MANUAL
- HG/GOUDA SCSI INTERFACE v1.1
- NOVAXIS ROM v1.5
- NFDISK v1.0

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PREFACE

Many Dutch buyers of the SCSI interface with NOVAXIS ROM are probably wondering why this manual is in English. Even I have had some trouble with it. However, in the present situation it was simply the best solution. Many, most is more honest, SCSI interfaces are sold outside Holland and sadly enough Dutch is not a world language, so we decided to write the manual in English. Maybe we will translate it into Dutch in the near future, but do not count on it.

By publishing all calls in the SCSI BIOS we hope to encourage programmers to write their own programs for the SCSI interface. Maybe this will result in faster programs and programs that are especially written for hard disk users, like a Norton Commander for MSX.

With the new FDISK program it is possible to create MS-DOS compatible partitions so that the connection with MS-DOS PCs will be much better. This is a very handy option for MSX emulator users and users of cross-compilers. Now do your development on the PC and immediately try the resulting code on your (real) MSX.

We wish you the best with our SCSI interface.
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CHAPTER 1 - GENERAL SCSI INFORMATION

1.1 - What is SCSI?

It is not very easy to give a clear explanation of SCSI. SCSI is an American standard from the middle eighties. It is short for Small Computers System Interface. During the first few years the standard was a terrible mess. In 1984 the standard was almost completed, but never published as the standard. So every producer made his own definition of the standard. Nothing was such incompatible as the SCSI standard then. In spite of this incompatibility SCSI had many advantages. In network systems (IBM compatible PCs, Apple) the SCSI was able to control hard disks with great capacities, like one gigabyte. Later the compatibility between SCSI improved.

SCSI was originally developed as the SASI-bus (Shugart Associated System Interface). It was meant to be the first standard with interface on both sides of the device. Earlier this kind of interfaces were too expensive. But with VLSI (very large scale integrated) technics it affordable for almost everyone. SASI was offered to the ANSI committee as a standard. This eventually resulted in the SCSI standard.

SCSI is a kind of bus where you could connect up to 7 devices. This could be all kind of devices: CD-ROM, SCSI interface, hard disk, etc. SCSI has its own protection scheme to prevent data collisions on the bus. Thus, offering a simple network environment.

1.2 - What about SCSI on MSX?

SCSI on an MSX computer is nothing more than a way to work with hard disks. Although some interfaces in Holland were also able to control floppy drives (the so-called ED-drives) this option is not used anymore. The ED-drives are too expensive.

New device types like tapestreamers, scanners, etc. are not really interesting for MSX users. Prices are high and there is almost no need for these devices. CD-ROM is an option that would be interesting on MSX, even though there are some problems. Most CD-ROMs use the ISO-9660 standard. This is a standard with a 16 bit FAT. Sadly enough the 12 bit FAT is used on MSX. Another problem is the partition size. With MSX-DOS 2.x, we are restricted to the 32MB partition size. On some CD-ROMs hundreds of megabytes are collected in just one partition.

What we needed was a new MSX-DOS. Yet with ASCII quitting development of MSX-software this is not a real option. We will keep working on a way to use the CD-ROM even on MSX as a normal hard disk.
Although it seems that a CD-ROM on your MSX is useless, it is not. Henrik Gilvad wrote some pleasing utilities to copy and type files from CD-ROM. It is not quite the way we wanted it to be, but at least we now can use some of the numerous CD-ROMs available. The utilities are on the disk supplied with your interface.

With this new ROM we decided to publish full documentation. This would enable programmers to write their own software for the SCSI interface. This information is on the disk. We would like to receive your programs, for as much as they are public domain or freeware. We added some utilities ourselves, like the ScanID and FrmtDsk utilities. A small example is included in chapter 6 of this manual.

1.2.1 - Hardware requirements

MSX2
- Dos 2 kernel
- One free cartridge slot

Turbo R
- One free cartridge slot
CHAPTER 2 - HARDWARE

2.1 - What kind of SCSI harddisk to buy

Maybe you do not own a hard disk yet. Well, just read this chapter and you will get an idea what to keep in mind when buying one.

If you buy a hard disk it is not likely it is built in a case. The first thing you need is a good case, with a built in power supply or a separate one. Make sure the power supply is able to supply the power needed by the hard disk. On PC fairs in Holland great cases from IBM are available, all with sufficient power supply built in. These cases are about 25,- to 50,- Dutch guilders.

When you have bought a case you have to find a hard disk. What capacity do you need? Will it be 850 MB or 20 MB? This depends on the way you are using your hard disk. Is it just for fun (games) or are you an enthousiastic collector of GIF and music files? When it is just for fun a 100 MB will be more than enough. In the other case you probably need a hard disk with the maximum our interface could access, 480 MB. This 480 MB is only available with the MAP-program. When not using the MAP-program the maximum access quantity is 192 MB. But even this will be sufficient for most users.

Another problem is the kind of SCSI hard disk. Do you need SCSI-1, SCSI-2 or Wide SCSI? It is easiest to say only SCSI-1 and SCSI-2 drives are to be connected to our interface. This not 100% true, but these drives will always work and for others nothing can be guaranteed. Please do not buy the 5.25" SCSI-1 hard disks. They are very old and very likely to give problems, like disk-errors, refusing to start on MSX2 computers upgraded to 7 Megahertz, etc.

Right now you have a case, a hard disk and an interface. It seems you are ready to connect all of them together. This is not true. You are missing one important part of your SCSI system: the cable to connect interface and hard disk. You can make it yourself, just buy 100 cm of 50-pin cable and two connectors, and place the connectors on both ends of the cable. Only do this if you know what you are doing, a cable with the connectors upside down, or whatever else can go wrong, may damage both your hard disk and interface.

From the above we extract the following: do not behave like a fool! Just spend those few dollars more after you have spent a few hundred dollars for a hard disk and an interface. Every computershop will supply a SCSI cable if you ask for it.
2.2 - Connecting hard disk and SCSI interface

The SCSI cable is actually a SCSI bus connecting all devices on the cable. For a correct working both ends of the SCSI cable should be terminated. This is done with the so-called terminators. All SCSI devices have terminators on it. These look something like this:

![Terminator Image]

Mostly they are removable. Our interface, which is usually not used in a network environment, does not have removable terminators. If you ask for it, we will make them removable before deliverance.

