the different tests. After typing the select sequence for the DIOC1, that is going to be tested it should respond with the following message on the terminal:

dioc1 u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the DIOC1 is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the DIOC1. The example shows the menu from a DIOC1 with unit number E:

```
diocl E   > M
Hard test of DIOC1

A - Test memory mapper
B - Test DMA
C - Test all
D - Test peripheral units
E - Test peripheral interface
F - Test timer interrupt
G - Test memory A000 to F000
O - Repeat test(s)
Q -  Call Debug
X - Bustest. Passive unit
Y - Bustest. Active unit
M - Menu
V - Version

diocl E   >
```

A - Memory mapper

The memory mapper consists of six 16x4 static RAMS which are organized as 48 map registers each 8 bits wide. During test of the mapper all registers are initialized with 00, and each bit is set separately. When a bit is set all registers are read back and checked.

B - DMA

The DMA test only checks the communication with the AM9517 four channel DMA controller. Test of the four channels will be performed during execution of other test programs. Before test, the 9517 is given a master clear. Then the status register and the temporary register are read. These registers must contain 00 after reset. All address and word count registers are initialized with 00, and each bit is set separately. When a bit is set all registers are read back and checked.

C - Test All

This test will run one time through test A, B, E, F, and G.

D - Test Peripheral Units

The Diagnostic Program for Peripheral Units will always be resident in the DIOC1, except after running the bustest *X* or *Y*. Refer to the chapter concerning Diagnostic Program for Peripheral Units, to see the features of that program.

E - Test Peripheral Interface

This test consist of 3 parts:

- **Floppy Disk Interface.** A counter is written in the track register and the sector register of the FD 1795 floppy disk controller and read back. The test only checks the communication with the FD 1795 and not the interface to the drive.

- **Streaming Tape Interface.** The test checks the data bus in the interface. A counter is written in a register in the interface and read back.
- **Winchester Disk Interface.** The test checks the data bus in the interface. A counter is written in a register in the interface and read back.

F - Test Timer Interrupt

The internally generated timer interrupt is checked for correct function. You can calculate the timer interrupt interval by measuring the time between two writings of **Timer Interrupt** on the terminal and then divide that time by 100. The timer frequency is strapable, and has one of the following values: 1.3, 6.4, 12.8, 64.0 or 128 milliseconds. The DIOC1 should be strapped to 128 ms.

G - Test Memory

Memory area from A000 to F000 is tested as described below. A 16-bit counter (start value 0000) is written in the RAM area which is to be tested. Then the RAM area is read back and the content is checked against the written value in order to locate any errors. After this test a counter with start value FFFF (count down) is written and read back.

O - Repeat Test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (*O*) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled. It is not possible to select *X* and *Y* together with *O*.

Q - Call Debug

Go to debugging program. Return to Diagnostic Program by entering **<CR>1XG**.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

M - Menu.

Display the menu on the terminal.

V - Version

Display version, date and elapsed time from last reset, on the form hh:mm.

Status register on the DIOC1 module

ESR(7:0), Error Status Register	
ESR(0)	Time out
ESR(1)	Bus error out
ESR(2)	Bus error in
ESR(3)	Parity error
ESR(4)	Error signal in I/O bus
ESR(5)	BTU time out
ESR(6)	BTU bus error in
ESR(7)	DMA parity error

DIAGNOSTIC PROGRAMS 4.3

CIOC 0900

The purpose of this program is to evaluate the basic functions of the CIOC module 0900, which is the Communication Input Output Controller in the Supermax card family. The following functions can be tested using this program:

- Baud rate generators
- USART channels
- USART interrupts
- DMA channels
- Line interface signals
- HDLC channels
- Timer interrupt
- Memory mapper
- Memory

The program, except for test **E**, is able to run on a CIOC with standard mounted straps. However, if the communication lines are to be tested, the 50 pin flat cable between the CIOC back panel and the CIOC module must be connected. Two special plugs must be placed in the CIOC back panel 25 pin connectors, and two special plugs must be placed in the CIOC back panel 15 pin connectors before testing.

Running the Diagnostic Program

After pressing reset LED no. 4 will light. When the Diagnostic Program is loaded into the CIOC, the LED will turn off and the CIOC is ready to be selected, and to start execution of the tests. After typing the select sequence for the CIOC, that is going to be tested it should respond with the following message on the terminal:

cioc u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the CIOC is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the CIOC. The example shows the menu from a CIOC with unit number F:

```
cioc  F   > M
Hard test of CIOC

A - Test memory mapper
B - Test DMA and memory move
C - Test all
D - Test USARTs
E - Test USARTs with modem clocks
F - Test HDLC-0
G - Test HDLC-1
I - Test memory from 4000 to F000
H - Test timer interrupt
O - Repeat test(s)
Q - Call DEBUG
X - Bustest. Passive unit
Y - Bustest. Active unit
M - Menu
V - Version

cioc  F   >
```

A - Memory mapper

The memory mapper consists of six 16x4 static RAM's which are organized as 48 map registers each 8 bits wide. During test of the mapper all registers are initialized with 00, and each bit is set separately. When a bit is set all registers are read back and checked.

B - Test DMA and memory move

On the CIOC there are two DMA controllers AM9517 each with four channels. One of the channels is cascaded to the other controller giving a total of 7 channels. The DMA test only checks the communication with the two AM9517 DMA controllers. Before testing, the 9517 is given a master clear. Then the status register and the temporary register are read. These registers must contain 00 after reset. All address and word count registers are initialized with 00, and each bit is set separately. When a bit is set all registers are read back and checked. The memory move feature is tested by writing a counter in a part of the memory and then move this part of the memory to another part of the memory using DMA transfer. Then the second part of the memory is tested for correct content. After that the test is repeated, but this time moving from the second part of the memory to the first part.

C - Test All

This test will run one time through test I, A, B, and H.

D - Test USARTs

During this test the four USART's are tested. The baud rate during all tests is 9600 baud. During the test the Communication Select Register, Communication Interrupt Register, and Interrupt Mask Register are checked for correct function. This test consists of 4 parts:

- All line interface signals are checked. USART-D is used to test RS-232C interface and USART-X is used to test RS-422 interface.
- All RxRDY and TxRDY interrupts from the four USART's are tested.
- USART-X is tested with RxRDY and TxRDY interrupts. This test transmits and receives all possible characters ranging from 00 to FF, on the USART's. Interface RS-422 is used for this test.
- Testing USART-D channel with DMA controller 1. This test transmits and receives all possible characters ranging from 00 to FF, on the DMA/USART's. All DMA interrupts will be tested. Interface RS-232C is used for this test.

In order to test the serial channels there must be 4 special plugs in the back panel. The plugs are described at the end of this chapter.

E - Test USARTs with modem clocks

During this test receiver/transmitter clocks on the RS-232C interface and the Signal Element Timing on RS-422 interface are tested. Before testing set the straps STX0, SRX0, STX1, and SRX1 to CIOC driving the modem clocks (Position 2-3). The routines from test D are used to test the USARTs with modem clocks.

F - Test HDLC-0

During this test the HDLC-0 is tested. It checks the two baud rate generators RxClk and TxClk on the HDLC channel with baud rates from 19200 to 300 baud. During the test the Communication Select Register, Communication Interrupt Register, and Interrupt Mask Register are checked for correct function. Line interface RS-232C is used during this test. This test consists of 3 parts:

- Testing reset and initializing the HDLC-chip.
- Testing modem signals on the HDLC-chip.
- Testing HDLC channel with DMA controller 1. This test transmits and receives all possible characters ranging from 00 to FF, on the DMA/HDLC . Interrupts RxINT and TxINT will be tested.

In order to test the serial channels there must be 2 special plugs in the back panel. The plugs are described at the end of this chapter.

G - Test HDLC-1

The routines from test F are used to test HDLC-1.

I - Test Memory

Memory area from 4000 to F000 is tested as described below. A 16-bit counter (start value 0000) is written in the RAM area which is to be tested. Then the RAM area is read back and the content is checked against the written value in order to locate any errors. After this test a counter with start value FFFF (count down) is written and read back.

H - Test Timer Interrupt

The internally generated timer interrupt is checked for correct function. You can calculate the timer interrupt interval by measuring the time between two writings of **Timer Interrupt** on the terminal and then divide that time by 100. The CIOC should be strapped to 12 ms.

O - Repeat Test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (*O*) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled. It is not possible to select *X* and *Y* together with *O*.

Q - Call Debug

Go to debugging program. Return to Diagnostic Program by entering **<CR>1XG**.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

M - Menu.

Display the menu on the terminal.

V - Version

Display version, date and elapsed time from last reset, on the form hh:mm.

Special plugs needed to test the CIOC.

Special plugs	
RS-232C plug 25 pin	RS-422 plug 15 pin
2 ←→ 3	2 ←→ 4
4 ←→ 5	3 ←→ 5
4 ←→ 8	9 ←→ 11
6 ←→ 20	10 ←→ 12

In order to test the CIOC you must use two 25 pin Cannon connectors strapped as shown to the left, and two 15 pin Cannon connectors strapped as shown to the right, and place them in the CIOC back panel.

Status register on the CIOC module

ESR(7:0), Error Status Register	
ESR(0)	Time out
ESR(1)	Bus error out
ESR(2)	Bus error in
ESR(3)	Parity error
ESR(4)	Error signal in I/O bus
ESR(5)	BTU time out
ESR(6)	BTU bus error in
ESR(7)	DMA parity error

DIAGNOSTIC PROGRAMS 4.3

DIOC2 1100

The purpose of this program is to evaluate the basic functions of the DIOC2 module, which is the second version of the Disk Input Output Controller in the Supermax card family. The following functions can be tested using this program:

- DMA channels
- DMA memory
- Peripheral interface
- Timer interrupt
- Memory mapper
- Memory
- Peripheral units

The program is able to run on a DIOC2 with standard mounted straps.

Initialization

During the initial 15 seconds after reset an internal test and initialization is performed. First the DIOC2 runs in the EPROM and tests a part of the memory before it makes a copy of the EPROM to that part of memory. If any errors are detected during this test the program will stay in the EPROM, LED 3 and LED 2 will light and an error message will be displayed on the terminal. After copying the EPROM the memory mapper is tested, then the rest of the program memory is initialized and tested and finally the DMA memory is initialized and tested. If any errors are found LED 3 will never turn off. If no errors are found LED 3 will turn off after about 15 seconds and the DIOC2 will start to boot the system. If there is a hard error on the floppy disk or the winchester disk LED 2 will light, and the DIOC2 will keep trying to load the programs. When all Diagnostic Programs are loaded into the respective units, all LED's on the DIOC2 will be turned off.

Running the Diagnostic Program

When the initialization is successfully completed, the DIOC2 is ready to proceed with the more sophisticated parts of the test. After typing the select sequence for the DIOC2, that is going to be tested it should respond with the following message on the terminal:

dioc2 u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the DIOC2 is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the DIOC2. The example shows the menu from a DIOC2 with unit number E:

```
dioc2 E   > M
Hard test of DIOC2

A - Test memory mapper
B - Test memory
C - Test all
D - Test peripheral units
E - Test peripheral interface
F - Test bus interrupt and timer interrupt
G - Test DMA memory
H - Test DUARTs
O - Repeat test(s)
P - Set boot pointer
Q - Call DEBUG
S - Set test time for Non-Operator Mode
U - Display configuration
X - Bustest. Passive unit
Y - Bustest. Active unit
M - Menu
V - Version

dioc2 E   >
```

A - Memory mapper

The memory mapper consists of six 16x4 static RAM's which are organized as 48 map registers each 8 bits wide. During test of the mapper all registers are initialized with 00, and each bit is set separately. When a bit is set all registers are read back and checked.

B - Test Memory

Memory area from 10000 to 40000 is tested as described below. A 16-bit counter (start value 0000) is written in the RAM area which is to be tested. Then the RAM area is read back and the content is checked against the written value in order to locate any errors. After this test a counter with start value FFFF (count down) is written and read back.

C - Test All

This test will run one time through test B, A, G, E, and F.

D - Test Peripheral Units

The Diagnostic Program for Peripheral Units will always be resident in the DIOC2. Refer to the chapter concerning Diagnostic Program for Peripheral Units, to see the features of that program.

E - Test Peripheral Interface

This test consist of 3 parts:

- **Floppy Disk Interface.** A counter is written in the track register and the sector register of the FD 2795 floppy disk controller and read back. The test only checks the communication with the FD 2795 and not the interface to the drive.
- **Streaming Tape Interface.** The test checks the tape word count register by writing a counter in the two registers in the interface and read back.
- **BTU word count register.** The test checks the BTU word count register by writing a counter in the two registers in the interface and read back.

F - Test bus interrupt and timer interrupt

The internally generated timer interrupt is checked for correct function. You can calculate the timer interrupt interval by measuring the time between two writings of 'Timer interrupt' on the terminal and then divide that time by 100. The timer frequency is strapable, and has one of the following values: 10, 20, 40, 80 milliseconds. 80 milliseconds is default. Also an internal setting of external interrupts is tested.

G - Test DMA Memory

DMA memory area from 0000 to 10000 for all four banks (256 Kb) is tested as described in B.

H - Test DUART's

On the DIOC2 there are two DUART's giving four serial channels. This test consists of 3 parts:

- All channels are tested by writing all values from 00 - FF from one channel to the same channel at four different baud rates, 1200, 4800, 9600 and 38400, checking that the received character is the same as the one send.
- It is checked that it is possible to get an interrupt from all four channels when receiving a character.
- It is checked that the DUART's are able to set and reset all the modem signals.

In order to test the serial channels there must be 4 special plugs in the DIOC2 back panel. The plugs are described at the end of this chapter.

O - Repeat Test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (*O*) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled. It is not possible to select *X* and *Y* together with *O*.

P - Set boot pointer

If the Diagnostic Programs are booted from a disk located on this DIOC2, it is possible to change the boot pointer, which is a pointer to a logical disk where the boot programs are located. There are up to 4 pointers, which can be selected. Normally **Pointer 0** points to the **UNIX Operating System** and **Pointer 1** points to the **Diagnostic Programs** and **Pointer 2 and 3** are not used. Selecting **Default** will set the pointer to the one that was active before the Diagnostic Programs were loaded.

Q - Call Debug

Go to debugging program. Return to Diagnostic Program by entering **<CR>1XG**.

S - Set test time for Non-Operator Mode

This is used if the time for running in **Non-Operator Mode** is to be changed. Both the time for the internal test and the time for the bustest can be set individually. The program will ask if you want to use the default time. If the answer is **No**, you will be asked to type in the new values. It is not possible to use this command on a DIOC2, which is **not** the Master unit.

U - Display configuration

A configuration list will be written on the terminal, containing information about which units, type and unit number, were in the system when it was booted. It is not possible to use this command on a DIOC2, which is **not** the Master unit.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

M - Menu.

Display the menu on the terminal.

V - Version

Display version, date and elapsed time from last reset, on the form hh:mm.

Special plugs needed to test the DIOC2.

Special plugs
RS-232C plug
25 pin
2 ←→ 3
4 ←→ 5
6 ←→ 20

In order to run the DIOC2 serial channel Diagnostic Program you must use four 25 pin Cannon connectors strapped as shown above and place them in the back panel.

Status register on the DIOC2 module

ESR(7:0), Error Status Register	
ESR(0)	Error signal in I/O bus
ESR(1)	BTU bus error
ESR(2)	Parity error in DMA memory
ESR(3)	Time out during a BTU transfer
ESR(4)	Bus error
ESR(5)	Parity error in program memory
ESR(6)	Time out during an I/O bus cycle
ESR(7)	Time out because 8085 halt

DIAGNOSTIC PROGRAMS 4.4

NIOC 1600-3600 / SIOC2 3600

The purpose of this program is to evaluate the basic functions of the NIOC module and the SIOC2 module in the Supermax card family. The following functions can be tested with this program:

- The dynamic memory.
- The Memory Management Unit (MMU).
- All interrupts.
- The DUART modules.
- The Local Area Network (*LAN*) controller.
- The EEPROM.

The Diagnostic Program is able to run on a NIOC/SIOC2 with standard mounted straps. It is the same program running on both the NIOC 1600-3600 and the SIOC2 3600. The program will determine what module it is running on and only the tests concerning that module can be selected.

Initialization

Included in the boot prom of the NIOC/SIOC2 is a thorough self test, which includes the following items:

- MC68000 internal confidence test.
- High speed MMU memory test.
- Address Space Register test
- Interrupt Mask Register test
- Initialize and test memory from 0 - 80000, before copying the content of the prom to the memory.
- Initialize and test memory to top of memory, which is read in the configuration table in the EEPROM. If nothing or illegal value written in the EEPROM only memory up to 80000 will be tested.
- Initialize and test the buffer memory if installed. This is read in the configuration table in the EEPROM. If nothing or illegal value written in the EEPROM no test will be performed.

If all the mentioned tests run without any errors LED no. 4, indicating Error In Unit, will be turned off and the NIOC/SIOC2 is ready to be booted. If the LED does not turn off within appx. 15 seconds, it is because of an error during the self test. The NIOC/SIOC2 will not be booted if any error occurred. If this happens you should try to type the select sequence. Depending upon the error it is possible that you might get some information about the error when selecting the NIOC/SIOC2. When the LED is turned off and the NIOC/SIOC2 has been booted with the Diagnostic Program, you can proceed with the execution of those programs.

Running the Diagnostic Program

When the initialization is successfully completed, and the NIOC/SIOC2 is booted, the NIOC/SIOC2 is ready to proceed with the more sophisticated parts of the test. After typing the select sequence for the NIOC/SIOC2, that is going to be tested it should respond with a message on the terminal, depending upon what module it is.