Remember, only the devices on the beginning and on the end of the cable should have these terminators. From all the other devices, if available, the terminators should be removed. Write down the original position before you remove them. Mark which terminator was mounted where and how. This will prevent you from troubles when relocating the terminators.
CHAPTER 3 - NOVAXIS SCSI ROM

3.1 - What is new?

Although the ROM has changed a lot internally, the outside has not undergone extreme changes. The only thing noticeable for the user is the new option: Extended Partitions.

The ROM will recognize (almost) all partition tables used on MSX. The extended partition table is MS-DOS compatible. With the MAP-command, 480 MB per hard disk is made available to MSX. This feature will be explained later.

Inside, the ROM is made even more stable than its predecessor. CD-ROM devices are recognized more easily and a RESCAN option is available in the Setup-menu if a CD-ROM is not recognized on start-up time.

Further we deliver a few handy utilities on disk and some new calls in ROM.

If you have never used a NOVAXIS ROM before the changes are a lot more:

- Built-in BIOS Setup
- Software adjustable Host-ID
- Software adjustable Target-ID (hard disk from which to boot)
- Recognizing four different types of partition tables, including the new extended partition table
- Breaking the 192 MB barrier with MAP-command and extended partitions
- Enabling use of multiple hard disks in an easy way

3.2 - Getting Started with NOVAXIS ROM

To install the SCSI interface turn off the power of your system and external equipment. Now insert the SCSI interface cartridge in any unused slot. Connect the cable to the cartridge connector and the SCSI peripherals if you did not do this already.

The NOVAXIS SCSI BIOS supports SCSI hard disks (and some Magnetic Optical disks). Other devices should be managed by external programs (like we did for the CD-ROM) or drivers made especially for this device (none available at the moment).

Booting is only possible from a hard disk. Be sure the (first) hard disk’s ID is between 0 and 3 if you want to boot from it.

After you have properly connected all devices you can turn on the power. The computer should be turned on first. Just after you turn on your computer you turn on the other SCSI
equipment. Some hard disks take some time to spin up. If you do have such a hard disk just reset the computer once to give the hard disk some more time.

The SCSI BIOS appears to be installed if you see this message appear on the screen:

```
NOVAXIS MSX2/Turbo-R SCSI BIOS version 1.51
(c) 1994-1995 KMcs / MSX Club Gouda
Written by Jurgen Kramer - July 3rd. 1995 -
Hardware by H.G. 1993. version 1.1
```

Then if your hardware is checked ok, the following text should be displayed:

Hit <DEL> to run SETUP

By pressing <DEL> you enter the SETUP menu, in which you can configure your system. The SETUP menu is described in paragraph 3.3. When everything works properly the following message should appear on the screen:

```
please wait ---' (Here the system waits for the Target which you selected in the SETUP menu)
```

When the target is connected and ready a message similar to this one below appears on the screen:

```
Host ID: 7, Target ID: 0
```

Now the SCSI BIOS will search for a valid partition table on the first Target, and installs this Target if it contains a valid -MSX- partition. If the Multiple HDD switch in the SETUP menu is on it will continue to search for other Targets. After the first Target is checked, the other Targets at ID 0 up to 7 will be checked accordingly to the following sequence:

**Example 1 - Target ID is 0, Host ID is 7**

```
0 1 2 3 4 5 6
```

(The Host ID is skipped)

**Example 2 - Target ID is 2, Host ID is 6**

```
2 0 1 3 4 5 7
```

(The Host ID is skipped)

All installed Targets will be displayed on the screen, for example:
The number of partitions used on this device is shown as the last argument. At max. all partitions summed will be 6. The '-' sign means partitions on these devices are not supported by the SCSI ROM, ‘E’ means an Error in the partition table and ‘N’ means No(ne) partitions found.

The system will boot from the first Target and it tries to start MSX-DOS 2.x.

When your hard disk is not partitionized properly you should use the NFDISK program to partitionize the hard disk. Mostly you will run into errors like "Drive not ready", "Wrong driveletter" when a hard disk is not partitionized properly. For information on how to partitionize you hard disk see chapter 4.

Pressing <GRAPH> will prevent the NOVAXIS SCSI BIOS from being installed.

### 3.3 - Setup Utility

When starting with the interface connected to the computer and the hard disk to the interface the following message is printed on the screen:

NOVAXIS MSX2/Turbo-R SCSI BIOS version 1.51
(c) 1994-1995 KMcs / MSX Club Gouda
Written by Jurgen Kramer - July 3rd. 1995 -

Hit <DEL> to run SETUP

By pressing the del-key you will get the following (PC BIOS SETUP-like) inputscreen.
3.3.1 - Host ID

The Host ID is the ID of your interface. Usually it will be 7, but if you are working in a network environment where all IDs have to be different it might be in the range from 4 to 7.

3.3.2 - Target ID

The Target ID is the ID of the hard disk from which to boot. Normally with one hard disk attached this will be 0, but if you are working in a multiple hard disk environment the Target ID might be in the range from 0 to 3.

There is one more thing. If you are working in a multiple hard disk environment the way your drive letters (A-F) are filled with partitions is a bit different. This is described in chapter 3.2 (getting started with NOVAXIS ROM).

3.3.3 - Multiple HDD support

Usually, this option is disabled, meaning just one hard disk (or other SCSI device) is supported. Yet with prices of hard disk dropping almost every day, it is not very rare to have more than one hard disk. For example one solely on MSX and one shared by the MSX and a PC. This option enables the support for more than one hard disk (or other SCSI device) on MSX.

3.3.4 - Extended partitions

The restricted number of only 6 partitions was a great restriction on hard disk size. With only 32 MB per partition it gives a maximum hard disk size of 192 MB.
Even on hard disks with hundreds of MBs more. Extended partitions are the answer to this problem. With extended partitions you can make up to 15 partitions per hard disk. Thus, making it possible to use hard disks of 480 MB. You will need one external program, MAP, to use that many partitions and megabytes. MAP is described in chapter 7.

3.3.5 - Rescan

Sometimes a hard disk or CD-ROM is not recognized immediately by the ROM, for example when you turn on the CD-ROM right after you turn on your computer. The rescan option makes the interface search again for all connected devices, and if connected it will be shown on the screen.

3.3.6 - Quit without save / Save and quit

This BIOS setup program stores its information in the clockchip of your MSX. With the save and quit option you save the information to the clockchip. Thus, enabling to read it the next time on startup. Meaning you set up your BIOS once and then just keep using the installed settings. However, sometimes the bits the BIOS uses are also used by other programs. This will result in a mess. Keep this in mind when you have trouble booting.