If it is a NIOC 1600 it will respond:

nioc1 u > _ (**u** *is the unit number*)

If it is a NIOC 3600 it will respond:

nioc2 u > _ (**u** *is the unit number*)

If it is a SIOC2 3600 it will respond:

sioc2 u > _ (**u** *is the unit number*)

When one of these prompts are displayed on the terminal, the NIOC/SIOC2 is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the NIOC/SIOC2. The example shows the menu from a SIOC2 with unit number 5:

```
sioc2 5   > M
A - Test Main memory
B - Test Buffer memory
C - Test MMU memory
D - Test MMU. ASN - SEG
E - Test MMU. Size field check
F - Test DUART's. External loop back
G - Test DUART's. Internal loop back
H - Test LAN controller without Transceiver
K - Test LAN controller with Transceiver
I - Test Interrupt
J - Test EEPROM. Content will be saved
O - Repeat test(s)
S - Test All
X - Bustest. Passive unit
Y - Bustest. Active unit
N - Network monitor
W - Read/Write Network address in EEPROM
T - Insert Hardware configuration in EEPROM
P - Set test parameters       U - Write to parallel printer
M - Menu                      V - Version
Q - Debugger                  Z - Boot
sioc2 5   >
```

A - Test Main Memory

This is a test of the main memory on the NIOC/SIOC2. It is possible to have either 512 kB or 1 MB of main memory. The program will only test as much memory as mounted. The following 5 tests will be executed in the order mentioned.

- **High Speed**. This routine performs a fast test of the dynamic memory mounted on the NIOC/SIOC2 module. It takes the low order word of the current address and shifts it one bit to the right and writes that value in memory. Then the memory content is read and compared to the value written and errors are indicated. All of this is repeated using the high order word of the current address. The high order word is not shifted as the low order word.

- **Bit Test**. During this test every single bit in the main memory will be written with both true and inverted values. This is done using long word operations but on a word basis which means that during pass one the value written is 00010001, during pass 2 it is FFFEFFFE, during pass 3 it is 00020002, during pass 4 it is FFFDFFFD etc. All in all 32 passes. A plus (+) is written on the terminal for each pass.

- **Address Bit Test**. During this test every single address bit is tested. This is done by writing one value in the current address if the selected address bit is zero and another value if the address bit is one. The test is performed for address bits in the range 1-19 and the test runs two times, each time with two new write values.

Address bit	Pass 1	Pass 2
0	0000	FFFF
1	FFFF	0000

- **Galloping Ones And Zeroes**. This test is also performed two times. First of all the memory is initialized with a default value. Then a galloping value is written in a certain address. Then all addresses which are neighbours to that first address are tested. They must still contain the default value. A neighbour is an address which only differs in one bit from the original address. When all neighbours have been tested the default value is written back in the original address. This is repeated for all addresses.

Value	Pass 1	Pass 2
0	0000	FFFF
1	FFFF	0000

- **Read-Modify-Write**. The MC68000 microprocessor has a feature which makes it possible in one operation to read a byte in memory, test the byte, set one bit in the byte and to write it back again. This is called read modify write and this test will initialize memory with a default value and then perform the Test And Set (TAS) instruction on all memory locations and then check for correct memory content.

B - Test Buffer Memory

The buffer memory consists of 256 kB dynamic memory and will be tested using the same 5 routines as those for the main memory. The buffer memory is only mounted on NIOC modules.

- **High Speed.**
- **Bit Test.**
- **Address Bit Test.**
- **Galloping Ones And Zeroes.**
- **Read-Modify-Write.**

C - Test MMU Memory

The MMU memory consists of 2 kB static RAM. This memory will be tested using 4 of the routines mentioned above.

- **High Speed.**
- **Bit Test.**
- **Address Bit Test.**
- **Galloping Ones And Zeroes.**

D - Test MMU. ASN - SEG

This routine tests that the MMU is addressed correctly by Address Space Number and Segment Number. The main memory is initialized with physical addresses. The MMU memory is initialized with increasing offsets. For all Address Space Numbers and Segment Numbers the main memory is accessed using the relocating capabilities of the MMU. The calculated physical address is compared to the real physical address as read in the main memory.

E - Test MMU. Size field check

This routine tests the bit swapping and bit field test facilities in the memory protection capabilities of the MMU. It accesses main memory using different logical addresses and different Sizes while the checking facilities of the MMU are enabled. If the value of the Size field is called **Z** and the logical address is called **LADR**, then we have that whenever **LADR(19:10+Z) < > 0** then the memory access is illegal and a bus error should occur and if **LADR(19:10+Z) = 0** then the memory access is legal and no bus error should occur.

F - Test DUART's. External loop

On the SIOC2 there is a local bus, on which it is possible to connect from 1 to 8 DUART modules, each having 8 serial channels. All DUART modules are tested one by one using the following three tests:

- All channels are tested by transmitting characters with values from 00 - FF from one channel to the same channel at two different baud rates, 9600 and 38400, checking that the received character is the same as the one transmitted.
- It is checked that it is possible to get an interrupt from all 8 channels when receiving a character.
- It is checked that the DUART's are able to set and reset all the modem signals.

In order to test the serial channels with external loop you must insert 8 special plugs in each DUART back panel. The plugs are described at the end of this chapter.

G - Test DUART's. Internal loop

It is possible to configure the DUART's to a mode called internal loop. When doing that the DUART's will make an internal connection of the transmit and receive data pins. This enables the program to run the test without using the special plugs required in test F. However, it is not possible to test the modem signals in internal loop, so only the first and second test mentioned above will be made during this test.

H - Test LAN controller without Transceiver

Refer to the description of test K. The third test mentioned there will not be executed when running this test.

K - Test LAN controller with Transceiver

The Local Area Network (*LAN*) interface is based on Intel 82586 and SEEQ 8023A. The 82586 is the LAN controller and the 8023A is the manchester encoder/decoder. Communication between the 68000 and the 82586 is made through the buffer memory. A certain part of that memory is used to exchange commands and status information. The 82586 has some built-in test facilities and they are started when the 82586 has been initialized. If the internal test fails, no further testing will be done, the error will be reported and the program will return to the menu. Otherwise the buffer memory will be initialized with a lot of receive and transmit buffers and descriptors in order to enable the 82586 to receive and transmit packages on the network. This test will only run on NIOC modules. The test goes through three passes.

- The 82586 is configured to internal loop back and will transmit a package of 1 kB taken from the transmit buffer, receive the data and put them in the receive buffer. The program will check status from the 82586 and compare received data with transmitted data.
- The 82586 is configured to external loop back and the 82501 is configured to loop back. Now the transmitted data will be gated to receive data by the manchester encoder/decoder. When configured like this the 82586 is only able to handle packages of 18 bytes. Status and data are checked.
- The 82586 is configured to external loop back and the 82501 is configured to no loop back. Now the transmitted data will be gated to receive data by the transceiver connected to the NIOC. This means that during this test there will be activity on the Network cable. When configured like this the 82586 is only able to handle packages of 18 bytes. Status and data are checked.

When the test is completed a statistic is written on the terminal, giving all kinds of information about the transmission.

I - Test Interrupt

This routine tests the interrupt circuit by setting all eight levels of external interrupts and checking that they activate the bits in the Interrupt Status Register. The timer interrupt is also tested and you can calculate the time between timer interrupts by measuring the time between two writings of **Timer Interrupt** on the terminal and then divide that time by 100. Normally you should end up with 10 ms.

J - Test EEPROM. Content will be saved

All the network parameters are stored in the EEPROM. Because of that the content of the EEPROM is saved in main memory before testing it. The EEPROM is tested by writing 00 and FF into it. After that the original content is written back. The NIOC/SIOC2 will not respond to any interrupts from the service port during this test. This means that you should not try to select any other units, because that operation will not deselect the NIOC/SIOC2. An EEPROM is only able to perform appx. 10000 write operations, before it is destroyed and because of that you will not be allowed to run this test continuously, and you should not run it more than once when testing a NIOC/SIOC2.

O - Repeat test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (*O*) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled.

S - Test All

This test will run one time through test A, B, C, D, E, G, H and I. It is possible to add the *Repeat test* option *(O)* to this one.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

N - Network monitor

This entry is used to check the local area network. The LAN controller will receive all packages on the network and you can see statistics of the received packages by typing **R**.

W - Read/Write Network address in EEPROM

The individual address, assigned to all controllers connected to a Local Area Network, is located in the EEPROM. This address must be written in the EEPROM, otherwise the NIOC software will not work properly. This entrance in the Diagnostic Program will show you the 6 byte address including a checksum verification. Then it is possible to insert a network address, to change the old one or just to exit without any change. Please note, that it is impossible to change the first 3 bytes of the address. They must be 080075 in all networking equipment from DDE.
NOTE. All numbers typed will be right adjusted when written in the EEPROM.

T - Insert Hardware configuration in EEPROM

The Hardware configuration of the NIOC/SIOC2 is saved in the EEPROM. It is possible to display and change the configuration. The configuration table is used by the boot prom when running the initial self test and should normally not be changed. A typical configuration for a NIOC 1600 looks like this:

```
Main memory (80000/100000):  0x80000
Buffer memory  (Y/N):        Yes
82586 installed  (Y/N):      Yes
Number of DUART modules 0-8: 0
```

P - Set test parameters

This entry is used to tell the program how many of the DUART modules that should be tested, when running test **F** or **G**.

U - Write to parallel printer

This test will write the menu text to the parallel printer interface. The operator must visually inspect, if the written text is correct.

M - Menu

Display the menu on the terminal.

V - Version

Display version, date and elapsed time from last reset on the form hh:mm:ss.

Q - Debugger

Go to debugging program. Return to Diagnostic Program by entering **GO <CR>**.

Z - Boot

Give master reset to the system. This will not work on the NIOC 1600.

Special plugs needed to test the DUART's

Special plugs	
RS-232C plug 25 pin	RS-422 plug 15 pin
2 ⟷ 3 4 ⟷ 5 6 ⟷ 20	2 ⟷ 4 3 ⟷ 5 9 ⟷ 11 10 ⟷ 12

In order to test one DUART module you must use eight 25 pin Cannon connectors strapped as shown to the left or eight 15 pin Cannon connectors strapped as shown to the right.

Status register on the NIOC/SIOC2 module

STATUS(7:0), Status register	
STATUS(0)	Illegal bus
STATUS(1)	Illegal write
STATUS(2)	Segment too long
STATUS(3)	Bus error from bus
STATUS(4)	Time out
STATUS(7:5)	Not used

DIAGNOSTIC PROGRAMS 4.3

CPU 68020

The purpose of this program is to evaluate the basic functions of the CPU 68020 module and the dynamic memory connected to it. The following functions can be tested with this program:

- The dynamic RAM connected to the CPU.
- The Memory Management Unit (MMU).
- All interrupts.
- All R/W registers.
- The Error Detection and Correction unit.
- The Program and Data cache.

The Diagnostic Program is able to run on a CPU with standard mounted straps.

Initialization

Included in the boot prom of the CPU 68020 is a thorough self test, which includes the following items:

- Running MC 68020 internal confidence test.
- Testing the Address Space Register.
- Testing the MMU memory, high speed.
- Initializing and testing memory from 0 - 100000, before copying the content of the prom to the memory.
- Determining the actual memory size.
- Initializing and testing memory from 100000 to top of memory.
- Testing program cache, data cache and physical address cache comparator.
- Running MC 68881 FPC internal confidence test.

During the self test the front panel display will change according to the test currently running and the status of the test. The following table shows the possible display codes. F*n* means test *n* failed. P*n* means test *n* passed.

Display codes		
Passed	Failed	Test
P0	**F0**	Test stuck at high or low bits
P1	**F1**	Test data registers
P2	**F2**	Test control registers
P3	**F3**	Test address registers
P4	**F4**	Test status bits
P5	**F5**	68020 instruction test
P7	**F7**	Address Space Register
P8	**F8**	MMU memory
P9	**F9**	Testing memory 0 - 100000
PA		Just before copying prom
PC		Just after copying prom
Pd		Test caches
PE		Determine memory size
PF		Test memory to top
bo		Test MC 68881 FPC
	FA	Data error in memory
	FC	Single error in memory
	Fd	Error in cache test
	FE	Double fault in memory

When the display shows **Pd**, the CPU will enable the I/O bus in and then be ready to be booted. However it will continue the self test until finished. If any errors occur the display will keep the error code, but still try to run the program that has been loaded. If no errors occur the CPU will start the program, which could be either the **UNIX Operating System** or the **Diagnostic Programs**. If it is the Diagnostic Programs the CPU is ready to be selected, when the display is turned off. If any errors occur, which means the display is not turned off, it is possible to get further information about the error, by typing the select sequence. There are some additional display values used in the Diagnostic Programs.

- **bE** in the display indicates a bus error.
- **AE** in the display indicates an address error.
- **EE** in the display indicates any other exception.
- **Er** in the display indicates any other error.

Running the Diagnostic Program

When the initialization is successfully completed, and the CPU is booted, the CPU is ready to proceed with the more sophisticated parts of the test. After typing the select sequence for the CPU, that is going to be tested it should respond with the following message on the terminal:

cpu20 u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the CPU is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the CPU. The example shows the menu from a CPU with unit number 3:

```
cpu20 3   > M
 2 Mb memory. 68020 cache   = 'Enable'
              Program cache = 'Disable'. Data cache = 'Disable'
A - Test RAM High Speed
B - Test RAM Bit Test
C - Test RAM Address Bit Test
D - Test RAM Galloping Ones And Zeroes
E - Test RAM Byte Write
F - Test RAM Read Modify Write
G - Test MMU Memory
J - Test MMU Adder
K - Test MMU ASN - SEG
L - Test MMU Comparator
I - Test Interrupts
H - Test Cache
O - Repeat test(s)
S - Test All
X - Bustest. Passive unit
Y - Bustest. Active unit
M - Menu
V - Version
P - Set test parameters
Q - Debugger
Z - Boot
cpu20 3   >
```

A - Test RAM. High Speed

This routine performs a fast test of the dynamic memory connected to the CPU module. It writes the value of the current address in memory. Then the memory content is read and compared to the value written and errors are indicated. All of this is repeated using the inverted value of the current address. The Error Detection and Correction circuitry is switched **ON** during this test.

B - Test RAM Bit Test

During this test every single bit in the main memory will be written with both *true* and *inverted* values. This is done using long word operations with the following values. During pass one the value written is 00000001, during pass 2 it is FFFFFFFE, during pass 3 it is 00000002, during pass 4 it is FFFFFFFD etc. All in all 64 passes. A plus (+) is written on the terminal for each pass. The Error Detection and Correction circuitry is switched **OFF** during this test.

C - Test RAM. Address Bit Test

During this test every single address bit is tested. This is done by writing one value in the current address if the selected address bit is zero and another value if the address bit is one. After that the memory is checked for correct content. The test is performed for address bits in the range 2-23 and the test runs four times, each time with two new write values.

Address bit	Pass 1	Pass 2	Pass 3	Pass 4
0	00000000	FFFFFFFF	00000000	42070220
1	FFFFFFFF	00000000	42070220	00000000

The reason for the value 42070220 during pass 3 and 4 is to make sure that the bits concerning the Error Detection and Correction circuitry, which is switched **ON** during this test, also will be tested.

D - Test RAM. Galloping Ones And Zeroes

This test is also performed 4 times. First of all the memory space is initialized with a default value. Then a galloping value is written in a certain address. Then all addresses which are neighbours to that first address are tested. They must still contain the default value. A neighbour is an address, which only differs in one bit from the original address. When all neighbours are tested the default value is written back in the original address. This is repeated for all addresses. The Error Detection and Correction circuitry is switched **ON** during this test.

Value	Pass 1	Pass 2	Pass 3	Pass 4
Default	00000000	FFFFFFFF	00000000	42070220
Galloping	FFFFFFFF	00000000	42070220	00000000

E - Test RAM. Byte Write

Because of the error correcting code it is much more difficult to write a byte (*8 bits*) or a word (*16 bits*) in memory, than it is to write a long word (*32 bits*). 32 bits are used to contain data and 7 bits contain the ECC code belonging to that data. If one byte or one word is to be written the CPU module will have to read a whole long word into a register, then write the new byte or word into the register and then write the long word back in memory. The 68020 is able to do a long word operation even though the address being referenced is not on a long word boundary. This is called **Dynamic Bus Sizing**. In other words, if the 68020 writes to an address on a long word boundary, the long word will be written in one operation. But if the address is not on a long word boundary, the operation will be split into two operations as shown below:

Dynamic Bus Sizing		
Boundary	1. operation	2. operation
0	1 long word	
1	3 bytes	1 byte
2	1 word	1 word
3	1 byte	3 bytes

This test will write the long word FFAA5500 using long word operations, but using the four different boundaries. By doing that both byte, word and long word operations will be performed.

F - Test RAM. Read Modify Write

The MC68020 microprocessor has a feature which makes it possible in one operation to read a byte in memory, test the byte, set one bit in the byte and to write it back again. This is called *Read-Modify-Write* and this test will initialize memory with a default value and then perform the *Test And Set (TAS)* instruction on all memory locations and then check for correct memory content.

G - Test MMU Memory

The MMU memory consists of 16 kB static RAM. This memory can be tested using the same routines as those for the dynamic RAM. When you select this test the above mentioned tests A, B, C and D will be performed on the MMU memory.

J - Test MMU Adder

The 16 bit adder is built from four 4 bit adders, which can be tested separately. This routine tests each 4 bit section of the adder in the MMU. The main memory is initialized in such a way that each double word in memory contains its own logical address. The memory is accessed using the relocating capabilities of the MMU. The physical address is calculated by adding the offset stored in the MMU to the logical address used when accessing the main memory. The calculated physical address is compared to the real physical address as read in the main memory.

K - Test MMU ASN - SEG

This routine tests that the MMU is addressed correctly by Address Space Number (ASN) and Segment Number (SEG). The segment descriptor in the MMU memory, pointed to by one combination of ASN and SEG, will point to one specific memory location, which will be initialized with one value. All other segment descriptors will point to another location, initialized with a different value. Then a memory access is made using the relocating capabilities of the MMU, and using the specific ASN and SEG, and the value read is compared to the expected value. This is repeated using all combinations of ASN and SEG.

L - Test MMU Comparator

This routine tests the 7 bit comparator used in the memory protection capabilities of the MMU. It accesses main memory using different Block Numbers (BN) and different Sizes in the MMU while the checking facilities of the MMU are enabled. This is done in two different ways:

- **Normal Length Check.** Whenever BN > Size the memory access is illegal and a bus error should occur and if BN < = Size the memory access is legal and no bus error should occur.
- **Stack Length Check.** Whenever BN < = Size the memory access is illegal and a bus error should occur and if BN > Size the memory access is legal and no bus error should occur.