Save and quit will save the changes you made in the clockchip. Quit without save does not.

3.3.7 - Units online

The number of devices attached to your interface. The IDs these devices have will be shown in another color in the 'ID # : 0 1 2 3 4 5 6 7' message. The devices attached are colored yellow.

3.3.8 - Current Target

This shows the status of the Target-ID. This could be online and offline. By changing the Target-ID, you have a way to check the status of all attached devices.

3.3.9 - Device type

There are a few different SCSI device types. This option shows what kind of device the current Target-ID is. Hard disks will be of type “direct access device”. When you get the message “unknown device type” and you are certain you have a hard disk currently installed on this Target-ID, you should check the terminators.
3.4 - Extra programs built in

The NOVAXIS ROM has some nice little options built in. You will get a list of the build in programs by typing CALL INFO in basic. A list like the one below will appear on screen.

**CALL statements available:**

- CALL INFO  
  Show this text
- CALL SLOW  
  Z80 mode
- CALL MEDIUM  
  R800 ROM mode
- CALL FAST  
  R800 RAM mode
- CALL MAP  
  Fix DOS2 error
- CALL MAP2  
  ditto - version 2
- CALL HOSTID(variable)  
  Get SCSI HOST ID
- CALL TARGETID(variable)  
  Get SCSI TARGET ID
- CALL SETHOSTID(var.)  
  Set SCSI HOST ID
- CALL GETTARGETID(var.)  
  Set SCSI TARGET ID
- CALL INQUIRY(var, str, str, str)  
  Get INQUIRY of specified Target

**3.4.1 - CALL SLOW/MEDIUM/FAST**

These calls only work on Turbo R.

- CALL SLOW  
  Activates Z80 mode.
- CALL MEDIUM  
  Activates R800 ROM mode.
- CALL FAST  
  Activates R800 DRAM mode.

**3.4.2 - CALL MAP/MAP2**

- CALL MAP  
  CALL MAP is a utility which alters the working of memory mapper routines under DOS 2.x. Altering these will make some programs, which normally do not work on DOS 2.x, running.

- CALL MAP2  
  CALL MAP2 is a newer version of CALL MAP and should be used first. If CALL MAP2 is not working, try CALL MAP. Ease from Philips is one the programs which will work fine with CALL MAP2 being executed first.
3.4.3 - CALL HOST/TARGETID, SETHOST/TARGETID, INQUIRY, FORMAT

CALL HOSTID (variable)
After executing this call the variable is filled with the host ID number. The variable is allowed to be one of the following types: integer, single precision and double precision

Examples:  
10 CALL HOSTID(C): PRINT C  
11 CALL HOSTID(D!): PRINT D!  
12 CALL HOSTID(ID%): PRINT ID%

CALL TARGETID (variable)
After executing this call the variable is filled with the target ID number. The variable is allowed to be one of the following types: integer, single precision and double precision

Examples:  
10 CALL TARGETID(C): PRINT C  
11 CALL TARGETID(D!): PRINT D!  
12 CALL TARGETID(ID%): PRINT ID%

CALL SETHOSTID(x)
This call is used to set the host ID. The x is to be replaced with one of these:

- a numeric value (4-7)  
- integer, single precision, double precision  
- expression

Examples:  
10 CALL SETHOSTID(4)  
11 I=4: CALL SETHOSTID(I)  
12 V=3: CALL SETHOSTID(7-V)

CALL SETTARGETID(x)
This call is used to set the target ID. The x is to be replaced with one of these:

- a numeric value (4-7)  
- integer, single precision, double precision  
- expression

Examples:  
10 CALL SETTARGETID(4)  
11 I=4: CALL SETTARGETID(I)  
12 V=3: CALL SETTARGETID(7-V)
CALL INQUIRY
This call enables the BASIC programmer to get some basic information from the harddisk, like code of make and revision number.

Examples:  
10 CALL INQUIRY(4, A$, B$, C$)  
11 I=4: CALL INQUIRY(I, A$, C$, D$)  
12 V=3: CALL INQUIRY(7-V, F$, K$, G$)

A result could be: A$ = "IBM", B$= "KZ-P" and C$="R160". Meaning IBM is the maker of hard disk KZ-P and the revision is R160.

CALL FORMAT
Protects or enables writing to current partition.

Example:  
call format  
Drive name? (A, B, C, D, E, F) A

1 - Write protect partition  
2 - Write enable partition

? 1  
Strike a key when ready  
Not a DOS disk  
Ok

Now you are no longer able to write on drive A. Only resetting the computer or write enable the partition using call format will make it possible to write on that particular partition again. If a partition is write protected because of the owner ID of the partition is different from the current host ID, this call format function will not remove the write protection.
3.5 - Errors

These are the messages generated by the ROM when something is wrong:

**Controller test failed**

Your eprom is unable to control the SCSI controller of your interface. Mostly indicating a defective controller. Sometimes the crystal is broken. This is a fatal error, and you should contact your supplier for repairing the interface.

**ROM checksum error**

A few bits in the ROM have fallen from 0 to 1 or vice versa and now your ROM is creating the wrong checksum. It is a fatal error and means you have to replace your ROM with a new one.

**SCSI bus is down**

This is a general error. It is not a fatal one. Mostly it indicates something is wrong with your connections. Is the SCSI cable ok? What about the terminators, are they all in the right place? Is your harddisk turned on yet? Is it already at speed?
CHAPTER 4 - NFDISK

4.1 - What is NFDISK?

NFDISK is a program that enables you to initialize your hard disk. It is different from formatting a disk, but you need to initialize your hard disk before it can be used. You can create different partitions on your hard disk. (In general, each partition is treated as a different drive by the computer.) Splitting the harddisk into partitions is mostly necessary, because the MSX cannot handle drives larger than 32 MB.

4.2 - Starting NFDISK

NFDISK has to be started from MSX-DOS 2.x. If your harddisk is not initialized yet, start the computer while pressing the <GRAPH> key, so the harddisk is not seen by the computer on initialization. Then start MSX-DOS 2.x and NFDISK from a diskette.

If your hard disk has already been initialized but you want to take a look at NFDISK anyway, this can be done without any problem. Nothing on your hard disk will be changed - if you do not press the <W> key during execution of the program.

The program is easy to use, so you can start it without reading this manual first. Still, a reasonably complete description follows below.

4.3 - The beginning

NFDISK starts with displaying a copyright-window and waits for a key to be pressed. What happens next depends on the fact of having one or more hard disks connected to your system. In the last case, you first get a window where you have to choose one of the hard disks you want to work with.

After that, the information of the hard disk is read and the edit-screen is displayed. If you have started the computer with the <GRAPH> key pressed, reading the hard disk may take some seconds.

4.4 - The edit-screen

At this point, three windows are on the screen. Below, an overview of the keys and their functions is displayed. Above, on the left you can see some general information about the hard disk and on the right you can see the free space on the hard disk. Three values are displayed in megabytes.
The top value represents the space on the harddisk that is free for use by the partitions. The middle value represents the current space that is used by the partitions. On the bottom the unused space is displayed, which is the subtraction of the upper two values.

**Note:** the upper value is not equal to the total space on the harddisk! Some of the harddisk space is used for storing the partition-table. This space is not counted with the total free space.

The middle window contains the data of the partitions on the hard disk. There are six columns:

- **Nr** : The number of the partition.
- **WID (Write-ID)**: The SCSI-ID number that can write on this partition. See paragraph 4.5
- **Type**: The partition type. Normally this will be 'FAT12 (MSX)'. This is the only type of partition that NFDISK can generate. If there are already other types of partitions on the hard disk, NFDISK will recognize them. These partitions cannot be edited, however.
- **Sectors**: The partition size in sectors
- **MB**: De partition size in megabytes
- **Volume name**: The volume name. This name is displayed when you give a DIR command in MSX-DOS 2.x.

The fields 'Nr' and 'Type' are only on the screen for your information. The other data can be edited.

The fields 'Sectors' and 'MB' are two different representations of the same value. If you change one of the values, the other value will change too.

**4.5 - The write-ID**

The Write-ID is only important if there are multiple computers connected to a hard disk. If more computers can write on the same partition, things could go wrong.

Sometimes, a computer stores part of the information that is on disk (especially the FAT and/or directory) in memory so it does not have to read this from disk all the time. If one computer keeps information about a partition in its memory and another computer writes something on the same partition, the information in the computer's memory is not correct anymore. When this computer writes something to that partition, and uses, the (incorrect) information from its memory, data on the disk can be damaged. The SCSI ROM offers a solution by only having one ID reading and writing a certain partition. Other IDs only have read rights. Therefore, in this version of NFDISK it is only
possible to give one specific SCSI-ID write-access to a partition. This 'write-ID' should be the same as the host-ID of the computer from which you want to write on the partition.

The Write-ID is only supported by two of the four different partition-table-formats. If you have selected a format where the write-ID is not supported, the write-ID cannot be set and dashes are displayed in this column.

4.6 - Editing the partition data

You can change the current values by selecting these with the cursor keys and space bar, and entering a new value. While entering values you can always restore the old values by pressing <ESC>. If in a 'Sectors' or 'MB' field nothing is entered, but <RETURN> is pressed immediately, NFDISK will give a value that is equal to the remaining unused space on the hard disk. The maximum size of a partition is 65535 sectors, which is 32 MB. If the unused space is larger than 32MB, NFDISK will enter 65535 sectors. If the unused space is negative, NFDISK will restore the old value.

You can delete partitions from the table with <DEL>. The computer will first ask for a confirmation. You can insert new partitions with <INS>. The position where the partition is inserted depends on the position of the cursorbar. On inserting a partition, the size of the partition (in MB) has to be entered. Here, a value is also inserted automatically when <RETURN> is pressed immediately.

During the editing of the partition data, the changed data are not stored on the harddisk yet. The partition data are written when you press <W>. This version of NFDISK will initialise all partitions when writing the data. On one hand, this is convenient because the whole harddisk is ready for use with one keystroke. On the other hand, you cannot change partition information afterwards because all data on harddisk will be lost while writing the partition data!

4.7 - Different partition-table-formats

Over the past years, different ways have been used to store the partition data on harddisk. NFDISK can read different types of partitiontables, just like the new SCSI ROM, and can also write data in these different formats. By pressing <P> a window is displayed where you can choose one of the different table-formats.
An overview:

<table>
<thead>
<tr>
<th>Type</th>
<th>no. of partition(s)</th>
<th>Used by interfacetype</th>
</tr>
</thead>
<tbody>
<tr>
<td>(old) PC</td>
<td>1 - 4</td>
<td>MS-DOS PC interfaces, MK 1.x</td>
</tr>
<tr>
<td>(old) MSX</td>
<td>1 - 6</td>
<td>HSH, MAK 2.0, MK 2.x, Gouda/Henrik Gilvad with other ROM than Novaxis 1.5, HandlerGemeinschaft</td>
</tr>
<tr>
<td>MAK 3.0</td>
<td>1 - 8</td>
<td>MAK 3.0</td>
</tr>
<tr>
<td>Extended</td>
<td>1 - 32, 1 - 15</td>
<td>MS-DOS PC interfaces, HPN/B.E.R.T., Gouda/Henrik Gilvad with Novaxis 1.5 ROM</td>
</tr>
</tbody>
</table>

Note: Another typical thing of the extended format is that for each partition one sector of the harddisk (of 512 bytes) is used to store the partition data.

The other formats use one sector, regardless the number of partitions. This means that the free space on the harddisk, as it is displayed on the top right, can change when you change the partitiontable-format!

4.8 - So now what?

When you have changed and written the partition data, the harddisk is fully initialised and ready for use. You have to restart the computer at this point. Now suppose you have made three partitions on the harddisk, then the drives A: to C: are most probably used by the harddisk and drive D: will be the diskette drive. The computer will start MSX-BASIC, as it does not find anything on the A: drive.

Now you will probably want to put MSX-DOS on the A: drive, so the computer starts MSX-DOS at startup. This can be done from BASIC, or you can start MSX-DOS from disk by giving the right CALL CHDRV ("x:"), and a CALL SYSTEM.

Be sure to copy both MSXDOS2.SYS and COMMAND2.COM onto drive A:. When MSXDOS2.SYS is present and COMMAND2.COM is absent or corrupted, this is fatal and you have to re-initialise your harddisk! (Or find a good program(mer) to resolve this situation.)
4.9 - Problems

- PCs do not fully recognise extended partitions. Depending on the operating system, only two or three partitions are recognised.

- Some PC programs may have problems with the bootsector that is generated by NFDISK v1.0. To fix this, the number on position 015h of the bootsector (which is the Media ID) should be changed from 0F0h to 0F8h. This does not work with NOVAXIS SCSI ROM v1.0. Only higher versions work with Media ID 0F8h.