Besides the comparator test there is an access code test. This one also runs in two different ways:

- When the segment is used to access internal memory, it is tested that the following four conditions will give the expected bus errors.

Supervisor read allowed
Supervisor write allowed
User read allowed
User write allowed

- When the segment is used to access the I/O bus, it is tested that the following four conditions will give the expected bus errors.

```
Supervisor program allowed
User program allowed
User data allowed
User address reference allowed
```

I - Test Interrupts

This routine tests the interrupt circuit by setting all 2048 external interrupts and enabling all four interrupt levels and then checking that the circuitry can decode all interrupts. This is repeated, but only enabling three levels checking that the three levels are decoded and the last one is not. After that, two levels and then one level are tested in the same way. The timer interrupt is also tested and you can calculate the time between timer interrupts by measuring the time between two writings of **Timer Interrupt** on the terminal and then divide that time by 100. Normally you should end up with 40 ms.

H - Test Cache

On the 68020 CPU board there are two caches, a program cache and a data cache. The size of the caches depends upon the memory board connected to the CPU and on some straps on the CPU board. Before testing, the program will determine the cache size and print the information on the terminal when starting the test. First, the program cache is used as a data cache and the test will exercise the cache memory by reading data into it and test the content. After that the cache comparator will be tested. That is done by initializing the tag fields in the comparator and testing one field for *hit* and all neighbour fields for *no hit*, repeating this for all fields. Second, the data cache goes through the same test as above. Third the cache comparator located on the physical address bus is tested. This is done by initializing the tag field with consecutive physical addresses and then reading and writing the field again to see if there is a match from the comparator. The time used for the third test depends upon the actual memory size.

O - Repeat test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (O) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled.

S - Test All

When selecting this command, the following tests will be executed in the order written. A, B, C, D, E, F, G, J, K, L, I and H. It is possible to add the *Repeat test* option *(O)* to this one.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

M - Menu

Display the menu on the terminal. The first line contains the actual memory size.

V - Version

Display version, date and elapsed time from last reset, on the form hh:mm:ss.

P - Set test parameters

This entry is used to set start address and end address for the memory tests and to set the state of the different caches during the tests. The start and end address has to be on hexadecimal form. If nothing is entered, the program will use the default values shown on the terminal. Entering illegal addresses will not be allowed.

After reset the three caches have the following status:

- Program cache 'Disabled'
- Data cache 'Disabled'
- 68020 cache 'Enabled'

These values will be in effect on all tests except H (test cache). It is possible to enable or disable the three caches individually by selecting P. The cache status is shown whenever the menu is displayed.
NOTE. If the external cache is enabled the maximum amount of memory that can be tested is 16 Mb. In order to test more than 16 Mb you must disable the external cache. During Non-operator mode only 16 Mb will be tested.

Q - Debugger

Go to debugging program. Return to Diagnostic Program by entering **GO <CR>**.

Z - Boot

Give master reset to the system.

When the prompt is displayed on the terminal, tests can be selected by typing in the corresponding letter.

Status register on the CPU 68020 module

STATUS(15:0), Status register	
STATUS(0)	Illegal user read
STATUS(1)	Illegal user write
STATUS(2)	Illegal user data access to the I/O bus
STATUS(3)	Illegal user address reference
STATUS(4)	Illegal supervisor read
STATUS(5)	Illegal supervisor write
STATUS(6)	Illegal supervisor program access to the I/O bus
STATUS(7)	Illegal user program access to the I/O bus
STATUS(8)	Segment too long, normal length check
STATUS(9)	Segment too long, stack length check
STATUS(10)	Double fault in memory
STATUS(11)	No memory
STATUS(12)	No floating point unit installed
STATUS(13)	Time out
STATUS(14)	Bus error from bus
STATUS(15)	Illegal read modify write cycle to the I/O bus

Note. The bits in STATUS(15:0) are active low.

DIAGNOSTIC PROGRAMS 4.4

DIOC3 4000

The purpose of this program is to evaluate the basic functions of the DIOC3 module, which is the third version of the Disk Input Output Controller in the Supermax card family. The following functions can be tested using this program:

- Program memory
- Cache memory
- Memory mapper (SRAM)
- Block Transport Unit (BTU)
- Peripheral interface
- Interrupt
- Peripheral units

The program is able to run on a DIOC3 with standard mounted straps.

Initialization

Included in the boot prom of the DIOC3 is a thorough self test, which includes the following items:

- Running MC 68020 internal confidence test.
- Testing the SRAM memory.
- Initializing and testing memory from 0 - 100000, before copying the content of the Eprom to the memory.
- Determining the actual size of the cache memory.
- Initializing and testing the cache memory.

After reset the red LED3 will be turned **ON**. The self test runs for appx. 20 seconds and if it runs without any errors, the red LED3 will be turned **OFF**, and the DIOC3 will start the boot procedure. If any errors are found the red LED3 will stay **ON** and information about the error can be obtained when selecting the DIOC3 on the service port. If the DIOC3 discovers, that another DIOC in the system has booted the system, it will start the program loaded into its memory. If the DIOC3 has not been loaded it will try to boot the system. First it tries to access the floppy disk, in order to boot from that unit. If no floppy disk is installed it tries to access the winchester disk, located on SCSI 0 ID 0 in order to boot from that unit. If no boot information is located on either the floppy disk or the winchester disk, the DIOC3 will not load any programs, but still the DIOC3 can be loaded from another DIOC in the system. When all units have been booted the DIOC3 starts its own program which can be either the operating system or the Diagnostic Program. If the DIOC3 discovers a hard error on the floppy disk or the winchester disk or no boot information is found, the red LED3 will be turned **ON**.

Running the Diagnostic Program

When the initialization is successfully completed, the DIOC3 is ready to proceed with the more sophisticated parts of the test. After typing the select sequence for the DIOC3, that is going to be tested it should respond with the following message on the terminal:

dioc3 u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the DIOC3 is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the DIOC3. The example shows the menu from a DIOC3 with unit number E:

```
dioc3 E   > M
1 Mbyte program memory. 08 Mbyte cache memory.

A - Test program memory
B - Test cache memory
C - Test SRAM memory
D - Test SRAM mapping
E - Test BTU transport
F - Test BTU and SCSI transport
G - Test interrupt
S - Test all
O - Repeat test(s)
X - Bustest. Passive unit
Y - Bustest. Active unit
K - Set boot pointer on winchester
L - Set test time for Non-Operator Mode
N - Set tests for Non-Operator Mode
P - Set test parameters
T - Test peripheral units
U - Display configuration
Q - Debugger
V - Version
M - Menu

dioc3 E   >
```

When the prompt is displayed on the terminal, tests can be selected by typing in the corresponding letter.

A - Test program memory

The program memory consists of minimum 1 Mb dynamic ram. This memory will be tested using the different tests mentioned below. It is possible to select one or more tests to be performed if selecting *P*.

- **High Speed.** This routine performs a fast test of the dynamic memory. It writes the value of the current address in the memory. Then the memory content is read and compared to the value written and errors are indicated. All of this is repeated using the inverted value of the current address.
- **Bit Test.** During this test every single bit in the main memory will be written with both *true* and *inverted* values. This is done using long word operations with the following values. During pass one the value written is 00000001, during pass 2 it is FFFFFFFE, during pass 3 it is 00000002, during pass 4 it is FFFFFFFD etc. All in all 64 passes. A plus (+) is written on the terminal for each pass.
- **Address Bit Test.** During this test every single address bit is tested. This is done by writing one value in the current address if the selected address bit is zero and another value if the address bit is one. After that the memory is checked for correct content. The test is performed for address bits in the range 2-24 and the test runs two times, each time with two new write values.

Address bit	Pass 1	Pass 2
0	00000000	FFFFFFFF
1	FFFFFFFF	00000000

- **Galloping Ones And Zeroes.** This test is also performed 2 times. First of all the memory space is initialized with a default value. Then a galloping value is written in a certain address. Then all addresses which are neighbours to that first address are tested. They must still contain the default value. A neighbour is an address, which only differs in one bit from the original address. When all neighbours are tested the default value is written back in the original address. This is repeated for all addresses.

Value	Pass 1	Pass 2
Default	00000000	FFFFFFFF
Galloping	FFFFFFFF	00000000

- **Byte Write.** The MC68020 is able to do a long word operation even though the address being referenced is not on a long word boundary. This is called **Dynamic Bus Sizing**. In other words, if the MC68020 writes to an address on a long word boundary, the long word will be written in one operation. But if the address is not on a long word boundary, the operation will be split into two operations as shown in the table:

Dynamic Bus Sizing		
Boundary	1. operation	2. operation
0	1 long word	
1	3 bytes	1 byte
2	1 word	1 word
3	1 byte	3 bytes

This test will write the long word 0xFFAA5500 using long word operations, but using the four different boundaries. By doing that both byte, word and long word operations will be performed.

- **Read Modify Write.** The MC68020 microprocessor has a feature which makes it possible in one operation to read a byte in memory, test the byte, set one bit in the byte and to write it back again. This is called *Read-Modify-Write* and this test will initialize memory with a default value and then perform the *Test And Set (TAS)* instruction on all memory locations and then check for correct memory content.

B - Test cache memory

The cache memory consists of between 4 Mb and 32 Mb of dynamic memory. This memory will be tested using the following routines as described in test *A*.

- **High Speed.**
- **Bit Test.**
- **Address Bit Test.**
- **Galloping Ones And Zeroes.**
- **Byte Write.**
- **Read Modify Write.**

It is possible to select one or more tests to be performed if selecting *P*.

C - Test SRAM memory

The SRAM consists of 4 kb static memory. This memory will be tested using the following routines as described in test *A*.

- **High Speed.**
- **Bit Test.**
- **Address Bit Test.**
- **Galloping Ones And Zeroes.**

D - Test SRAM mapping

This test will check that the SRAM memory mapper can map correctly. A counter is written in the SRAM and each long word in the cache memory is written with the address of that long word. Then accesses are made to the cache memory through the memory mapper, and it is checked that the reference goes to the correct location in the memory.

E - Test BTU transport

The BTU (Block Transport Unit) is tested for correct function. The BTU will move a block of data from the cache memory through the I/O bus and back into the cache memory. 256 kb of the cache memory is initialized with an incrementing counter. This block is moved using the BTU to a location 256 kb further up in the memory space. Then it is checked that the block has been moved correctly. Then a new counter is written in the beginning of the cache memory. This block is moved to a location 512 kb further up in the memory space and it is checked. This will be repeated until no more cache memory is available. The whole sequence will then be repeated using a decrementing counter. While the BTU is moving the block of data, the MC68020 will access the cache memory in order to make sure that the MC68020 and the BTU can share the memory accesses. The test will run two times, each with different burst counts. Burst count is the number of long words transferred in one I/O bus access. Normally that number is 1, but on the DIOC3 it can be changed in order to increase performance. The default values used in this test are 1 and 16. The last value can be changed if selecting *P*.

F - Test BTU and SCSI transport

The purpose of this test is primarily to check the two SCSI channels, SCSI 0 and SCSI 1, on the DIOC3. Secondly to check the concurrent running of the DMA channels concerning the BTU, SCSI 0 and SCSI 1. In order to run this test you must connect a 50 pin flat cable between SCSI 0 and SCSI 1. The test actually runs as two independent processes, one for the SCSI test and one for the BTU test.

SCSI test — During this test the SCSI 0 is the initiator and SCSI 1 is the target. SCSI 0 will transfer data to and from SCSI 1, as if SCSI 1 was any standard SCSI unit, issuing read and write commands.

BTU test — The BTU will move a block of data from the cache memory through the I/O bus and back into the cache memory.

The two tests use the same algorithm when testing.

- Initialize block 1.
- Move block 1 to block 2 using a write command.
- Move block 2 to block 3 using a read command.
- Compare block 1 and block 3.

The test is completed when both the SCSI test and the BTU test is completed.

G - Test interrupt

This routine tests the interrupt circuit by setting all four external interrupts and enabling all four interrupt levels and then checking that the circuitry can decode all interrupts. This is repeated, but only enabling three levels checking that the three levels are decoded and the last one is not. After that, two levels and then one level are tested in the same way. The timer interrupt is also tested and you can calculate the time between timer interrupts by measuring the time between two writings of **Timer interrupt** on the terminal and then divide that time by 100. Normally you should end up with 50 ms.

S - Test all

When selecting this command, the following tests will be executed in the order written: A, B, C, D, E and G. It is possible to add the **Repeat test** option *(O)* to this one.

O - Repeat test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one (*O*) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

K - Set boot pointer on winchester

If the Diagnostic Programs are booted from the floppy disk or the winchester disk on SCSI 0 ID 0, both located on this DIOC3, it is possible to change the boot pointer, which is a pointer to a logical disk where the boot programs are located. If the winchester disk on SCSI 0 ID 0 is part of a mirrored disk system, the boot pointer will also be saved on the winchester located on SCSI 1 ID 0. There are up to 4 pointers, which can be selected. Normally **Pointer 0** points to the **UNIX Operating System** and **Pointer 1** points to the **Diagnostic Programs** and **Pointer 2 and 3** are not used. Selecting **Default** will set the pointer to the one that was active before the Diagnostic Programs were loaded.

L - Set test time for Non-Operator Mode

This is used if the time for running in **Non-Operator Mode** is to be changed. Both the time for the internal test and the time for the bustest can be set individually. The program will ask if you want to use the default time. If the answer is **No**, you will be asked to type in the new values. It is not possible to use this command on a DIOC3, which is **not** the Master unit.

N - Set tests for Non-Operator Mode

This command is used to tell the program, if a CRC test should be performed on all winchester disk drives, when the Non-Operator Mode is entered. If the Diagnostic Programs were booted from the winchester disk, the default is **Yes**. If the Diagnostic Programs were booted from the floppy disk, the default is **No**, and if you change that to **Yes** you have to check the error buffer manually, because no errors are reported to the terminal.

P - Set test parameters

This entry is used to set up various parameters for the different tests. The following list shows what can be changed.

- Start address and end address for the memory tests.
- Which memory tests will be performed.
- BTU burst count.
- Set MC68020 cache enable/disable.
- Write Bus access.

T - Test peripheral units

The Diagnostic Program for Peripheral Units will always be resident in the DIOC3. Refer to the chapter concerning Diagnostic Program for Peripheral Units, to see the features of that program.

U - Display configuration

A configuration list will be written on the terminal, containing information about which units, type and unit number, were in the system when it was booted. It is not possible to use this command on a DIOC3, which is **not** the Master unit.

Q - Debugger

Go to debugging program. Return to Diagnostic Program by entering **GO <CR>**.

V - Version

Display version, date and elapsed time from last reset.

M - Menu.

Display the menu on the terminal.

Status registers on the DIOC3 module

SR0(7:0), Status Register 0	
SR0(0)	Parity error in local memory
SR0(1)	The ERROR signal in the I/O bus is active
SR0(2)	Time out
SR0(3)	Illegal Read/Modify/Write
SR0(4)	Bus error from I/O bus
SR0(5)	Parity error in cache memory
SR0(6)	The POWER FAIL signal is active
SR0(7)	Selected floppy disk drive is ready

SR1(7:0), Status Register 1	
SR1(0)	Parity error in cache memory.
SR1(1)	Parity error in cache memory during a BTU transport.
SR1(2)	Parity error in cache memory during a SCSI0 transport.
SR1(3)	Parity error in cache memory during a SCSI1 transport.
SR1(4)	Parity error in cache memory during a floppy transport.
SR1(5)	Time out during a BTU cycle.
SR1(6)	Bus error received during a BTU cycle.
SR1(7)	BTU error, SR1(6) or SR1(5) is active.

DIAGNOSTIC PROGRAMS 4.3

CPU 68030

The purpose of this program is to evaluate the basic functions of the CPU 68030 module and the dynamic memory connected to it. The following functions can be tested with this program:

- The dynamic RAM connected to the CPU.
- The Active Memory Management Unit (AMMU).
- The Passive Memory Management Unit (PMMU).
- All interrupts.
- The Error Detection and Correction unit.
- The external physical cache.

The Diagnostic Program is able to run on a CPU with standard mounted straps.

Initialization

Included in the boot prom of the CPU 68030 is a thorough self test, which includes the following items:

- Running MC 68030 internal confidence test.
- Testing the PMMU/AMMU memory, high speed.
- Initializing and testing memory from 0 - 100000, before copying the content of the prom to the memory.
- Determining the actual memory size.
- Initializing and testing memory from 100000 to top of memory.
- Testing the external cache.
- Running MC 68881/68882 FPC internal confidence test.

During the self test the front panel display will change according to the test currently running and the status of the test. The following table shows the possible display codes. F*n* means test *n* failed. P*n* means test *n* passed.

Display codes		
Passed	Failed	Test
P0	**F0**	Test stuck at high or low bits
P1	**F1**	Test data registers
P2	**F2**	Test control registers
P3	**F3**	Test address registers
P4	**F4**	Test status bits
P5	**F5**	68030 instruction test
P7		USART initialized
P8	**F8**	PMMU/AMMU memory
P9	**F9**	Testing memory 0 - 100000
PC		Just after copying eprom
Pd		Test caches
PE		Determine memory size
PF		Test memory to top
bo	**FF**	Test MC 68881/68882 FPC
	FA	Data error in memory
	FC	Single error in memory
	Fd	Error in cache test
	FE	Double fault in memory

When the display shows **Pd**, the CPU will enable the I/O bus in and then be ready to be booted. However it will continue the self test until finished. If any errors occur the display will keep the error code, but still try to run the program that has been loaded. If no errors occur the CPU will start the program, which could be either the **UNIX Operating System** or the **Diagnostic Programs**. If it is the Diagnostic Programs the CPU is ready to be selected, when the display is turned off. If any errors occur, which means the display is not turned off, it is possible to get further information about the error, by typing the select sequence. There are some additional display values used in the Diagnostic Programs.

- **bE** in the display indicates a bus error exception.
- **AE** in the display indicates an address error exception.
- **EE** in the display indicates any other exception.
- **Er** in the display indicates any other error.

Running the Diagnostic Program

When the initialization is successfully completed, and the CPU is booted, the CPU is ready to proceed with the more sophisticated parts of the test. After typing the select sequence for the CPU, that is going to be tested it should respond with the following message on the terminal:

cpu30 u > _ (**u** *is the unit number*)

When this prompt is displayed on the terminal, the CPU is ready to take commands. When typing **M <CR>** the menu will be displayed. The menu shows all the possible tests, that might be performed on the CPU. The example shows the menu from a CPU with unit number 3 and 4 Mb of memory:

```
cpu30 3   > M
04 Mb memory. External cache  = 'Disable'
              68030 prg.cache = 'Enable' 68030 data cache = 'Disable'
A - Test RAM High Speed
B - Test RAM Bit Test
C - Test RAM Address Bit Test
D - Test RAM Galloping Ones And Zeroes
E - Test RAM Byte Write
F - Test RAM Read Modify Write
G - Test AMMU Memory
J - Test PMMU Memory
K - Test AMMU Mapping
L - Test PMMU Mapping
I - Test Interrupt
H - Test External Cache
S - Test All
O - Repeat test(s)
X - Bustest. Passive unit
Y - Bustest. Active unit
P - Set test parameters
Q - Debugger
V - Version
Z - Boot
M - Menu
cpu30 3   >
```

When the prompt is displayed on the terminal, tests can be selected by typing in the corresponding letter.

A - Test RAM. High Speed

This routine performs a fast test of the dynamic memory connected to the CPU module. It writes the value of the current address in memory. Then the memory content is read and compared to the value written and errors are indicated. All of this is repeated using the inverted value of the current address. The Error Detection and Correction circuitry is switched **ON** during this test.

B - Test RAM Bit Test

During this test every single bit in the main memory will be written with both *true* and *inverted* values. This is done using long word operations with the following values. During pass one the value written is 00000001, during pass 2 it is FFFFFFFE, during pass 3 it is 00000002, during pass 4 it is FFFFFFFD etc. All in all 64 passes. A plus (+) is written on the terminal for each pass. The Error Detection and Correction circuitry is switched **OFF** during this test.

C - Test RAM. Address Bit Test

During this test every single address bit is tested. This is done by writing one value in the current address if the selected address bit is zero and another value if the address bit is one. After that the memory is checked for correct content. The test is performed for address bits in the range 2-27 and the test runs four times, each time with two new write values.

Address bit	Pass 1	Pass 2	Pass 3	Pass 4
0	00000000	FFFFFFFF	00000000	42070220
1	FFFFFFFF	00000000	42070220	00000000

The reason for the value 42070220 during pass 3 and 4 is to make sure that the bits concerning the Error Detection and Correction circuitry, which is switched **ON** during this test, also will be tested.

D - Test RAM. Galloping Ones And Zeroes

This test is also performed 4 times. First of all the memory space is initialized with a default value. Then a galloping value is written in a certain address. Then all addresses which are neighbours to that first address are tested. They must still contain the default value. A neighbour is an address, which only differs in one bit from the original address. When all neighbours are tested the default value is written back in the original address. This is repeated for all addresses. The Error Detection and Correction circuitry is switched **ON** during this test.

Value	Pass 1	Pass 2	Pass 3	Pass 4
Default	00000000	FFFFFFFF	00000000	42070220
Galloping	FFFFFFFF	00000000	42070220	00000000

E - Test RAM. Byte Write

Because of the error correcting code it is much more difficult to write a byte (*8 bits*) or a word (*16 bits*) in memory, than it is to write a long word (*32 bits*). 32 bits are used to contain data and 7 bits contain the ECC code belonging to that data. If one byte or one word is to be written the CPU module will have to read a whole long word into a register, then write the new byte or word into the register and then write the long word back in memory. The 68030 is able to do a long word operation even though the address being referenced is not on a long word boundary. This is called **Dynamic Bus Sizing**. In other words, if the 68030 writes to an address on a long word boundary, the long word will be written in one operation. But if the address is not on a long word boundary, the operation will be split into two operations as shown in the table:

Dynamic Bus Sizing		
Boundary	1. operation	2. operation
0	1 long word	
1	3 bytes	1 byte
2	1 word	1 word
3	1 byte	3 bytes

This test will write the long word FFAA5500 using long word operations, but using the four different boundaries. By doing that both byte, word and long word operations will be performed.

F - Test RAM. Read Modify Write

The MC68030 microprocessor has a feature which makes it possible in one operation to read a byte in memory, test the byte, set one bit in the byte and to write it back again. This is called *Read-Modify-Write* and this test will initialize memory with a default value and then perform the *Test And Set (TAS)* instruction on all memory locations and then check for correct memory content.

G - Test AMMU Memory

The AMMU memory consists of 2 kB static RAM. This memory can be tested using the same routines as those for the dynamic RAM. When you select this test the above mentioned tests A, B, C and D will be performed on the AMMU memory.

J - Test PMMU Memory

The PMMU memory consists of 32 kB static RAM. This memory can be tested using the same routines as those for the dynamic RAM. When you select this test the above mentioned tests A, B, C and D will be performed on the PMMU memory.

K - Test AMMU Mapping

One entry at a time is set up in the AMMU. This entry points to a valid memory location all other entries points to invalid memory locations. Then an I/O bus access to the unit itself is made. This access goes through the AMMU to the I/O bus and back into the unit and into the memory. Then it is checked that the access went to the valid memory location. This is repeated using 256 different values in the memory location. All this is repeated for 1024 entries in the AMMU.

L - Test PMMU Mapping

One entry at a time is set up in the PMMU. This entry points to a valid memory location all other entries points to invalid memory locations. Then an I/O bus access to the unit itself is made. This access goes through the AMMU to the I/O bus and back into the unit, through the PMMU and into the memory. Then it is checked that the access went to the valid memory location. This is repeated using 256 different values in the memory location. All this is repeated for all 16384 entries in the PMMU.

I - Test Interrupt

This routine tests the interrupt circuit by setting all 2048 external interrupts and enabling all four interrupt levels and then checking that the circuitry can decode all interrupts. This is repeated, but only enabling three levels checking that the three levels are decoded and the last one is not. After that, two levels and then one level are tested in the same way. The test is performed for both start address 0x2000 and 0x10000. The timer interrupt is also tested and you can calculate the time between timer interrupts by measuring the time between two writings of **Timer Interrupt** on the terminal and then divide that time by 100. Normally you should end up with 40 ms.

H - Test Cache

On the 68030 CPU board there are three caches, an on-chip program cache, an on-chip data cache and an external cache, normally used as a physical cache. When testing the external cache, it is programmed to be a data cache only. The size of the external cache is either 64 kb or 128 kb. Before testing, the program will determine the cache size and print the information on the terminal when starting the test. The test will exercise the cache memory by reading data into it and then test the content. After that the cache comparators will be tested. That is done by initializing the tag fields in the comparator and testing one field for *hit* and all neighbour fields for *no hit*, repeating this for all fields. The time used for the test depends upon the actual memory size.

S - Test All

When selecting this command, the following tests will be executed in the order written. A, B, C, D, E, F, G, J, K, L, I and H. It is possible to add the *Repeat test* option *(O)* to this one.

O - Repeat test(s)

All of the above mentioned tests will run one time through when selected. If, when selecting test(s), this one *(O)* is also selected, the test(s) will repeat itself (themselves) until otherwise canceled.

X - Bustest. Passive unit

Refer to the chapter concerning the bustest.

Y - Bustest. Active unit

Refer to the chapter concerning the bustest.

P - Set test parameters

This entry is used to set start address and end address for the memory tests and to set the state of the different caches during the tests. The start and end address has to be on hexadecimal form. If nothing is entered, the program will use the default values shown on the terminal. Entering illegal addresses will not be allowed.

After reset the three caches have the following status

- 68030 program cache 'Enabled'
- 68030 data cache 'Disabled'
- External cache 'Disabled'

These values will be in effect on all tests except H (test cache). It is possible to enable or disable the three caches individually by selecting P. When the external cache is enabled it is possible to select it as a physical cache or as a data cache only. The cache status is shown whenever the menu is displayed.

Q - Debugger

Go to debugging program. Return to Diagnostic Program by entering **GO <CR>**.

V - Version

Display version, date and elapsed time from last reset.

Z - Boot

Give master reset to the system.

M - Menu

Display the menu on the terminal. The first line contains information about the actual memory size and the state of all the caches.

Status register on the CPU 68030 module

STR(15:0), Status register	
STR(0)	Not used
STR(1)	Not used
STR(2)	Double fault in memory
STR(3)	Double fault in memory from a cache entry
STR(4)	Time out
STR(5)	No memory
STR(6)	Illegal read/modify/write cycle to the I/O bus
STR(7)	Bus error from the I/O bus
STR(8)	FPC not present
STR(9)	FPC disabled
STR(10)	Illegal breakpoint address
STR(11)	Illegal coprocessor address
STR(12)	Not used
STR(13)	Not used
STR(14)	Not used
STR(15)	Not used

Note. The bits in STR(7:2) are active high. The bits in STR(11:8) are active low.

Diagnostic Programs 4.3

Installation guide for Non-Operator Diagnostic Programs.

Introduced with the version 4.0 of the Diagnostic Programs is the **Non-Operator Mode** of the programs. Running the programs in this mode is only possible when the programs are booted from the winchester disk. This guide will show you how to install the Diagnostic Programs on the winchester disk and how to update your system in order to use the facility.

Create two logical disks on the physical winchester, located on the same DIOC as where the floppy disk drive, that you normally use to boot the system, is located. In most cases it is DIOC no. 14 channel no. 8. The first one is used for the *UNIX System V operating system* and its size should be 1 Mb. The second one is used for the Diagnostic Programs and its size should be 1 Mb.

Use the utility **mkwboot** to install winchester boot on the system. Refer to *System V Reference Manual* on how to use **mkwboot**. If the two logical disks have subdisk numbers 3 and 4, the following example shows you what to do.

```
# mkwboot /dev/dsk/u14c8s3
# mkwboot -t1 /dev/dsk/u14c8s4
```

Insert the diskette containing the *UNIX System V operating system* into the floppy disk drive and copy it to the winchester disk. If the special file /dev/flop points to the floppy disk drive in your system this example shows you one way to copy the diskette to the winchester disk.

```
# cp /dev/flop /dev/dsk/u14c8s3
```

Insert the diskette containing the the Diagnostic Programs into the floppy disk drive and copy it to the winchester disk. If the special file /dev/flop points to the floppy disk in your system this example shows you one way to copy the diskette to the winchester disk.

```
# cp /dev/flop /dev/dsk/u14c8s4
```

Now winchester boot is installed on your system. In order to use the Diagnostic Programs some changes in **/etc/inittab** must be made.

The following lines are changed or added to the existing file **/etc/inittab**.

```
fl:056:wait:/etc/led -f >/dev/console 2>&1 </dev/console  (changed)
s0:056:wait:/etc/rc0 >/dev/console 2>&1 </dev/console  (changed)
DP:5:wait:echo "Diagnostics will be started." >/dev/console 2>&1  (added)
dp:5:wait:/etc/boot 1 >/dev/console 2>&1 < /dev/console  (added)
```

In this case *init run level 5* will flash the LED's, shut down the system, change the boot pointer on the winchester disk from the **UNIX operating system** to the **Diagnostic Programs** and then reset the system, which now will be booted with the **Diagnostic Programs**. They will run for a certain time, depending upon the configuration of your system. Upon completion the boot pointer will be changed from the **Diagnostic Programs** to the **UNIX operating system** and the system will be reset, and now the **UNIX operating system** will be restarted.

Diagnostic Programs for Peripheral Units on the Supermax

Dansk Data Elektronik A/S

Version 4.3 September 1988

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DIAGNOSTIC PROGRAMS 4.5

DIAGNOSTIC PROGRAMS 4.3

Introduction

This chapter will introduce you to the Diagnostic Program for Peripheral Units. The manual is divided into two parts, one telling about the DIOC1/DIOC2 and one telling about the DIOC3.

Introduction to DIOC1/DIOC2

The Diagnostic Program for Peripheral Units is loaded into the DIOC1/DIOC2 when loading the Diagnostic Programs for the Supermax Card Family. On the DIOC1 the program will be destroyed, when running the bustest. Otherwise it will always be resident. On the DIOC2 the program will always be resident. All the features applying to the Diagnostic Programs for the Supermax Card Family goes for this program also. In order to run the program just type **D <CR>** when the DIOC1/DIOC2 is in the menu. When doing that the prompt will change. A letter indicating the subprogram currently running will be in the prompt. The following letters might appear.

Letter	Subprogram
P	Peripheral Units
W	Winchester test
F	Floppy test
S	Streamer test
T	Tape drive test

Typing **M <CR>** will show the menu of the current subprogram. The example shows what happens on a DIOC2.

```
dioc2 E   > D
dioc2 E P >M
Test of peripheral units

S - Test streamer
W - Test winchester
F - Test floppy
T - Test tape drive
R - Return to main menu
M - Menu
V - Version

dioc2 E P >
```

S - Test streamer
This entry gives you the subprogram used to test streamer drives.

W - Test winchester
This entry gives you the subprogram used to test winchester disk drives.

F - Test floppy
This entry gives you the subprogram used to test floppy disk drives.

T - Test tape drive
This entry gives you the subprogram used to test tape drives.

R - Return to main menu
This entry will return the DIOC1/DIOC2 to the main menu.

M - Menu
This entry will show the menu on the terminal.

V - Version
This entry will show the version of the program.

Introduction to DIOC3

The Diagnostic Program for Peripheral Units is loaded into the DIOC3 when loading the Diagnostic Programs into the units. On the DIOC3 the program will always be resident in memory. All the features applying to the Diagnostic Programs for the Supermax Card Family goes for this program also. In order to run the program just type **T <CR>** when the DIOC3 is in the main menu. When doing that the prompt will change. A letter indicating the subprogram currently running will be in the prompt. The following letters might appear.

Letter	Subprogram
P	Peripheral Units
W	Winchester test
F	Floppy test
T	Tape drive test
M	Multiple select

Typing **M <CR>** will show the menu of the current subprogram. The example shows the first submenu on the DIOC3.

```
dioc3 E P > M
Diagnostic program for peripheral units

A - Select all units on SCSI interface 0
B - Select all units on SCSI interface 1
E - Display errors on all peripheral units
F - Test floppy drive
T - Test tape drive
W - Test winchester drive
R - Return to main menu
M - Menu

dioc3 E P >
```

A - Select all units on SCSI interface 0

When selecting this entry the following will be performed:

- Reset SCSI interface 0.
- Read from ID 0 to ID 6 to find out which units are connected to SCSI interface 0.
- If a unit is found to be present on the interface, then the manufacturers name, type, model and revision is read and displayed.
- If the type is a winchester then the parameters are read from the configuration table in the first track of the winchester. This configuration table is written on the winchester by the Diagnostic Program, when formatting it.
- If the type is a tape drive, then the parameters are read from the drive.

When all this is done a message is written on the terminal. The following is an example of a DIOC3 with two winchesters on ID 0 and ID 1.

```
dioc3 E P > A
Reset SCSI interface: 0
SCSI channel: 0 ID number: 0          Unit type: Winchester
Name: MAXTOR  XT-3280                 Revision:  E.3
SCSI channel: 0 ID number: 1          Unit type: Winchester
Name: MAXTOR  XT-3280                 Revision:  E.3
No unit on SCSI channel: 0  ID number: 2
No unit on SCSI channel: 0  ID number: 3
No unit on SCSI channel: 0  ID number: 4
No unit on SCSI channel: 0  ID number: 5
No unit on SCSI channel: 0  ID number: 6
dioc3 E P >
```

B - Select all units on SCSI interface 1

This entry performs the same as *A*, except that SCSI interface 1 is used.

E - Display errors on all peripheral units

This entry will write the error buffers concerning all units on the terminal. One unit at a time will be displayed. This is an easy way to get an overview of the test results. Otherwise each unit would have to be selected one at a time in order to display the error buffer concerning that unit.

F - Test floppy drive

This entry gives you the subprogram used to test floppy disk drives.

T - Test tape drive

This entry gives you the subprogram used to test tape drives.

W - Test winchester drive

This entry gives you the subprogram used to test winchester disk drives.

R - Return to main menu

This entry will return the DIOC3 to the main menu.

M - Menu

This entry will show the menu on the terminal.

Program control

It is possible to control program execution by using some special control characters as mentioned below.

- **Ctrl C.** This is used to cancel a running test. Program execution stops and the prompt will be displayed on the terminal. It only affects the unit currently selected.
- **Ctrl E.** A running test is stopped when the test is completed, and the program returns to menu. **Ctrl E** only affects the following tests:

DIOC1/DIOC2
B, C, I, M, L in the Winchester test.
C, I, W in the Streamer test.
B, C, D, F, G in the Floppy test.

DIOC3
A, B, C, D, I, K in the winchester drive test.
A, B, C, D, F, G, H, I in the tape drive test.
A, B, C, F, K in the floppy drive test.

- **Ctrl S.** This is used to send *XOFF* character to the program, which will stop printing on the terminal. If the unit is selected the program will stop when it tries to print on the terminal and *XON* character must be received to continue. If the unit is deselected, it will remember the *XOFF* character when selected and *XON* character must be received to continue.
- **Ctrl Q.** This is used to send *XON* character to the program, which will start printing again. This affects all units whether selected or not.
- **Ctrl N.** This is used to stop printing on the terminal, but program execution continues.
- **Ctrl P.** This is used to start printing again after a **Ctrl N** has been pressed.

DIAGNOSTIC PROGRAMS 4.3

Streamer

The streamer Diagnostic Program is able to test any streamer, that are compatible with the QIC-02 interface descriptions for streaming tape cartridge drives. The program does not use any commands that are classified as optional or vendor unique in the QIC-02 interface proposal. If the user wants to apply any of these commands (eg. a self test command), it can be done by selecting H (set command) in the menu.

The status format

After execution of all commands in the menu, except the write/read test, the status from the drive is reported. The status is either

Exception did not occur

or

Exception occurred

Exception is not an error signal, but is used to inform the host about the condition that caused termination of a command. The termination may be a normal completion or an interrupt due to an encountered fault (hard errors, write protected, etc).