- Although under normal circumstances this will never happen, it is possible that the partiontable or a bootsector on the hard disk contains invalid values. This is not checked by NFDISK v1.0, which can have two effects:
  - At the beginning, NFDISK tries to read a sector that does not exist. This causes a 'Read Error' which cannot be fixed in NFDISK.
  - At writing the partition, a far too large number of FAT or directory sectors is initialised. The computer will be busy writing very long and will probably give a 'Write Error' in the end. This can be fixed by deleting the partition with the invalid bootsector values and creating the same one again.

4.10 - Remarks

NFDISK will be under development for a long time, but even this 1.0 version is a lot better than previous FDISK programs.

NFDISK v1.0 is made by: Roderik Muit and Arjan Mels

Thanks go to:

- Jurgen Kramer (maker of NOVAXIS SCSI ROM)
  for cooperation and suggestions
- Gert de Boom, Jan Botman and Arjan Prosman
  for support and supplying hardware
- Jeffrey Timmer
  for making the window routines that are used in NFDISK

NFDISK v1.0 is copyrighted by MSX Club Gouda. NFDISK v1.0 is made only for spreading with the NOVAXIS SCSI ROMs and only works with these ROMs. For future versions, other copyrights and spreading rules may apply.

When new versions of NFDISK are finished, they will probably be spread freely. For questions about this, contact Roderik Muit. This can be done best by writing e-mail to <roderik@ripe.net>. Unfortunately it is impossible at this moment to supply addresses or phone numbers that will be valid for a longer period. If you do not have e-mail access, then contact MSX Club Gouda for the right address.
CHAPTER 5 - NETWORKING

5.1 - Hardware

Hardware connections in a network are not very different from the standard situation with one hard disk and one interface. At first you have to make sure that all hard disks and interfaces have different IDs. Interfaces are usually numbered from 7 downto 4 and hard disks are numbered from 0 upto 3.

In a network you have to remove the terminators from some of the devices. Only the device on the beginning of the cable and the device on the end of the cable must have terminators installed.

If your cable does not have enough connectors, just put on a few more. Look at the lips on the connectors. The new ones should have the same direction as the old ones. Further you have to keep in mind the maximum length of a SCSI cable, which is 6 meters.

Not keeping to the rules above means trouble. Network errors, read and write errors, hardware errors, etc.

5.2 - Setting up hosts and targets

Make sure all SCSI devices have different IDs. Interface have IDs from 7 to 4, hard disks have IDs from 0 to 3.

5.3 - Adding an MS-DOS PC to the network

With NOVAXIS' 'network' facilities it is possible to connect your MSX to an IBM compatible PC sharing SCSI devices. This PC should of course be equipped with a SCSI HOST adapter (e.g. from Adaptec). Most PC host adapters have an external SCSI connecter, which can be used to connect the shared hard disk to it. Now you can use NFDISK (on the MSX) to create an extended or (old) PC partition on the hard disk.

The (old) MSX partitiontable can also be used, but keep in mind these things:
- it might be possible that the PC’s bootprogram is destroyed
- only partitions 3 to 6 are seen by the PC

The PC mostly uses a 16-bit FAT, and your MSX only uses a 12-bit FAT, so the PC will be able to use your MSX partition, but you can not use PC partitions.

When you share a PC drive with a MSX, you should disable all diskcaching on that
particular drive because your PC will not know that you have modified some data with your MSX and still displays that directory you have just deleted. Do not use compressing software! Tools like neverending disk, doublespace, drvspace, stacker, lzexe and all these kind of compressing software are not allowed if you want your data to be consistent.
CHAPTER 6 - WRITING SOFTWARE

6.1 - BIOS CALLS

For the programmers we have published all the BIOS calls in the NOVAXIS SCSI BIOS. This is the complete list.

Register A is mostly used as follows:

\[
A = LLL00III \\
| | | +++------ Target ID \\
+++--------------- Logical Unit Number (LUN) usually 0
\]

New routines, which are new regarding to the first SCSI BIOS made by Uwe Schroeder, are marked with '1.00' or '1.50', indicating the first NOVAXIS ROM in which they were implemented.

Sometimes these calls do not give enough information. The following documents, which are on the supplied disk, should be examined for more sophisticated information about how some SCSI commands should be used, ANSI document X3.131-199X (SCSI-2) or X3-131-1986 (SCSI-1).

At address 07f80h the SCSI BIOS ROM ID is found: HD# (in ASCII). Checking this ID is not enough for finding out if the BIOS is made by NOVAXIS. For that you need a find-routine which is on the disk supplied with your interface.

And here is the list with calls:

<table>
<thead>
<tr>
<th>Name</th>
<th>RdLogBlk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>07f83h</td>
</tr>
<tr>
<td>Descript.</td>
<td>READ logical block(s) from HDD</td>
</tr>
<tr>
<td>Input</td>
<td>A = LUN + SCSI Target ID</td>
</tr>
<tr>
<td>Output</td>
<td>A = SCSI STATUS</td>
</tr>
<tr>
<td>Modify</td>
<td>AF, DE, IX, IY, HL</td>
</tr>
<tr>
<td>Note</td>
<td>See ANSI 8.2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>SetWD3393</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>07f83h</td>
</tr>
<tr>
<td>Descript.</td>
<td>Initialise SCSI controller</td>
</tr>
<tr>
<td>Input</td>
<td>-</td>
</tr>
<tr>
<td>Output</td>
<td>-</td>
</tr>
<tr>
<td>Modify</td>
<td>All</td>
</tr>
<tr>
<td>Note</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>TermAct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>07f86h</td>
</tr>
<tr>
<td>Descript.</td>
<td>Terminate HDD actions</td>
</tr>
<tr>
<td>Input</td>
<td>-</td>
</tr>
<tr>
<td>Output</td>
<td>A = SCSI STATUS</td>
</tr>
<tr>
<td>Modify</td>
<td>AF, D, E</td>
</tr>
<tr>
<td>Note</td>
<td>-</td>
</tr>
</tbody>
</table>
Name: WrLogBlk
Address: (07f8ch)
Description: WRITE logical block(s) to HDD
Input: A = LUN + SCSI Target ID
       B = number of blocks to write
       C D E = start logical block #
       HL = transfer address
Output: A = SCSI Status
        D = Target Status
        E = Message
Modify: AF, BC, DE, HL, IX
Note: See ANSI 8.2.5