The status bytes from the drive contain the following information:

Status byte 1

Bit	Name	Text
0	POR	The power on reset bit is set after the host asserts **RESET** or when the controller is powered up.
1	RES	Reserved
2	RES	Reserved
3	BOM	Beginning of media bit is set whenever the cartridge is at the beginning of the tape. This bit does not set **EXCEPTION** .
4	MBD	Marginal block detected is set when 8 or more retries were required during the read of a data block.
5	NDT	No data detected is set when an unrecoverable data error occurs due to a lack of recorded data.
6	ILL	Illegal command.
7	ST1	Is set, if any other bit in status byte 1 is set.

Status byte 0		
Bit	**Name**	**Text**
0	FIL	This bit is set when a file mark is detected during a read data or a read file mark sequence.
1	BNL	Block in error not located is set when an unrecoverable read data error occurs, and the controller can not confirm, that the last block transmitted was the block in error.
2	UDE	Unrecoverable data bit is set when the controller detects a hard error during a read or a write operation.
3	EOM	End of media bit is set when the logical warning hole of the last track is detected during a write operation.
4	WRP	Write protected bit is set if the cartridge is write protected.
5	USL	Drive unselected bit is set if the selected drive is not connected or is not receiving power.
6	CNI	Cartridge not in place bit is set if a cartridge is not inserted into the drive.
7	ST0	Is set, if any other bit in status byte 0 is set.

Data error counter

The data error counter accumulates the number of blocks rewritten for write operations and the number of soft read errors during read operations.

As data is written on the tape, a read after write check is performed. If a CRC error occurs the data block is rewritten without stopping the tape. If this operation is successful, writing continues and the data error counter is incremented. The drive will make 16 attempts to write the block in error before declaring a hard error.

During a read operation the drive verifies each block. If an error occurs, the drive will read the next two blocks to see if the block was rewritten without error. If not, the drive stops the tape, backs up and tries to read the block a second time. The drive will make 16 attempts to re-read before declaring a hard error. The number of re-reads is reported to the data error counter.

Underrun counter

The underrun counter accumulates the number of times that streaming was interrupted because the host failed to maintain the minimum data transfer rate.

The folllowing shows the menu from the streamer Diagnostic Program.

```
diocl E S >M
Diagnostic program for streamers

A - Reset drive and interface
B - Begining of tape
C - Continuous write/read
D - Display status buffer
E - Erase
F - Write file mark
G - Set test pattern
H - Set command
I - Read tape
J - Search to file mark
T - Retension
W - Write tape
M - Menu
R - Return to main menu

diocl E S >
```

A - Reset drive and interface

This command resets the drive and clears the interface registers. Upon start of the program this reset is done automatically. If the drive is not ready a timeout is reported.

B - Begining of tape

Rewinds the tape cartridge to the beginning of the tape.

C - Continuous write/read

The number of blocks selected by the user is written on the tape. The two first bytes in each block contains the block number, the rest of the block contains the byte pattern selected by the user. When the last block is written a file mark is written and the tape is rewinded. Then a read command is issued. When reading the program checks the block number in each block. If any errors occur, the program stops and reports 'data error'.

After each read or write operation the status is read from the drive and this information is stored in the status buffer. The test stops after 64 passes (then 128 status informations are in the buffer and it is filled up). The user can also stop the test by typing control E. **Ctrl E** only interrupts the test if it is typed during read or write operations otherwise **Ctrl C** can be used.

D - Display status buffer

Status information obtained from the drive during a write/read test is displayed. Refer to the description of the status bytes. The status buffer is cleared when write/read test is selected.

E - Erase

The entire tape is erased.

F - Write file mark

A file mark is written on the tape at the current tape position.

G - Set test pattern

The write buffer is set with the bit pattern selected by the user. Upon start of the program the bit pattern defaults to 29 hex.

H - Set Command

This feature enables the user to send commands to the controller. Only commands without data transfer from or to the drive may be set. If a read or write file mark command is issued remember to set on-line.

I - Read tape

Drive reads the tape from the current tape position, until an exception occurs. If **Ctrl E** is typed the drive rewinds the tape before status is displayed.

J - Search to file mark

The drive reads the tape searching for a file mark. When a file mark is found exception is asserted.

T - Retension

This command rewinds the tape to the beginning, then winds to the end and then rewinds to the beginning again.

W - Write tape

The number of blocks selected by the user is written on the tape from the current tape position. Each block contains the byte pattern selected by the user. When the selected number of blocks are written, or when control E is typed, a file mark is written and the tape motion stops.

Whenever you select one of the write tests, you are asked to type in the number of blocks you want to test. The maximum number of blocks for the three different tape drives is:

Type	Blocks	Bytes
Archive 3020	009A00	≏ 20 Mb
Archive 9045	015700	≏ 45 Mb
Tandberg TDC 3320	03E000	≏ 120 Mb

Different data formats

All ¼-inch streaming drives used on the Supermax are intelligent drives, that automatically formats each data block as it is written on the tape drive by the drive.

Data format				
Type	Archive 3020	Archive 3020L	Archive 9045L	Tandberg TDC 3320
Tracks	4	4	9	15
Tape speed	30 ips	30 ips	90 ips	90 ips
Write format	QIC-11	QIC-11/24	QIC-11/24	QIC-120
Read format	QIC-11 4 track	QIC-11/24 4 track	QIC-11/24 4, 9 track	QIC-11/24/120 4, 9, 15 track

Archive tape drive type 3020L/9045L will use the QIC-11 standard when they are reset, but during normal operation the Archive 9045 runs the QIC-24 standard. This means that you should switch from QIC-11 to QIC-24 whenever you are going to test an Archive 9045. This is done by giving the command 27 to the drive. Use the **H** command from the Diagnostic Program to do that.

The Tandberg TDC 3320 drive always writes in QIC-120 format, but it is able to read QIC-11 and QIC-24 formats without receiving any change format commands.

M - Menu

Display the menu on the terminal.

R - Return to the main menu

Return to menu for the peripheral units.

DIAGNOSTIC PROGRAMS 4.3

Winchester

The winchester Diagnostic Program is able to handle all known winchester disk drives and different SASI/SCSI controllers. In order to obtain this flexibility several parameters must be set by the user. If these parameters are incorrectly set, the program will not work properly. Therefore it is important to know which controller and disk type you are going to test. In this manual you will find a description of the different types of controllers used by DDE, as well as a complete list of parameters for all winchester drives. Please notice that the parameter list is a combination of controller-, winchester-, and DIOC type. Timeout is implemented in all handshake routines. If timeout occurs the error is reported.

```
dioc2 E W >M
Diagnostic programs for winchesters

A - Define parameters
B - Write/read test
C - CRC test
D - Display skiplist
E - Display error buffer
F - Format drive
G - Format drive retaining skiplist
H - Format track
I - Seek test
J - Read skiplist
K - Write skiplist
L - Random write/read
Q - Exerciser
N - Set command
O - Read single sector and display
P - Reset controller
S - Reassign block
U - Performance test
M - Menu

dioc2 E W >
```

A - Define parameters

You will only be asked to type in the parameters, needed by the specified controller. Upon start of program always select **A**.

Parameter	Comment
Controller Number	controller 0 to 7
Drive Number	drive number 0 to 7
Controller type	
Number of cylinders	
Minimum cylinder	Is the lowest cylinder used in the tests.
Number of heads	
Number of sectors	If number of sectors is incorrectly set, all conversion from logical address to cylinder, head, sector address (and vice versa) is invalid.
ECC error length	
Step period	
Reduced write current	
Write precompensation	
Control byte	Refer to description of controllers
Bytes/track	

B - Write/read test

Write/read test will keep the track skiplist, but the data will be destroyed. All errors obtained from the controller are stored in the error buffer. The user selects whether the skiplist should be updated with bad tracks or not. Data fields are written with 63H in first pass, complement in next pass(9C), then 9D, then 62, 63, 9C, and so on. The test writes an entire track, then reads an entire track. The track number is written in the two first bytes in each sector. When reading a track, the program checks the track number, and if an error occurs (transmission or memory error) write/read test is stopped and the program reports error 0F. The test runs from minimum cylinder to maximum cylinder.

C - CRC test

The CRC test reads one track in a command. All errors obtained from the controller are stored in the error buffer. The test runs from minimum cylinder to maximum cylinder.

D - Display skiplist

The skiplist is displayed from memory. If read skiplist or write/ read test has been selected, the skiplist is valid, otherwise the skiplist contains only FF. If format drive is selected an empty skiplist is written on the drive. The empty skiplist contains drive parameters, but of course no bad tracks.

Editing in the skiplist		
Letter	Command	Text
M	Modify	Double bytes in the skiplist can be modified. The program stays in this mode until an unmodified double byte is written to the skiplist.
N	Next	Display the next sector of the skiplist.
I	Insert	Insert bad tracks in the skiplist. The program stays in this mode until the user tries to insert track 0000.
D	Delete	Delete tracks from the skiplist. The program stays in this mode until the user tries to delete track 0000.
S	Serial no.	Insert/replace serial number of the disk drive.
W	Write	The 1 Kb skiplist is written on the disk drive.
R	Return	Return to the menu.

Note. Editing in the skiplist does not change the skiplist on the drive. Only if write skiplist is selected the modified skiplist is written on the drive.

E - Display error buffer

All errors obtained from write/read test, CRC-test, Seek test or exerciser are displayed. Error buffer is cleared if one of these tests are selected. Maximum number of errors in buffer is 128, if this number is exceeded an overrun is detected, and the buffer is refilled from start. Informations from error buffer are:

Error	Error code in hex form reported from the controller.
Cylinder	Cylinder address (only if address valid).
Head	Head address (only if address valid).
Sector	Sector address (only if address valid).
Track	Track address in HEX code. This information makes it possible to check with the skiplist.
Pass	The pass in which the error from the controller occurred.

F - Format drive

Drive will be formatted and an empty skiplist with the correct parameters will be written on the drive. You will be asked for the interleave factor and the physical disk size, which will be written in sector 4 of the skiplist.

G - Format drive retaining skiplist

Drive will be formatted retaining the 1 Kb skiplist. You will be asked for the interleave factor. If there has been a change to any parameters concerning the skiplist, they will also be updated in the skiplist.

H - Format track

The selected track is formatted. This command is only valid if Xebec controller is used. Data from the track is read sector by sector and stored in memory. When the track is formatted, the data is rewritten. Only data in failing sectors are lost. Information about these sectors is displayed on the terminal.

I - Seek test

This test starts by reading data on minimum cylinder, head number 0, then reads data on maximum cylinder, head number 0, then reads on minimum cylinder + n, head number 0, then reads on maximum cylinder - n, head number 0 where n has a value in the range from 1 to maximum cylinder. Then the test is repeated for head numbers from 1 to maximum head. All errors reported from the controller are stored in the error buffer.

J - Read skiplist

If the controller is not able to read the skiplist, the error information is displayed.

K - Write skiplist

The format of the skiplist is checked. If the format is illegal the skiplist is not written, and an error is reported.

L - Random write/read

Random write/read test will keep track skiplist, but data is destroyed. All errors obtained from controller are stored in the error buffer. When you select this test you will be asked for a number of sectors ranging from 1 to 32. This is the number of sectors each time written with a continuous counter and then read back and checked for correct content. The sector address is calculated on a pseudo random basis.

Q - Exerciser

Sectors are read one by one on the selected track. Errors are stored in the error buffer. The exerciser keeps on reading the selected track until another track is selected or control E is pressed.

Key	Command
↑	increment head number
↓	decrement head number
←	decrement cylinder number
→	increment cylinder number
X	select read operation
Y	select no read operation
R	restore drive

N - Set command

This feature enables the user to send commands to controllers. Only commands without data transfer from or to the drive may be set. The first byte must contain the number of command bytes transmitted to the controller. Only use Set command to exercise the controller, not the drive.

O - Read single sector and display

The selected sector is read into memory and displayed on the terminal. The following may be used:

Letter	Command	Text
M	Modify	Modify bytes in the sector
N	Next	Read next sector
W	Write	Write current sector
P	Previous	Read previous sector
D	Display	Display next part of the sector if the sector size is 256 part 0 is valid if the sector size is 512 part 0,1 are valid if the sector size is 1024 part 0,1,2,3 are valid
A	Address	Read a new sector address

P - Reset controller

All controllers on the SCSI bus are reset.

S - Reassign block

This command is only implemented on the embedded disk controllers. The Reassign block command requests the drive to reassign a defective block to a spare block reserved for this purpose. If a spare block is available on the track, where the defect block is located, this block will be used, otherwise a spare block on a other track will be used. The defect block address is added to the grown defect list. It is not necessary to reformat the drive after using the reassign block command, and only one block of data is corrupted. If the drive is reformatted it will use the grown defect list, and the primary defect list to map out all defect blocks so the media appears error free. It is possible to use either a sector address or the cylinder, head and sector number as input to the command. Sector 1 of the skiplist will be updated with the sector address. This information is not used by any programs.

U - Performance test

This command can be used to measure the performance of the disk drive. When the test is completed the actual time used is the number written on the terminal times 80 ms.

M - Menu

Display the menu on the terminal.

R - Return to main menu

Return to the menu of peripheral units.

Skiplist

The skiplist contains information about the physical parameters of the drive, and the type of controller. This information is used to initialize the disk controller, if necessary. The skiplist also contains information about all the bad tracks on the drive, and is used by the disk driver program to skip the tracks if the address of that track is included in the disk command issued by the operating system. The track skipping is invisible for the operating system. Track skipping is not used on winchesters with embedded controller.

Address 0x00 - 0xFF	
Byte	**Text**
00-3D	Two bytes for every bad track on the drive. The numbers must be arranged in increasing order, and the list must be continued with FF until byte number 3F is reached.(byte 3E and 3F must be FF hex). If the first two bytes in the skiplist are FFFE, sector 2 and sector 3 of the skiplist contain the bad tracks.
3E	Must contain FF.
3F	Must contain FF.
40	Number of heads.
41	Msb of number of cylinders.
42	Lsb of number of cylinders.
43	Number of sectors on a track.
44	Interleave factor.
45	Hard sector flag. (must contain FF)
46	Not used
47	Not used
48	Not used
49	Control byte for controller.
4A	Msb of starting cylinder for reduced write current.
4B	Lsb of starting cylinder for reduced write current.
4C	Msb of starting cylinder for write precompensation.
4D	Lsb of starting cylinder for write precompensation.
4E	Not used
4F	Controller type. Must contain 02 if Xebec S1410 is used. Must contain 01 if Dtc 600 is used. Must contain 08 if Adaptec ACB 4000 is used. Must contain 08 if Adaptec ACB 5580 is used. Must contain 08 if Xebec S1490 is used. Must contain 04 if NEC DS800B is used. Must contain 09 if embedded controller is used.
50	Sector size. For all types except embedded controller the sector size is 256 (0x01). For embedded controller the sector size is 512 (0x02) or 1024 (0x04).
51-EF	not used
F0-FF	Serial number

Address 0x100 - 0x1FF

Only used if the two first bytes in sector 1 contain FFFE. Entire sector contains bad tracks or FFFF. If embedded controller is used, this sector contains block addresses on blocks that have been reassigned. The block address contains of 4 bytes MSB...LSB. Msb is always 00.

Address 0x200 - 0x2FF

Only used if the two first bytes in sector 1 contain FFFE, and the entire 2. sector contains bad tracks. The entire sector contains bad tracks or FFFF. If the entire sector is used for bad tracks the two last bytes must contain FFFF.

Address 0x300 - 0x3FF

This sector is used by the operating system, and describes the configuration of a winchester disk. The sector is a part of the skiplist.

Controllers used on the Supermax

One of the parameters used by the test program is the controller type. If you select unknown type no initialize command will be issued, and you will be unable to format the drive.
Seen from the program the controllers differ in two ways:

- The way they handle initialize and format commands.
- The function of the control byte. The control byte (set by the user) is the last byte in all commands to the controllers. This byte must be set to match the specific controller.

Xebec S1410

The Xebec S1410 controller can control up to two 5.25 inch winchester disk drives with ST-506 interface. Please note that the two drives must have the same parameters. When all parameters are set under **A** in the menu (Set Parameters) the controller is initialized with the following parameters:

Number of cylinders
Number of heads
Starting cylinder for reduced write current
Starting cylinder for write precompensation
ECC data burst length. If set to zero no error correction is attempted, max. set to 11.

Control byte: r0000sss (8 bits)

r 1 - Disable the four retries on all disk access commands.
0 - Enable the four retries on all disk access commands.
During test and formatting of a drive, this bit should be set to 1.

sss Set to 111 for max. step speed.

During test, control byte is normally set to 87 Hex.

Number of sectors/track is always 32 when Xebec S1410 is used.

Dtc 610

The DTC-610 controller can control up to four CDC 9410 series winchester disk drives. The controller is initialized only with number of heads. In case this controller is used, all other disk parameters (except interleave factor) only affects the program and not the controller.

Control byte: abc00000

a 1 - Disable retry
  0 - Enable retry
b 1 - Disable error correction
  0 - Enable error correction
c 1 - Disable overlap seek
  0 - Enable overlap seek

During test, control byte is normally set to C0 Hex.

Number of sectors/track is always 42 when Dtc 610 is used.

Adaptec ACB 4000

The Adaptec ACB 4000 controller can control up to two 5.25 inch winchester disk drives with ST-506 interface. The controller is not initialized by the program. At reset time the controller reads the disk parameters from the disk. Therefore, the program is able to read the disk parameters from the controller. If the controller is unable to read the parameters, the program will report an error. The following disk parameters are read by the program from the controller or typed in by the user:

Number of cylinders
Number of heads
Starting reduced write current
Starting write precompensation
Step period

If the user wants to modify these parameters, it will only affect the controller if the drive is formatted.

The control byte must always be set to 00. Error correction and retries cannot be disabled.

Note. The Adaptec controller has 33 sectors/track when using interleave factor 2 or more, but only 32 sectors/track using interleave factor 1.