Name: ModeSel
Address: 07f9bh
Description: MODE SELECT
Input: A = LUN + SCSI Target ID
       B = Parameter List length
       HL = transfer address
Output: A = SCSI Target ID
        D = Target Status
        E = Message
Modify: AF, BC, DE, HL
Note: See ANSI 8.2.8

Name: ReadCap
Address: 07f95h
Description: READ CAPACITY
Input: A = LUN + SCSI Target ID
       HL = transfer address
Output: A = SCSI Status
        D = Target Status
        E = Message
Modify: AF, BC, DE, HL
Note: Returns 8 bytes, see ANSI 8.2.7

Name: ModeSense
Address: 07f98h
Description: MODE SENSE
Input: A = LUN + SCSI Target ID
       B = transfer address
       P P P C C C C C C
        | | | +---------- Page Code
        +-+-------- Page Control Field
Output: A = SCSI Status
        D = Target Status
        E = Message
Modify: AF, BC, DE, HL
Note: See ANSI 7.2.10

Name: InsWork
Address: 07fa7h
Description: Install Workspace
Input: ?
Output: ?
Modify: ?
Note: Do not use this call

Name: ClrEndLn
Address: 07faah
Description: Clear To End Of Line (print escape

---

Name: ReqSense
Address: 07f92h
Description: REQUEST SENSE
Input: A = LUN + SCSI Target ID
Output: A = DOS error code
        IX = address of sectorbuffer filled with Sense Data
Modify: AF, BC, DE,
Note: Sense data will be delivered in Extended Sense Format (12h bytes).
      See ANSI 7.2.14

Name: Inquiry
Address: 07f92h
Description: INQUIRY
Input: A = LUN + SCSI Target ID
       HL = transfer address
Output: A = SCSI Status
        D = Target Status
        E = Message
Modify: AF, BC, DE, HL
Note: Returns 24h bytes of information, see ANSI 7.2.5

Name: FmtUnit
Address: 07f99h
Description: FORMAT UNIT
Input: A = LUN + SCSI Target ID
       B = 000FCDDD
        | | | ++---- Defectlist format
        | | | +-------- Complete
        +------------ Format data
       DE = interleave (msb - lsb)
       HL = data address
Output: A = SCSI Status
        D = Target Status
        E = Message
Modify: AF, BC, DE, HL
Note: See ANSI 8.2.1

Name: TstUnitRdy
Address: 07fa1h
Description: TEST UNIT READY
Input: A = LUN + SCSI Target ID
Output: A = SCSI Status
        D = Target Status
        E = Message
Modify: AF, DE
Note: See ANSI 7.2.16

Name: Initialise
Address: 07fa4h
Description: Print Init Text
Input: ?
Output: ?
Modify: ?
Note: Do not use this call

Name: InsWork
Address: 07fa7h
Description: Install Workspace
Input: ?
Output: ?
Modify: ?
Note: Do not use this call

Name: ClrEndLn
Address: 07faah
Description: Clear To End Of Line (print escape

---
**Verify**

Input: A = LUN + ID
B = Verification Length (Blocks)
C, D, E = 21 bit Logical Block #
HL = data address

Output: A = SCSI Status
D = Target Status
E = Message

Modify: AF, BC, HL, IX

Note: Do not use this call

**StrtStpUn**

Input: A = LUN + ID
B = 0 > Stop Unit
B = 1 > Start Unit

Output: A = SCSI Status
D = Target Status
E = Message

Modify: AF, BC, DE, HL, IX

Note: See ANSI 8.2.17

**SndDiag**

Input: A = LUN + ID

Output: A = SCSI status
D = Target Status
E = Message

Modify: ?

Note: On MSX this function always performs a Self Test, see ANSI 7.2.1

**Copy (1.03)**

Input: A = LUN + ID
DE = Parameter List Length
HL = Data address

Output: A = SCSI Status
D = Target Status
E = Message

Modify: ?

Note: See ANSI 7.2.3

**RdDefect (1.00)**

Input: A = LUN + ID
B = 000PGDLF

Output: A = SCSI Status
D = Target Status
E = Message

Modify: AF, BC, DE, HL, IX, IY

Note: See ANSI 8.2.8

**GetWrk (1.00)**

Input: -

Output: HL = IX = Start of work area

Modify: AF, BC, HL, IX

Note: -

**PartInfo (1.00)**

Input: A = drive #

Output: HL = IX = start of work area desired drive

Modify: AF, BC, DE, HL, IX

Note: -

**GetUnitsOn (1.00)**

Input: -

Output: A = # of Units online
C = ID vector
D = HOST ID

Modify: AF, BC, DE

Note: -

**SetHOST_ID (1.00)**

Input: A = HOST ID (4-7)

Output: Carry is set when error occurred

Modify: AF, D

Note: -
Name : SetTargetID (1.00)
Address : 07fceh
Description : Set Target ID (0-3)
Input : A = Target ID (0-3)
Output : Carry is set when error occurred

Name : GetTargetID (1.00)
Address : 07fd1h
Description : Get Target ID
Input : -
Output : A = Target ID
Modify : AF
Note : -

Name : GetHOST_ID (1.00)
Address : 07fd4h
Description : Get HOST ID
Input : -
Output : A = HOST ID
Modify : AF
Note : -

Name : GetSense (1.00)
Address : 07fd7h
Description : Get Sense data
Input : A = LUN + ID
Output : A = Sense Key
B = Sense Code
C = Additional Sense Code
D = Target status
IX = Sense data address
Modify : AF,BC,DE
Note : This does the same as the ReqSense call except all necessary information is loaded into registers.

Name : MedRemoval (1.09.03)
Address : 07fdah
Description : Prevent Allow Medium Removal
Input : A = LUN + ID
B = 0, allow removal
B = 1, prevent removal
Output : A = SCSI Status
D = Target status
E = Target message
Modify : -
Note : See ANSI 8.2.4

6.2 - Additional NOVAXIS info

Address Description
07ff0h NOVAXIS ROM ID (ASCII) - 'KMcs'
07ff4h ROM type (byte)
0 = MSX2, 1 = Turbo-R, 2 = MSX2/Turbo-R
07ff5h Version # High (BCD) - currently 1
07ff6h Version # Low (BCD) - currently 51
07ff7h Default HOST ID (byte)
b0h = 7, b1h = 6, b2h = 5, b3h = 4
07ff8h Base I/O (byte) - 1Ch, 24h, 34h, etc.
07ff9h - 07fffh Reserved for future use

6.3 - Disk Parameter Block

+00h - Drive #
+01h - Media ID
+02h / 03h - Bytes / sector
+04h - Directory mask
+05h - Directory shift
+06h - Cluster mask
+07h - Cluster shift
+08h / 09h - First FAT sector
+0ah - Number of FATs
+0bh        - Number of directory entries
+0ch / 0dh  - First data sector
+0eh / 0fh  - Number of clusters + 1
+10h        - Sectors / FAT
+11h / 12h  - First directory sector
+13h / 14h  - FAT-address (not used)
6.4 - Layout of Work Area

The work area consists of 6*8 bytes, which means 8 bytes for each logical drive.

Entry:

+00  P00FXTAR
  | |+++------ Target ID
  | |+-------- normally 1, can be reset after DSKIO
  | +-------- Formatted, 1 = partition not (MSX) formatted
    +---------- Partition Enable, 1 = enabled

+01-03 First sector in partition
+04-05 Number of sectors in partition

+06  W0000NNN
  | +++------ Network Write ID
  | +---------- Write Protected, 0 = write protected

+07  F00000HM
  | |++++-- MSX type, 0 = MSX2/2+, 1 = Turbo-R
  | |+-------- Multiple HDD support, 1 = on
  | |---------- Fast RAM transfer (currently not used)

6.5 - An example in BASIC

10 ' Only for use with Uwe Schroeder like BIOS
20 ' and SCSI interface being the first diskdriver
30 ' The routine checks for "D" at #7F81 only
40 ' It will stop and start the motor of your harddisk
50 ' This stop/start sequence is not working on all harddisks
60 ' Henrik Gilvad
70 '
100 CLEAR200,&HD000
110 DEFINTA-Z
120 A=&HD000:DEFUSR=A
130 READA$:IFA$<""$THENPOKEA,VAL("H"+A$):A=A+1:GOTO130
140 PRINT"Now turning the motor OFF"
150 A=USR(0)
160 PRINT"Press any key to turn it ON again."
170 Z$=INPUT$(1)
180 A=USR(1)
190 PRINT"That was all.";END
200 DATA 3A,22,FB,21,81,7f,CD,0C,00,FE,44,c0
210 DATA 3a,22,fb,26,40,CD,24,00,3A,F8,F7,47
220 DATA 3E,08,CD,B0,7F,AF,26,40,C3,24,00,$
6.6 - An example in ML

This example reads a sector. It does this only when the interface is in slot 1-0. If you want to have this demo program runned on all computers, you need to add a search-routine like the one on the disk supplied with your interface.

; EXAMPLE.GEN - Example of programming NOVAXIS SCSI BIOS
; Written by Jurgen Kramer - 05/06/95 -
; This program is merely a example how to use the NOVAXIS SCSI calls

ENASLT  equ  0024h
EXPSLT  equ  0fcc1h

org 0c000h

; use SRCHROM.GEN and CHKVER.GEN to get the right slot ID and NOVAXIS
; version number or see NOVAUTIL.MAC for an complete example.
; Assume NOVAXIS SCSI BIOS is installed in SLOT 1-0

begin:  ld a,1 ; Slot ID
ld h,40h ; ROM starts at 4000h
call ENASLT ; Enable ROM

; This example reads logical blocks from SCSI device with ID 0
ld a,0 ; SCSI ID 0, LUN 0
ld c,0
ld de,0 ; Logical block # 0
ld b,1 ; Read 1 block
ld h1,0c100h ; Transfer address
call 07f89h ; RdLogBlk
inc d
dec d ; Status GOOD ?
jr nz,RdError

Exit: ld a,(EXPSLT) ; Get slot ID of BASIC
ld h,40h
call ENASLT
ret

; An error occurred, find out what's wrong
RdError:
ld a,0 ; SCSI ID 0, LUN 0
call 07fd7h ; Request Sense
inc d
dec d ; Status GOOD ?
jr nz,Exit ; Device is not accessable

; Now register A contains SCSI Sense Key
and a ; No Sense?
jr z,Exit
cp 2 ; Not Ready?
jr z, Exit

cp 6 ; Unit Attention?
jr nz, Exit

; Register B contains the Sense Code
ld a, b ; Power on?
jr nz, Exit

; Register C contains the Additional Sense Code
ld a, c
and a
jr nz, Exit

; Now you could retry the read operation
jr Exit ; In this example just exit

6.7 - An example in ASCII-C (version 1.2)

Because ASCII-C is not used by many people we have decided to put this example only on the disk. You can find it in the directory HDDINFO.
CHAPTER 7 - UTILITIES