Xebec S1490

The Xebec S1490 controller can control up to two winchester disk drives that are compatible with the SMD interface. The controller is not initialized by the program. At reset time the controller reads the disk parameters on the disk. Therefore, the program is able to read the disk parameters from the controller. If the controller is unable to read the parameters, the program will show an error. The following disk parameters are read by the program or typed in by the user:

Number of cylinders
Number of heads
Number of sectors/track
Number of bytes/track
Maximum burst error correction

If the user wants to modify these parameters, it will only affect the controller if the drive is formatted. If format retaining old skiplist is selected, it is possible to change drive parameters without formatting the drive.

Control byte: r000ss00

r 1 - Disable the retry after errors on all disk access commands.
0 - Enable the retry after errors on all disk access commands.

ss Head strobe
00 - normal
01 - strobe late
10 - strobe early

Control byte is normally set to 80 Hex during test.

Note. The controller reserves cylinder 0 on each drive for internal use. This means that the actual track address of the disk have a track displacement matching the number of heads of the disk drive. This is especially important when talking about bad tracks and the skiplist. The actual bad track is in fact the *number of heads* added to the track written in the skiplist. When you have to change the Xebec S1490 controller with one that does not reserve cylinder 0, you must update the skiplist.

NEC DS800B

The NEC DS800B controller can control up to four winchester disk drives, that are compatible with the SMD interface. Upon reset the controller must be initialized with the following parameters, which must be set by the user.

Number of heads
Number of cylinders
Number of sectors/track

The controller cannot read anything from the disk drive unless initialized by the program.

Control byte: rc000000 (8 bits)

r 1 - Disable the retry after errors on all disk access commands.
0 - Enable the retry after errors on all disk access commands.
c 0 - Automatic correction of correctable errors.
1 - No correction of correctable errors.

Control byte is normally set to C0 Hex during test.

Adaptec ACB 5580

The Adaptec ACB 5580 controller can control up to four SMD compatible disk drives. The controller is not initialized by the program. At reset time the controller reads the disk parameters from the disk. Therefore, the program is able to read the disk parameters from the controller. If the controller is unable to read the parameters, the program will report an error. The following disk parameters are read by the program from the controller or typed in by the user:

Number of cylinders
Number of heads
Number of sectors

If the user wants to modify these parameters, it will only affect the controller if the drive is formatted. The control byte must always be set to 00. Error correction and retries cannot be disabled.

Embedded controller

The SCSI controller is embedded in the drive electronics. The controller is able to handle media defects. When the drive is formatted it uses two different sets of defect information:

- **Primary defect list.** This list is supplied by the manufacturer and is resident on the drive.
- **Grown defect list.** This list contains defects which have been identified to the drive using the reassign block command.

Normally the drive is formatted using both lists, but it is possible to clear the grown defect list during the format procedure. If a hard error occurs during operation, it is recommended to use the reassign block command. It is not necessary to format the drive after using the reassign block command.

DIAGNOSTIC PROGRAMS 4.3

Floppy

The DIOC1 0400 module in the Supermax card family is equipped with the FD1795-02 floppy disk formatter/controller. The DIOC2 1100 module in the Supermax card family is equipped with the FD2795-02 floppy disk formatter/controller. The Diagnostic Program for Floppy Disk Drives is able to handle two types of drives.

- 8" drive. 1Mb diskette (double side, double density).
- 5¼" drive. 560Kb diskette (double side, double density).

Parameters used by the program must be set according to the drive type. These parameters are:

Drive type	8"	5¼"
Number of cylinders	77	80
Number of sectors	26	16

All tests start by issuing a restore command to the drive. If the drive is not ready or the track 00 flag is not set the test stops and the error is reported. If other types of errors occur during a restore command the error is reported to the error buffer and the test is continued.

```
dioc2 E F >M
Diagnostic program for floppy drives

A - Define parameters
B - Write/read test
C - CRC test
D - Seek/read test
E - Display error buffer
F - Format disk
G - Exerciser
H - Display sectors
M - Menu
R - Return to main menu

dioc2 E F >
```

A - Define parameters

Upon start of the program always select A.

Drive number	Drive 0, 1, 2 or 3 is selected. Normally drive 1 is used, if only one floppy disk drive is connected to the DIOC.
Number of cylinders	Defaults to 5¼" drive
Number of sectors	Defaults to 5¼" drive
Start of write precom.	Defaults to cylinder 43
Step rate	

Step rate	8"	5¼"
0	3 ms	6 ms
1	6 ms	12 ms
2	10 ms	20 ms
3	15 ms	30 ms

Note: All drives connected to the Supermax are specified to step rate 0.

B - Write/read test

The following test pattern is written in all sectors of the diskette:

Byte	Pattern
0	Head number (00 head 0, 01 head 1)
1	Cylinder number (0 to maximum cylinder)
2	Sector number (1 to maximum sector)
3-255	63 Hex

The test writes from cylinder 0 to maximum cylinder, then reads from maximum cylinder to cylinder 0. Head number, cylinder number and sector number in all sectors on each track are verified and the error buffer is updated if any errors occur.

C - CRC test

All cylinders from cylinder 0 to maximum cylinder are read, a restore command is issued and the test starts again. The error buffer is updated if any errors occur.

D - Seek test

This test starts by reading data on cylinder 0, head number 0, then reads data on maximum cylinder, head number 0, then reads on cylinder n, head number 0, then reads on maximum cylinder - n, head number 0, where n has a value in the range from 1 to maximum cylinder. Then the test is repeated for head number 1. All errors reported from the controller are stored in the error buffer.

E - Display error buffer

All errors obtained from write/read test, CRC-test, seek test, exerciser or the formatting command are displayed. The error buffer is cleared if one of these tests are selected. Maximum number of errors in the buffer is 128. If this number is exceeded an overrun is detected, and the buffer is refilled from the start. Informations from the error buffer are:

Commands

Code	Command
R	Read
W	Write
F	Format
S	Restore
P	Step
K	Seek

Status is displayed in binary code

Restore, seek and step commands.		
Bit	**Name**	**Text**
7	not ready	if set, drive is not ready.
6	write protect	if set, write protect is activated.
5	head loaded	if set, head is loaded.
4	seek error	if set, the desired track was not verified.
3	CRC error	CRC error encountered in the ID field.
2	track 00	if set, head is positioned in track 00.
1	index	if set, index mark detected from drive.
0	busy	if set, command is in progress.

Write, read and format commands.		
Bit	**Name**	**Text**
7	not ready	if set, drive is not ready.
6	write protect	if set, write protect is activated.
5	write fault	if set, indicates a write fault.
4	record not found	if set, the desired track, sector or side were not found.
3	CRC error	if bit 4 is set, an error is found in then ID field, otherwise error in the data field.
2	lost data	if set, indicates that the DMA did not respond on data request in one byte time.
1	data request	this bit is a copy of the DRQ output from the FD1795.
0	busy	if set, command is under execution.

Cylinder	Cylinder address
Sector	Sector address
Pass	The pass in which the error from the controller occurred.

F - Format disk

The floppy disk is formatted. After formatting a track, the entire track is read. All errors reported from the controller are stored in the error buffer.

G - Exerciser

Upon start of the exerciser, the drive will restore and no read operation is performed. When selecting X all sectors are read on the selected track. Errors are stored in the error buffer. The exerciser keeps on reading the selected track until another track is selected or until selecting Y.

Key	Command
↑	select head 1
↓	select head 0
←	decrement cylinder number
→	increment cylinder number
X	select read operation
Y	select no read operation
R	restore drive

In combination with an alignment diskette the exerciser can be used to test track alignment, head alignment etc.

H - Display sectors

Is used in combination with the exerciser. The track selected by the exerciser is displayed sector by sector.

M - Menu

Display the menu on the terminal.

R - Return to main menu

Return to menu for peripheral units.

DIAGNOSTIC PROGRAMS 4.3

Tape Drive

The tape drive Diagnostic Program is able to test any tape drive, which conforms to the SCSI standard for tape drives.

When typing **M <CR>** the menu of the current subprogram will be displayed on the terminal. The example shows the menu from the tape drive Diagnostic Program.

```
dioc2 E T >M
Diagnostic program for tape drives

A - Define parameters
B - Write/read test
C - Read tape
D - Rewind
E - Display error buffer
F - Write tape
H - Write variable block mode
I - Read variable block mode
J - Write file mark
P - Reset controller
R - Return to main menu
M - Menu

dioc2 E T >
```

Whenever the prompt is displayed on the terminal it is possible to select tests.

A - Define parameters

The following parameters can be defined to the program.

- Controller number
- Tape speed
- Tape density
- Block size
- Number of blocks in each command

Normally the default values shown on the terminal should be used. Otherwise you should consult the data sheet of the unit you are going to test.

B - Continuous write/read

The number of blocks selected by the user is written on the tape. When the last block is written the tape is rewound. Then a read command is issued. When reading, the program checks the data pattern if requested by the user. If any errors occur, the error buffer is updated.

C - Read tape

The drive reads the tape from the current tape position, until a file mark is found, a hard error occurs, end of tape occurs, etc. If **Ctrl E** is pressed the drive stops and the program reports the number of commands issued.

D - Rewind

Rewinds the tape to the beginning of the tape.

E - Display error buffer

The error buffer contains information about all errors obtained from the controller. An example of the error buffer looks like this:

```
Sense byte  00  02  17  18
            XX  YZ  WW  WW
```

XX must be 0x70 or 0xF0.

Y is 4 bits with the following information:
Bit 7 is Filemark detected.
Bit 6 is End Of Medium.
Bit 5 is Incorrect Length Indicator.
Bit 4 is allways 0.

Z is the error code. Refer to Chapter 9 in order to see the meaning.

WWWW is retry counter.

F - Write tape

The drive writes the tape from the current tape position, until a hard error occurs, end of tape or **Ctrl E** is pressed. Then the tape motion stops, and the program reports the number of commands issued.

H - Write variable block mode

This command should **not** *be used.*
Implemented only for evaluation purposes.

I - Read variable block mode

This command should **not** *be used.*
Implemented only for evaluation purposes.

J - Write file mark

A file mark is written on the tape at the current tape position.

P - Reset controller

A reset of the SCSI controller will be performed.

R - Return to the main menu

Return to menu for the peripheral units.

M - Menu

Display the menu on the terminal.

DIAGNOSTIC PROGRAMS 4.5

Floppy DIOC3

The DIOC3 4000 module in the Supermax card family is equipped with the National DP8473 floppy disk controller. The Diagnostic Program for Floppy Disk Drives is able to handle all kinds of formats on 5¼" and 3½" disk drives.

When typing **M <CR>** the menu of the current subprogram will be displayed on the terminal. The example shows the menu of the floppy diagnostic program, where floppy disk drive number 0 is selected.

```
dioc3 E F > M
Diagnostic program for floppy

              ID number: 0          Unit type: Floppy
A - Seek test
B - Write/read test
C - CRC test
F - Format disk
O - Repeat test(s)
G - Format track
K - Exerciser
L - Read single sector and display
S - Set command
P - Set floppy parameters
E - Display error buffer
N - Select new floppy
T - Enable test of both floppy drives
Z - Reset floppy interface
R - Return to main menu
M - Menu

dioc3 E F >
```

All tests start by issuing a restore command to the drive. If the drive is not ready, the test stops and the error is reported. If other kinds of errors occur during a restore command the error is reported to the error buffer and the test is continued.

A - Seek test

This test starts by reading data on cylinder 0, head number 0, then reads data on maximum cylinder, head number 0, then reads on cylinder n, head number 0, then reads on maximum cylinder - n, head number 0, where n has a value in the range from 1 to maximum cylinder. Then the test is repeated for head number 1. All errors reported from the controller are stored in the error buffer.

B - Write/read test

The following test pattern is written in all sectors of the diskette:

Byte	Pattern
0	Head number (00 head 0, 01 head 1)
1	Cylinder number (0 to maximum cylinder)
2	Sector number (1 to maximum sector)
3-Sector size	0x63

The test writes from track 0 to maximum track, then reads from maximum track to track 0. Head number, cylinder number and sector number in all sectors on each track are verified and the error buffer is updated if any errors occur.

C - CRC test

All tracks from track 0 to maximum track are read. The error buffer is updated if any errors occur.

F - Format disk

The floppy disk is formatted. After formatting one track, the entire track is read. All errors reported from the controller are stored in the error buffer.

O - Repeat test(s)

If you add this option to the test(s) mentioned above, the test(s) will repeat itself (themselves) until otherwise cancelled.

G - Format track

One track can be selected and that track will be formatted. After formatting the track, the entire track is read. All errors reported from the controller are stored in the error buffer.

K - Exerciser

Upon start of the exerciser, the drive will restore and no read operation is performed. When typing X all sectors are read on the selected track one by one. Errors are stored in the error buffer. The exerciser keeps on reading the selected track until another track is selected or until typing Y. The following commands can be given to the the exerciser.

Key	Command
↑	select head 1
↓	select head 0
←	decrement cylinder number
→	increment cylinder number
X	select read operation
Y	select no read operation
R	restore drive

In combination with an alignment diskette the exerciser can be used to test track alignment, head alignment etc.

L - Read single sector and display

The selected sector is read into memory and displayed on the terminal. The following commands may be given to the program:

Letter	Command	Text
R	Return	Return to menu
A	Address	Select a new disk address
C	Cylinder	Select a new cylinder number
D	Display	Display next part of the sector. Is used to display part of the sector that lies beyond the first 256 bytes.
N	Next	Read next sector
P	Previous	Read previous sector
M	Modify	Modify bytes in the sector
W	Write	Write current sector

S - Set command

This feature enables the user to send commands to the drive. **Note.** During normal test conditions it is **NOT** necessary to use this feature.

P - Set floppy parameters

The following parameters can be set or changed, when running the different tests. There are two standard parameter settings, DDE 560 kb and PC/AT 1.2 Mb. If you want to use any other standard, the following parameters must be changed. The parameters will default to DDE 560 kb diskette format.

Floppy parameters			
Parameter	**560 kb**	**1.2 Mb**	**Description**
Sector size	256	512	
Number of sectors/track	16	15	
Number of cylinders	80	80	
Density	L	H	
Step rate	0x0E	0x0C	(0x10-val)millisec * 2
Head settling time	0x02	0x04	val * 2 millisec
Gap length	0x20	0x20	
Gap format	0x32	0x32	

E - Display error buffer

All errors obtained from the floppy disk drive during one or more tests are displayed. The error buffer is cleared every time one of these tests are selected from the menu. If a test is selected to be repeated the error buffer will only be cleared before the first pass. The maximum number of errors in the error buffer are 128. If this number is exceeded an overrun is detected, and the first 127 errors are saved. Any additional errors will replace each other at location 128. Information from the error buffer are:

Error buffer	
Name	**Text**
ID	Drive number
Com	Command code. 0x04 = Format command. 0x08 = Read command. 0x0a = Write command. 0x0b = Seek command.
Stat2	See status register 2
Stat1	See status register 1
Stat0	See status register 0
Cylinder	Cylinder address.
Head	Head address.
Sector	Sector address.
Pass	The pass in which the error from the floppy controller occurred.
Time from reset	The time from reset when the error from the floppy controller occurred.

Status register 2		
Bit	**Name**	**Text**
7	Nc	Not used.
6	Control mark	Floppy controller tried to read a sector which contained a deleted data address mark.
5	CRC error	Valid only if bit 5 of ST1 is set. 0 = CRC error detected in the address field. 1 = CRC error detected in the data field.
4	Wrong track	The floppy controller cannot find the track.
3	Scan equal hit	Not used.
2	Scan not satisfied	Not used.
1	Bad track	Bad track on the disk.
0	Missing address mark	Valid only if bit 0 of ST1 is set. 0 = Cannot find address field address mark. 1 = Cannot find data field address mark.

Status register 1		
Bit	**Name**	**Text**
7	End of track	Floppy controller transferred the last byte of the last sector, without the TC pin becoming active.
6	Nc	Not used.
5	CRC error	CRC error detected, see ST2 bit 5.
4	Overrun	DMA did not respond to data request in one byte time.
3	Nc	Not used.
2	No data	Cannot find the sector.
1	Not writable	Write protect pin is active.
0	Missing address mark	The controller cannot find the address or data field mark, see ST2 bit 0.

Status register 0		
Bit	**Name**	**Text**
7-6	Interrupt code	00 = Normal termination of command. 01 = Abnormal termination of command. 10 = Invalid command issue. 11 = Ready changed state.
5	Seek end	Seek or recalibrate command completed.
4	Equipment check	After a recalibrate command, track 0 signal failed to occur.
3	Not ready	Ready pin is inactive.
2	Head address	0 = head 0 selected. 1 = head 1 selected.
1-0	Drive number	00 = drive 0 selected. 01 = drive 1 selected.

N - Select new floppy

This is used to select the other drive on the floppy disk interface. You will be asked about the ID number.

T - Enable test of both floppy drives

This is used to tell the program to test both floppy disk drives. When selecting this one for the first time a **M** will appear in the prompt indicating that multiple test is enabled. When selecting any of the tests A, B, C, or F, that test will be performed on both floppy disk drives. Any errors obtained from the test will be saved in each units own error buffer. If selecting *T* again the **M** will disappear from the prompt, indicating that multiple test is disabled. The two drives **must** use the same format on the diskette.

Z - Reset floppy interface

This command will issue a reset to the floppy interface and will initialize parameters for the controller. If the default parameters should be used it is enough to issue this command. If the parameters must be changed you should use the command **P**.

R - Return to main menu

Return to the menu for peripheral units.

M - Menu

Display the menu on the terminal.

Internal error codes

During execution of a command the floppy controller goes through different phases. If the controller enters an unexpected phase it is considered an error and the test is terminated. The following error codes are not included in the standard error codes, but are internally generated error codes.

Internal error codes	
0x10-0x1F	Floppy controller not ready.
0x20-0x2F	Unexpected interrupt from the floppy controller.
0x30-0x3F	No interrupt occured from the floppy controller.
0x40-0x4F	Data buffer not ready during reset command.
0x50-0x5F	Data buffer not ready during seek command.
0x60-0x6F	Data buffer not ready during format command.
0x70-0x7F	Data buffer not ready during write/read command.
0x80-0x8F	Wrong status occured from the floppy controller.
0xF0	Floppy interface not implemented.
0xF1	Illegal command to the floppy controller.
0xF2	Illegal sector size to the floppy controller.
0xF3	Floppy disk not ready.

DIAGNOSTIC PROGRAMS 4.5

Tape drive DIOC3

The tape drive Diagnostic Program for the DIOC3 is able to test any tape drive, that are compatible with the SCSI interface descriptions for tape drives. This includes the streaming tape drives.

When typing **M <CR>** the menu of the current subprogram will be displayed on the terminal. The example shows the menu of the tape drive diagnostic program.

```
dioc3 E T > M
Diagnostic program for tape drives

A - Rewind
B - Write tape
C - Read tape
D - Write/read test
F - Erase
G - Retension
H - Write file mark
I - Search to file mark
O - Repeat test(s)
J - Read parameters from tape drive
L - Read single block and display
S - Set command
P - Set tape drive parameters
E - Display error buffer
N - Select new tape drive
T - Enable test of all tape drives
Z - Reset SCSI interface
R - Return to main menu
M - Menu

dioc3 E T >
```

Whenever the prompt is displayed on the terminal it is possible to select tests. Before running any tests one must be sure that the SCSI interface has been reset and that the program knows the parameters of the units, that are going to be tested.

A - Rewind

Rewinds the tape to the beginning of the tape.

B - Write tape

The number of blocks selected by the user is written on the tape from the current tape position. The four first bytes in each block contains the SCSI number, the ID number and the block number and the rest of the block contains the byte pattern selected by the user. When the selected number of blocks are written, or when **Ctrl E** is pressed, a file mark is written and the tape motion stops.

C - Read tape

The drive reads the tape from the current tape position, until a file mark occurs. If any errors occur the error buffer is updated.

D - Write/read test

The number of blocks selected by the user is written on the tape. The four first bytes in each block contains the SCSI number, the ID number and the block number and the rest of the block contains the byte pattern selected by the user. When the last block is written a file mark is written and the tape is rewinded. Then a read command is issued. When reading, the program checks the header field in each block. If any errors occur, the error buffer is updated.

F - Erase

The entire tape is erased.

G - Retension

This command rewinds the tape to the beginning, then winds it to the end and then rewinds it to the beginning again.

H - Write file mark

A file mark is written on the tape at the current tape position.

I - Search to file mark

The drive reads the tape searching for a file mark. When a file mark is found tape motion stops.

O - Repeat test(s)

If, when selecting test(s) A, B, C, D, F, G, H, I, this option is also added, the test(s) will repeat itself (themselves) until otherwise cancelled.

J - Read parameters from tape drive

Parameters are read from the tape drive, in order to find out what type it is and in order to set default parameters for the tests.

L - Read single block and display

The program will allways start by reading block 0 into the memory and display it on the terminal. The following commands may be used:

Letter	Command	Text
R	Return	Return to the menu
A	Address	Select a new tape address
B	Block	Select a new block number
D	Display	Display next part of the block. Is used to display part of the block that lies beyond the first 256 bytes.
N	Next	Read next block
P	Previous	Read previous block

S - Set command

This feature enables the user to send commands to the controller. The first byte must contain the number of command bytes transmitted to the drive. **NOTE.** During normal test conditions it is **NOT** necessary to use this feature.

P - Set tape drive parameters

The following tape drive parameters must be set before running any tests. Not all parameters affect all tests.

- Block size
- Number of blocks to transfer in one command
- Number of blocks to write
- Pattern for test
- Disconnect/Reconnect option. Defaults to 0x03 which enables the D/R option. Type 0x00 in order to disable the D/R option. Disconnect/Reconnect is a feature in the SCSI interface that enables the target to free the SCSI bus during execution of a command. Consequently the DIOC3 is able to have pending commands to each device on the SCSI bus.

E - Display error buffer

All errors obtained from the tape drive during one or more tests are displayed. The error buffer is cleared every time one of these tests are selected from the menu. If a test is selected to be repeated the error buffer will only be cleared before the first pass. The maximum number of errors in the error buffer are 128. If this number is exceeded an overrun is detected, and the first 127 errors are saved. Any additional errors will replace each other at location 128. Information from the error buffer are:

Error buffer	
Name	**Text**
SCSI	SCSI channel number.
ID	Drive number.
Com	SCSI standard command. 0x00 means Test unit ready 0x01 means Rewind 0x03 means Request sense 0x08 means Read 0x0A means Write 0x10 means Write file mark 0x11 means Searching for file mark 0x12 means Inquiry 0x19 means Erase 0x1A means Mode sense 0x1B means Retension
Error	Error code in hex form reported from the drive. 0x80 File mark 0x40 EOM. End of media 0x20 ILI. Incorrect length indicator 0x10 Not used 0x00-0x0F Error code
Status	Status code in hex form reported from the drive. Must be 0x70 or 0xF0.
Block	Block address (only if address valid ˜ status code = 0xF0).
Pass	The pass in which the error from drive occurred.
Time from reset	The time from reset when the error from the drive occurred.

N - Select new tape drive

This is used to select another drive on one of the SCSI interfaces. You will be asked about SCSI channel number and ID number.

T - Enable test of all tape drives

This is used to tell the program to test all tape drives connected to both SCSI interfaces. When selecting this one for the first time a **M** will appear in the prompt indicating that multiple test is enabled. When selecting any of the tests A, B, C, D, F, G, H or I, that test will be performed on all tape drives which have had their parameters read by the program. The test starts on SCSI 0 ID 0 and ends on SCSI 1 ID 6. If the Disconnect/Reconnect option is enabled the test will run simultaneously on all tape drives. Any errors obtained from the test will be saved in each units own error buffer. If selecting *T* again the **M** will disappear from the prompt, indicating that multiple test is disabled.

Z - Reset SCSI Interface

A reset will be performed on the SCSI interface currently in use.

R - Return to main menu

Return to the menu for the peripheral units.

M - Menu

Display the menu on the terminal.

Internal error codes

During execution of an SCSI command the SCSI controller goes through different phases. If the controller enters an unexpected phase it is considered an error and the test is terminated. The following error codes are not included in the standard SCSI command format, but are internally generated error codes. If any of those errors are encountered a Reset SCSI command must be performed.

Internal error codes	
0x00-0x0F	Time out in handshake between SCSI controller and drive.
0x10-0x1F	Wrong interrupt (Only when Disconnect/Reconnect enabled)
0x80-0x8F	Illegal interrupt.
0xA0-0xAF	Illegal interrupt.

DIAGNOSTIC PROGRAMS 4.5

Winchester DIOC3

The winchester Diagnostic Program for the DIOC3 is able to handle all embedded winchester disk drives, which are supported by DDE. In order to format a winchester disk some parameters must be set. Therefore it is important to know which winchester disk drive you are going to test. In **Chapter 10** of this manual you will find a description of the different types of winchester disk drives used by DDE, as well as a complete list of parameters for the disk drives. Please notice that the parameter list is a combination of controller-, winchester-, and DIOC type. Only use the parameters indicated for DIOC3.

When typing **M <CR>** the menu of the current subprogram will be displayed. The example shows the menu of the winchester test program.

```
dioc3 E W > M
Diagnostic program for winchester

A - Seek test
B - Write/read test
C - CRC test
D - Random write/read
O - Repeat test(s)
F - Format drive
G - Reassign block
I - Performance test
J - Read parameter from winchester
K - Exerciser
L - Read single sector and display
S - Set command
P - Set winchester parameter
E - Display error buffer
N - Select new winchester
T - Enable test of all winchester units
Z - Reset SCSI interface
R - Return to main menu
M - Menu

dioc3 E W >
```

When the prompt is displayed on the terminal, tests can be selected by typing in the corresponding letter.

A - Seek test

This test starts by reading data on cylinder 0, head number 0, then reads data on maximum cylinder, head number 0, then reads on cylinder *n*, head number 0, then reads on maximum cylinder - *n*, head number 0 where *n* has a value in the range from 1 to maximum cylinder. Then the test is repeated for head numbers from 1 to maximum head. All errors reported from the drive are stored in the error buffer.

B - Write/read test

Write/read test will keep the configuration table, but the data on the disk drive will be destroyed. All errors obtained from the drive are stored in the error buffer. Data fields are written with 0x63 in the first pass, the complement 0x9C in the second pass, then 0x9D, then 0x62, 0x63, 0x9C, and so on. The test writes on the entire disk, then reads the entire disk. The first four bytes in each sector contain the SCSI number, the ID number and the sector number. When reading a sector, the program checks this field and the rest of the sector will only get a CRC test. The program will write and read a number of sectors in each command. This number can be changed when selecting *P*. The test runs from minimum cylinder to maximum cylinder.

C - CRC test

The CRC test reads one track/command from the disk drive. When doing that a CRC test is performed. All errors obtained from the controller are stored in the error buffer. The test runs from cylinder 0 to maximum cylinder.

D - Random write/read

Random write/read test will keep the configuration table, but the data on the disk drive is destroyed. All errors obtained from the drive are stored in the error buffer. The program will write a number of sectors on the disk drive. This number can be changed when selecting *P*. The default value is equal to the number of sectors/track. The number of sectors will be written with the SCSI number, the ID number and the sector number followed by a continuous counter and then read back and checked for correct content. Between the write and the read operation, the drive will read from track 0 before seeking back. The sector address is calculated on a pseudo random basis.

O - Repeat test(s)

If, when selecting test(s) A, B, C, D, this one (O) is also selected, the test(s) will repeat itself (themselves) until otherwise canceled.

F - Format drive

Drive will be formatted and a new configuration table with the correct parameters will be written on the drive. You have to select *P* to set up parameters before formatting the disk drive. You have to know the manufacturer, the type and preferably the serial number of the disk drive in order to answer the questions asked by the program.

G - Reassign block

The Reassign block command requests the drive to reassign a defective block to a spare block reserved for this purpose. If a spare block is available on the track, where the defect block is located, this block will be used, otherwise a spare block on a other track will be used. The defect block address is added to the grown defect list. It is not necessary to reformat the drive after using the reassign block command, and only one block of data is corrupted. If the drive is reformatted it will use the grown defect list, and the primary defect list to map out all defect blocks so the media appears error free. It is possible to use either a sector address or the cylinder, head and sector number as input to the command. Sector 1 of the configuration table will be updated with the sector address. of the reassigned block. This information is not used by any programs.

I - Performance test

This command can be used to measure the performance of the disk drive. The following tests can be measured.

- Read test.
- Write test.
- Seek test.

When the test is completed the actual time used for the test is the number written on the terminal times 50 ms.

J - Read parameters from winchester

Parameters are read from the configuration table on the winchester. If the parameters are invalid they will not be used. Instead the program will use the default parameters read from the disk drive itself.

K - Exerciser

Sectors are read one by one on the selected track. Errors are stored in the error buffer. When the exerciser is started it seeks to the selected track and does not read until you type *X*. After that the exerciser keeps on reading the selected track until another track is selected or you type *Y*.

Key	Command
↑	increment head number
↓	decrement head number
←	decrement cylinder number
→	increment cylinder number
X	select read operation
Y	select no read operation
R	restore drive
^E	exit

L - Read single sector and display

The selected sector is read into memory and displayed on the terminal. The following may be used:

Letter	Command	Text
R	Return	Return to menu
A	Address	Select a new disk address
C	Cylinder	Select a new cylinder number
D	Display	Display next part of the sector. Is used to display part of the sector that lies beyond the first 256 bytes.
N	Next	Read next sector
P	Previous	Read previous sector
M	Modify	Modify bytes in the sector
W	Write	Write current sector

S - Set command

This feature enables the user to send commands to the drive. The first byte must contain the number of command bytes transmitted to the drive.

Note. During normal test conditions it is **NOT** necessary to use this feature.

P - Set winchester parameters

The following parameters can be set or changed when running the different tests. Not all parameters affect all tests.

- Sector size
- Number of sectors/track
- Number of heads
- Number of cylinders
- Physical disk size
- Min. cylinder for write
- No. of sectors in write/read tests
- Disconnect/Reconnect option. Defaults to 0x03 which enables the D/R option. Type 0x00 in order to disable the D/R option. Disconnect/Reconnect is a feature in the SCSI interface that enables the target to free the SCSI bus during execution of a command. Consequently the DIOC3 is able to have pending commands to each device on the SCSI bus.

E - Display error buffer

All errors obtained from the disk drive during one or more tests are displayed. The error buffer is cleared every time one of these tests are selected from the menu. If a test is selected to be repeated the error buffer will only be cleared before the first pass. The maximum number of errors in the error buffer are 128. If this number is exceeded an overrun is detected, and the first 127 errors are saved. Any additional errors will replace each other at location 128. Information from the error buffer are:

Error buffer	
Name	**Text**
SCSI	SCSI channel number.
ID	Drive number 0-6.
Com	SCSI standard command. 0x00 means Test unit ready 0x03 means Request sense 0x04 means Format 0x07 means Reassign 0x08 means Read 0x0A means Write 0x0B means Seek 0x12 means Inquiry 0x15 means Mode select 0x1A means Mode sense
Error	Error code in hex form reported from the drive.
Cylinder	Cylinder address (only if address valid).
Head	Head address (only if address valid).
Sector	Sector address (only if address valid).
Pass	The pass in which the error from the drive occurred.
Time from reset	The time from reset when the error from the drive occurred.

N - Select new winchester

This is used to select another drive on one of the SCSI interfaces. You will be asked about SCSI channel number and ID number.

T - Enable test of all winchester units

This is used to tell the program to test all winchester units connected to both SCSI interfaces. When selecting this one for the first time a **M** will appear in the prompt indicating that multiple test is enabled. When selecting any of the tests A, B, C, D or I now, that test will be performed on all winchesters which have had their parameters read by the program. The test starts on SCSI 0 ID 0 and ends on SCSI 1 ID 6. If the Disconnect/Reconnect option is enabled the test will run simultaneously on all disks. Any errors obtained from the test will be saved in each units own error buffer. If selecting *T* again the **M** will disappear from the prompt indicating that multiple test is disabled.

Z - Reset SCSI interface

A reset will be performed on the SCSI interface currently in use.

R - Return to main menu

Return to the menu of peripheral units.

M - Menu

Display the menu on the terminal. If *J* has been selected the first two lines of the menu will tell about the selected winchester drive.

Configuration table

The configuration table is located in the first 1 kbyte from address 0x000 to 0x3ff on the disk drive. It contains information about the physical parameters of the drive. The parameters are read by the Diagnostic Program. It also contains information about all the bad blocks that have been reassigned on the drive. The last information is about the physical disk size, about the division of the physical disk into logical disks and about pointers used for winchester boot.

Address 0x00 - 0xFF	
Byte	**Text**
0x00-0x3F	Not used.
0x40	Number of heads.
0x41	Msb of number of cylinders.
0x42	Lsb of number of cylinders.
0x43	Number of sectors on a track.
0x44	Interleave factor.
0x45	Hard sector flag. (must contain FF)
0x46-0x4E	Not used
0x4F	Controller type. Must contain 09.
0x50	Sector size. This number times 256 bytes is the sector size.
0x51-0xEF	not used
0xF0-0xFF	Serial number

Address 0x100 - 0x2FF

This address space contains block addresses on blocks that have been reassigned. The block address consists of 4 bytes MSB...LSB. MSB is always 00.

Address 0x300 - 0x3FF

This address space is used by the operating system, and describes the configuration of a winchester disk.

Address 0x1000 - 0x100f

This address space is used by the operating system, and describes if mirrored disks are installed on the system.

Embedded controller

The SCSI controller is embedded in the drive electronics. The controller is able to handle media defects. When the drive is formatted it uses two different sets of defect information:

- **Primary defect list.** This list is supplied by the manufacturer and is resident on the drive.
- **Grown defect list.** This list contains defects which have been identified to the drive using the reassign block command.

Normally the drive is formatted using both lists, but it is possible to clear the grown defect list during the format procedure. If a hard error occurs during operation, you must use the reassign block command. It is **NOT** necessary to format the drive after using the reassign block command.

Internal error codes

During execution of an SCSI command the SCSI controller goes through different phases. If the controller enters an unexpected phase it is considered an error and the test is terminated. The following error codes are not included in the standard SCSI command format, but are internally generated error codes. If any of those errors are encountered a Reset SCSI command must be performed.

Internal error codes	
0x00-0x0F	Time out in handshake between SCSI controller and drive.
0x10-0x1F	Wrong interrupt (Only when Disconnect/Reconnect enabled)
0x80-0x8F	Illegal interrupt.
0xA0-0xAF	Illegal interrupt.

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Error codes

On the following pages error codes belonging to the different controllers used on the Supermax are shown.

Error codes for Xebec S1410	
Number	**Text**
00	No error detected (command completed OK).
01	No index detected from disk drive.
02	No seek complete from disk drive.
03	Write fault from disk drive.
04	Drive not ready after it was selected.
05	Not used.
06	Track 00 not found.
07-0F	Not used.
10	ID field read error.
11	Uncorrectable data error.
12	Address mark not found.
13	Not used.
14	Target sector not found.
15	Seek error.
16-17	Not used.
18	Correctable data error.
19	Bad track flag detected.
1A	Format error.
1B-1F	Not used.
20	Invalid command.
21	Illegal disk address.
22-2F	Not used.
30	Ram diagnostic failure.
31	Program memory checksum error.
32	ECC diagnostic failure.
33-3F	Not used.

Error codes for DTC 610

Number	Text
00	No error.
01	No index from drive.
02	No seek complete.
03	Write fault.
04	Drive not ready.
05	Drive not selected.
06	Return to zero not successful.
07	Multiple drives selected.
08-09	Not used.
0A	Drive fault.
0B	No data transition received from 9410 drives.
0C-0F	Not used.
10	ID read error. ECC error in ID field.
11	Uncorrectable data error.
12-13	Not used.
14	Record not found.
15	Seek error.
16	Not used.
17	Write protected sector.
18	Correctable data error.
19	Bad sector found.
1A	Track format error.
1B	Not used.
1C	Unable to read the alternate track address.
1D-1F	Not used.
20	Invalid command.
21	Illegal disk address.
22	Invalid function for the present drive type.
23-2F	Not used.
30	Ram error.
31-3F	Not used.