7.1 - Low Level Format

One utility on the disk is the Low Level Formatter (NFRMDSK). It will look like this:

```
NOVAXIS SCSI HDD Low-Level Formatter version 1.04
(c) 1994-1995 KMcs
Written by Jurgen Kramer - 06/04/95 -
Number of Units online : 1           HOST ID : 7            Taget ID : 0
------------------------------------------------------------------------
SCSI ID #0 - IBM
!! please wait !! please wait !!
Depending on your disk capacity,
Formatting may take one minute
to several hours
!! please wait !! please wait !!
------------------------------------------------------------------------
[ESC] - Quit to DOS      [ENTER] - format a drive
Busy formatting...

This utility is to be used to format hard disks. Usually you will never need it, but
sometimes it might be usefull and even necessary to get a hard disk working.

Not all hard disks will support the format-routine this program calls.

7.2 - LOCK

A utility designed to prevent ejecting a disc from a CD-ROM or other removable-media
drive by pushing the drive’s front panel button. Note: not all removable-media drives do
support this option.

Example :

A:\LOCK 3

This will lock the device with ID 3.
7.3 - UNLOCK

A utility which is the opposite of LOCK; it “unlocks” a CD-ROM or other removable-media drive, permitting the disc to eject by pushing the drive’s front panel button.

Example:

A:\UNLOCK 3

This will unlock the device with ID 3.

7.4 - MAP

The utility to map a certain partition on a certain hard disk to a certain logical drive making it possible to break the 192 MB border.

Example:

A:\MAP A 1 4

This will MAP partition 4 on the hard disk with ID1 to drive A. Drive can not be one of the floppydrives.

A list of all partitions on a certain hard disk can be obtained as follows:

A:\MAP -L 2

This will give a list of all partitions on the hard disk with ID2. In case you do not have a hard disk with ID2 the utility will quit with the message “Invalid target ID”.

Typing MAP without argument gives some help information.
APPENDICES

A. PROBLEMS

Problems with MSX2 machines running at 7 MHz.

Some MSX2 computers which have been upgraded to 7 Megahertz will give problems if the 7 Megahertz is enabled and the SCSI interface is inserted. All kind of problems may appear: no boot, many errors, etc. This problem is likely to occur only when you have an old hard disk, an interface with NOVAXIS 1.5 ROM and 7 Megahertz enabled.

The only solution to the problem is to get a step back with one of the components. Not using 7 Megahertz is the easiest solution. Another solution is to buy another hard disk (newer) and the final solution is to keep working with 7 Megahertz and the old hard disk but now use NOVAXIS 1.0 ROM. This ROM is less sophisticated, but still very useful.

These problems mostly appear on Philips computers. The computers from Sony seem to have less problems.

Problems with an RS232C interface

MSX was never developed to work with speeds you are forcing it to work now. The SCSI interface is almost operating at your MSX top-speed. Connecting an RS232c interface which is mostly connected to some high-speed modem is asking to much from the computer. It will give transmission errors (either the SCSI interface, the RS232c interface or both) and sometimes will not operate at all.

Some people are lucky. They are working with this combination of interfaces and do not have problems at all. You cannot damage your computer trying it, but we can not give any guarantee it will work correctly.
Hard disk starts normally and is initialized ok, but never goes to load MSX DOS 2.x. This mostly will happen after the drive is partitioned again. The answer is:

Start with the hard disk attached and search which driveletter is the floppydrive. If you have made two partitions the driveletter will be "c:," if you made three partitions it will be "d:," etc. Type the command CALL CHDRV("floppydrive:"; <return> in BASIC and copy the files COMMAND2.COM and MSXDOS2.SYS from the MSX DOS 2 bootfloppy to the A-partition of your hard disk. Now start again and you will see MSX DOS 2.x booting up..

Even after trying the above solution my problems are not solved.

This is a tough one. It could be a broken hard disk, but also a jumper problem. Both are equally difficult. A broken hard disk is mostly not repairable. Jumper problems could be fixed if you have the documentation by your hard disk.

My set keeps showing the message "waiting......." and eventually is replaced by the message 'host interface selftest failed, SCSI bus is down'

This means one of the parts is not connected in the right way. Check everything, and try to start again.
B. SCSI Message codes

00h - COMMAND COMPLETE
01h,xx,00h - MODIFY DATA POINTERS
* 01h,xx,01h - SYNCHRONOUS DATA TRANSFER REQUEST
* 01h,xx,03h - WIDE DATA TRANSFER REQUEST
02h - SAVE DATA POINTERS
03h - RESTORE POINTERS
04h - DISCONNECT
05h - INITIATOR DETECTED ERROR
06h - ABORT
07h - MESSAGE REJECT
08h - NO OPERATION
09h - MESSAGE PARITY ERROR
* 0ah - LINKED COMMAND COMPLETE
* 0bh - LINKED COMMAND COMPLETE (WITH FLAG)
0ch - BUS DEVICE RESET
* 0dh - ABORT TAG
* 0eh - CLEAR QUEUE
* 0fh - INITIATE RECOVERY
* 10h - RELEASE RECOVERY
* 11h - TERMINATE I/O PROCES
* 20h - SIMPLE QUEUE TAG
* 21h - HEAD OF QUEUE TAG
* 22h - ORDERED QUEUE TAG
* 23h - IGNORE WIDE RESIDUE
80h - 0ffh - IDENTIFY

C. SCSI Target STATUS (HDD)

00h - GOOD
02h - CHECK CONDITION
* 04h - CONDITION MET
08h - BUSY
* 10h - INTERMEDIATE
* 14h - INTERMEDIATE CONDITION MET
* 18h - RESERVATION CONFLICT
* 22h - COMMAND TERMINATED
* 28h - QUEUE FULL
D. SCSI Sense Keys

<table>
<thead>
<tr>
<th>Sense Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0h</td>
<td>NO SENSE</td>
</tr>
<tr>
<td>1h</td>
<td>RECOVERED ERROR</td>
</tr>
<tr>
<td>2h</td>
<td>NOT READY</td>
</tr>
<tr>
<td>3h</td>
<td>MEDIUM ERROR</td>
</tr>
<tr>
<td>4h</td>
<td>HARDWARE ERROR</td>
</tr>
<tr>
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E. SCSI-Sense-codes

The first column shows the sensecode, the second the additional sensecode and the third a description by these sensecodes.

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<td>UPDATED BLOCK READ</td>
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<tr>
<td>5A 00</td>
<td>OPERATOR REQUEST OR STATE CHANGE INPUT (UNSPECIFIED)</td>
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<tr>
<td>5A 01</td>
<td>OPERATOR MEDIUM REMOVAL REQUEST</td>
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<tr>
<td>5A 02</td>
<td>OPERATOR SELECTED WRITE PROTECT</td>
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<tr>
<td>5A 03</td>
<td>OPERATOR SELECTED WRITE PERMIT</td>
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<tr>
<td>5B 00</td>
<td>LOG EXCEPTION</td>
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<tr>
<td>5B 01</td>
<td>THRESHOLD CONDITION MET</td>
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<tr>
<td>5B 02</td>
<td>LOG COUNTER AT MAXIMUM</td>
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<tr>
<td>5B 03</td>
<td>LOG LIST CODES EXHAUSTED</td>
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<td>5C 00</td>
<td>RPL STATUS CHANGE</td>
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<tr>
<td>5C 01</td>
<td>SPLINDLES SYNCHRONIZED</td>
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</tr>
<tr>
<td>5C 02</td>
<td>SPLINDLES NOT SYNCHRONIZED</td>
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<tr>
<td>60 00</td>
<td>LAMP FAILURE</td>
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<tr>
<td>61 00</td>
<td>VIDEO ACQUISITION ERROR</td>
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<tr>
<td>61 01</td>
<td>UNABLE TO ACQUIRE VIDEO</td>
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</tr>
<tr>
<td>61 02</td>
<td>OUT OF FOCUS</td>
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</tr>
<tr>
<td>62 00</td>
<td>SCAN HEAD POSITIONING ERROR</td>
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63 00 END OF USER AREA ENCOUNTERED ON THIS TRACK
64 00 ILLEGAL MODE FOR THIS TRAC