Error codes for Adaptec ACB 4000

Number	Text
00	No sense.
01	No index signal.
02	No seek complete.
03	Write fault.
04	Drive not ready.
05	Not used.
06	Track 00 not found.
07-0F	Not used.
10	ID CRC error.
11	Uncorrectable data error.
12	ID address mark not found.
13	Data address mark not found.
14	Record not found.
15	Seek error.
16-17	Not used.
18	Data check in no retry mode.
19	ECC error during verify.
1A	Interleave error.
1B	Not used.
1C	Unformatted or bad format on drive.
1D	Self test failed.
1E	Defective track (media errors).
1F	Not used.
20	Invalid command.
21	Illegal block address.
22	Not used.
23	Volume overflow.
24	Bad argument.
25	Invalid logical unit number.
26-3F	Not used.

Error codes for Xebec S1490 (SMD)

Number	Text
00	No error detected (command completed OK).
01	No index detected from disk drive.
02	No seek complete from disk drive.
03	Write fault from disk drive.
04	Drive not ready after it was selected.
05	Drive not select.
06	Seek error from drive.
07	Drive write protected.
08	Disk drive still seeking.
09	Drive busy.
0A	Drive not initialized.
0B	Time out error.
0C	Set wrong sector # per track on drive.
0D-0F	Not used.
10	Sector ECC error.
11	Uncorrectable data error.
12-13	Not used.
14	Target sector not found.
15	Seek error.
16	Data miscompare error.
17	Not used.
18	Correctable data error.
19	Bad track flag detected.
1A-1B	Not used.
1C	Direct access to alternate track.
1D	Alternate track already assigned.
1E	Assigned alternate track not found.
1F	Alternate and defective track point to the same.
20	Invalid command.
21	Illegal disk address.
22	Illegal parameter on initialize format command.
23-2F	Not used.
30	Ram diagnostic failure.
31	Program memory checksum error.
32	ECC diagnostic failure.
33-3F	Not used.

Error codes for NEC DS800B (SMD)

Number	Text
00	No error detected (command completed OK).
01	No index detected from disk drive.
02	No seek complete from disk drive.
03	Fault.
04	Drive not ready.
05	Drive not select.
06	Not used.
07	Multiple drive selected.
08-0B	Not used.
0C	Drive is write protected.
0D	Seek in progress.
0E-0F	Not used.
10	ID read error.
11	Uncorrectable data error during read.
12-13	Not used.
14	Record not found.
15	Seek error.
16	No valid alternate sector found.
17	Not used.
18	Correctable data field error.
19	Bad block found.
1A	Format error.
1B-1E	Not used.
1F	Time out or handshake error.
20	Invalid command.
21	Illegal disk address.
22-2F	Not used.
30-3F	Not used.

Error codes for Adaptec ACB 5580

Number	Text
00	No sense.
01	No index signal.
02	No seek complete.
03	Write fault.
04	Drive not ready.
05	Selection failure.
06-0F	Not used.
10	ID CRC error.
11	Uncorrectable data error.
12	ID address mark not found.
13-14	Not used.
15	Seek error.
16-17	Not used.
18	Data check in no retry mode.
19	ECC error during verify.
1A-1B	Not used.
1C	Unformatted or bad format on drive.
1D-1F	Not used.
20	Invalid command.
21	Illegal block address.
22	Not used.
23	Volume overflow.
24	Bad argument.
25	Invalid logical unit number.
26	Not used.
27	Write protect.
28	Cartridge changed.
29	Media error.
2A	Not used.
2B	Set limit violation.
2C	Error count overflow.
2D	SCSI initiator detected error.
2E	SCSI bus out parity check.
2F	Adapter parity check.

Error codes for embedded controllers

Number	Text
00	No sense.
01	No index/sector signal.
02	No seek complete.
03	Write fault.
04	Drive not ready.
05	Selection failure.
06	No track zero found.
07	Multiple drives selected.
08	Logical unit communication failure.
09	Track following error.
0A-0F	Not used.
10	ID CRC/ECC error.
11	Uncorrectable data error.
12	No address mark found in ID field.
13	No address mark found in data field.
14	No record found.
15	Seek error.
16	Data synchronization mark error.
17	Recovered read data with retries (without ECC).
18	Recovered read data with ECC.(without retries).
19	Defect list error.
1A	Parameter overrun.
1B	Synchronous transfer error.
1C	Primary defect list not found.
1D	Compare error.
1E	Recovered ID with ECC correction.
1F	Not used
20	Invalid command.
21	Illegal block address.
22	Illeal function for device type.
23	Not used.
24	Illegal field in CDB.
25	Invalid logical unit number.
26	Invalid field in parameter list.
27	Write protect.
28	Cartridge changed.
29	Power on, reset, or bus device reset.
2A	Mode select parameters changed.
2B-2F	Not used.

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continued

30	Incompatible cartridge.
31	Medium format corrupted.
32	No defect spare location available.
33-3F	Not used.
40	Ram failure.
41	Data path diagnostic failure.
42	Power on diagnostic failure.
43	Message reject error.
44	Internal controller error.
45	Select/reselect failed.
46	Unsuccessful soft reset.
47	SCSI interface parity error.
48	Initiator detected error.
49	Illegal message.
4A-8F	Not used.

Error codes for Cipher ½" Magtape

Number	Text
00	No sense
01	Recovered error
02	Not ready
03	Medium error
04	Hardware error
05	Illegal request
06	Unit attention
07	Data protect
08	Blank check
09	Vendor unique (not used)
0A	Copy aborted
0B	Aborted command
0C	Reserved
0D	Volume overflow
0E	Not used
0F	Reserved

Error codes for EXABYTE 8mm Video Streamer

Number	Text
00	No sense
01	Not used
02	Not ready
03	Medium error
04	Hardware error
05	Illegal request
06	Unit attention
07	Data protect
08	Blank check
09	Vendor unique (not used)
0A	Copy aborted
0B	Aborted command
0C	Reserved
0D	Volume overflow
0E	Not used
0F	Reserved

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Winchester Drive Parameters

On the following pages you will find a list of disk drive parameters for all winchester disk drives, that might be used in a Supermax computer. **Note.** The parameters depend on both the DIOC and the controller.

Drive parameters for NEC D5224 (10Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	4	4
Cylinders	320	320
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	128	128
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	9C0000	9C0000
Max number of skip	31	31

Drive parameters for NEC D5224 (10Mb)		
DIOC2	Adaptec ACB 4000	
Heads	4	
Cylinders	320	
Sectors	32	
Reduced Write Current	not used	
Precompensation	128	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	9C0000	
Max number of skip	31	

Drive parameters for RODIME RO 202 (10Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	4	4
Cylinders	320	320
Sectors	33	32
Reduced Write Current	132	132
Precompensation	0	0
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	9C0000	9C0000
Max number of skip	31	31

Drive parameters for RODIME RO 202 (10Mb)		
DIOC2	Adaptec ACB 4000	
Heads	4	
Cylinders	320	
Sectors	32	
Reduced Write Current	132	
Precompensation	0	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	9C0000	
Max number of skip	31	

Drive parameters for FUJITSU M2235 (20Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	8	8
Cylinders	320	320
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	128	128
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	12F0000	12F0000
Max number of skip	31	31

Drive parameters for FUJITSU M2235 (20Mb)		
DIOC2	Adaptec ACB 4000	
Heads	8	
Cylinders	320	
Sectors	32	
Reduced Write Current	not used	
Precompensation	128	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	12F0000	
Max number of skip	31	

Drive parameters for NEC D5244 (20Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	8	8
Cylinders	320	320
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	128	128
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	12F0000	12F0000
Max number of skip	31	31

Drive parameters for NEC D5244 (20Mb)		
DIOC2	Adaptec ACB 4000	
Heads	8	
Cylinders	320	
Sectors	32	
Reduced Write Current	not used	
Precompensation	128	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	12F0000	
Max number of skip	31	

Drive parameters for NEC D5126 (20Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	4	4
Cylinders	640	640
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	128	128
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	12F0000	12F0000
Max number of skip	31	31

Drive parameters for NEC D5126 (20Mb)		
DIOC2	Adaptec ACB 4000	
Heads	4	
Cylinders	640	
Sectors	32	
Reduced Write Current	not used	
Precompensation	128	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	12F0000	
Max number of skip	31	

Drive parameters for Finch 9410 (25Mb)		
DIOC1	DTC 610	
Heads	4	
Cylinders	605	
Sectors	42	
Control byte	00	
Interleave factor	5	
Physical disk size	1870000	
Max number of skip	31	

Drive parameters for Finch 9410 (25Mb)		
DIOC2	DTC 610	
Heads	4	
Cylinders	605	
Sectors	42	
Control byte	00	
Interleave factor	14	
Physical disk size	1870000	
Max number of skip	31	

Drive parameters for ATASI 3046 (36Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	7	7
Cylinders	645	645
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	319	319
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	22C0000	22C0000
Max number of skip	64	64

Drive parameters for ATASI 3046 (36Mb)		
DIOC2	Adaptec ACB 4000	
Heads	7	
Cylinders	645	
Sectors	32	
Reduced Write Current	not used	
Precompensation	319	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	22C0000	
Max number of skip	64	

Drive parameters for HITACHI DK511-5 (36Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	7	7
Cylinders	699	699
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	256	256
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	22C0000	22C0000
Max number of skip	64	64

Drive parameters for HITACHI DK511-5 (36Mb)		
DIOC2	Adaptec ACB 4000	
Heads	7	
Cylinders	699	
Sectors	32	
Reduced Write Current	not used	
Precompensation	256	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	22C0000	
Max number of skip	64	

Drive parameters for HITACHI DK511-8 (63Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	10	10
Cylinders	823	823
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	823	823
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	3F40000	3F40000
Max number of skip	125	125

Drive parameters for HITACHI DK511-8 (63Mb)		
DIOC2	Adaptec ACB 4000	
Heads	10	
Cylinders	823	
Sectors	32	
Reduced Write Current	not used	
Precompensation	823	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	3F40000	
Max number of skip	125	

Drive parameters for MICROPOLIS 1325 (63Mb).		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	8	8
Cylinders	1024	1024
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	1024	1024
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	3F40000	3F40000
Max number of skip	94	94

Drive parameters for MICROPOLIS 1325 (63Mb).		
DIOC2	Adaptec ACB 4000	
Heads	8	
Cylinders	1024	
Sectors	32	
Reduced Write Current	not used	
Precompensation	1024	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	3F40000	
Max number of skip	94	

Drive parameters for VERTEX V185 (63Mb).		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	7	7
Cylinders	1166	1166
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	1166	1166
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	3F40000	3F40000
Max number of skip	64	64

Drive parameters for VERTEX V185 (63Mb).		
DIOC2	Adaptec ACB 4000	
Heads	7	
Cylinders	1166	
Sectors	32	
Reduced Write Current	not used	
Precompensation	1166	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	3F40000	
Max number of skip	64	

Drive parameters for NEC D2257 (120Mb)		
DIOC1	Xebec SMD	
Heads	8	
Cylinders	1024	
Sectors	56	
ECC burst error	0	
Control byte	00	
Interleave factor	not used	
Bytes/track	5000	
Physical disk size	6E20000	
Max number of skip	125	

Drive parameters for NEC D2257 (120Mb)		
DIOC2	NEC DS 800B SMD	
Heads	8	
Cylinders	1024	
Sectors	64	
Control byte	00	
Interleave factor	1	
Physical disk size	7E00000	
Max number of skip	125	

Drive parameters for PERTEC DX332 (240Mb)		
DIOC2	Adaptec ACB 5580	
Heads	10	
Cylinders	1649	
Sectors	62	
Control byte	00	
Interleave factor	1	
Physical disk size	F690000	
Max number of skip	198	

Drive parameters for HITACHI DK511-5 (40Mb)		
DIOC1	Adaptec ACB 4000	Xebec S1410
Heads	7	7
Cylinders	714	714
Sectors	33	32
Reduced Write Current	not used	not used
Precompensation	256	256
ECC burst error	not used	6
Control byte	00	07
Step period	02	not used
Interleave factor	2	7
Physical disk size	2630000	2630000
Max number of skip	64	64

Drive parameters for HITACHI DK511-5 (40Mb)		
DIOC2	Adaptec ACB 4000	
Heads	7	
Cylinders	714	
Sectors	32	
Reduced Write Current	not used	
Precompensation	256	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	2630000	
Max number of skip	64	

Drive parameters for NEC D5146H (40Mb)		
DIOC1	Adaptec ACB 4000	
Heads	8	
Cylinders	615	
Sectors	33	
Reduced Write Current	not used	
Precompensation	128	
ECC burst error	not used	
Control byte	00	
Step period	02	
Interleave factor	2	
Physical disk size	2630000	
Max number of skip	31	

Drive parameters for NEC D5146H (40Mb)		
DIOC2	Adaptec ACB 4000	
Heads	8	
Cylinders	615	
Sectors	32	
Reduced Write Current	not used	
Precompensation	128	
Control byte	00	
Step period	02	
Interleave factor	1	
Physical disk size	2630000	
Max number of skip	31	

Drive parameters for MAXTOR XT 3280 (240Mb)	
DIOC2	Embedded controller
Heads	15
Cylinders	1220
Sectors	13 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	E850000
Max number of skip	not used

Drive parameters for MAXTOR XT 3280 (240Mb)	
DIOC3	Embedded controller
Heads	15
Cylinders	1220
Sectors	13
Bytes/sector	1024
Physical disk size	E850000

Drive parameters for MICROPOLIS 1375 (130Mb)	
DIOC2	Embedded controller
Heads	8
Cylinders	1018
Sectors	35 (512 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	8B20000
Max number of skip	not used

Drive parameters for MICROPOLIS 1375 (130Mb)	
DIOC3	Embedded controller
Heads	8
Cylinders	1018
Sectors	35
Bytes/sector	512
Physical disk size	8B20000

Drive parameters for WREN III (130Mb)	
DIOC2	Embedded controller
Heads	9
Cylinders	967
Sectors	35 (512 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	8B20000
Max number of skip	not used

Drive parameters for WREN III (130Mb)	
DIOC3	Embedded controller
Heads	9
Cylinders	967
Sectors	35
Bytes/sector	512
Physical disk size	8B20000

Drive parameters for PRIAM 717 (130Mb)	
DIOC2	Embedded controller
Heads	7
Cylinders	1210
Sectors	18 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	8B20000
Max number of skip	not used

Drive parameters for PRIAM 717 (130Mb)	
DIOC3	Embedded controller
Heads	7
Cylinders	1210
Sectors	18
Bytes/sector	1024
Physical disk size	8B20000

Drive parameters for PRIAM 728 (240Mb)	
DIOC2	Embedded controller
Heads	11
Cylinders	1210
Sectors	18 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	E850000
Max number of skip	not used

Drive parameters for PRIAM 728 (240Mb)	
DIOC3	Embedded controller
Heads	11
Cylinders	1210
Sectors	18
Bytes/sector	1024
Physical disk size	E850000

Drive parameters for PRIAM 738 (320Mb)	
DIOC2	Embedded controller
Heads	15
Cylinders	1218
Sectors	18 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	14100000
Max number of skip	not used

Drive parameters for PRIAM 738 (320Mb)	
DIOC3	Embedded controller
Heads	15
Cylinders	1218
Sectors	18
Bytes/sector	1024
Physical disk size	14100000

Drive parameters for MICROPOLIS 1578 (320Mb)	
DIOC2	Embedded controller
Heads	15
Cylinders	1218
Sectors	18 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	14100000
Max number of skip	not used

Drive parameters for MICROPOLIS 1578 (320Mb)	
DIOC3	Embedded controller
Heads	15
Cylinders	1218
Sectors	18
Bytes/sector	1024
Physical disk size	14100000

Drive parameters for MICROPOLIS 1373 (65Mb)	
DIOC2	Embedded controller
Heads	4
Cylinders	1015
Sectors	35 (512 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	3F40000
Max number of skip	not used

Drive parameters for MICROPOLIS 1373 (65Mb)	
DIOC3	Embedded controller
Heads	4
Cylinders	1015
Sectors	35
Bytes/sector	512
Physical disk size	3F40000

Drive parameters for MICROPOLIS 1674 (130Mb)	
DIOC2	Embedded controller
Heads	7
Cylinders	1239
Sectors	18 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	8B20000
Max number of skip	not used

Drive parameters for MICROPOLIS 1674 (130Mb)	
DIOC3	Embedded controller
Heads	7
Cylinders	1239
Sectors	18
Bytes/sector	1024
Physical disk size	8B20000

1684-7

7
1770
27
1024 Bytes
14100000

Drive parameters for MICROPOLIS 1588 (640Mb)	
DIOC2	Embedded controller
Heads	15
Cylinders	1626
Sectors	27 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	28300000
Max number of skip	not used

Drive parameters for MICROPOLIS 1588 (640Mb)	
DIOC3	Embedded controller
Heads	15
Cylinders	1626
Sectors	27
Bytes/sector	1024
Physical disk size	28300000

Drive parameters for MAXTOR XT 8760 (640Mb)	
DIOC2	Embedded controller
Heads	15
Cylinders	1626
Sectors	27 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	28300000
Max number of skip	not used

Drive parameters for MAXTOR XT 8760 (640Mb)	
DIOC3	Embedded controller
Heads	15
Cylinders	1626
Sectors	27
Bytes/sector	1024
Physical disk size	28300000

Drive parameters for WREN VI (640Mb)	
DIOC2	Embedded controller
Heads	15
Cylinders	1626
Sectors	27 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	28300000
Max number of skip	not used

Drive parameters for WREN VI (640Mb)	
DIOC3	Embedded controller
Heads	15
Cylinders	1626
Sectors	27
Bytes/sector	1024
Physical disk size	28300000

Drive parameters for WREN VI (640Mb)	
DIOC2	Embedded controller
Heads	15
Cylinders	1626
Sectors	27 (1024 bytes/sector)
Control byte	00
Interleave factor	1
Physical disk size	28300000
Max number of skip	not used

Drive parameters for WREN VI (640Mb)	
DIOC3	Embedded controller
Heads	15
Cylinders	1626
Sectors	27
Bytes/sector	1024
Physical disk size	28300000

DIAGNOSTIC PROGRAMS 4.5