



















## 2. Drive start

To read and write data, a HDD has to pass successfully the startup procedure that consists of several initialization stages (the subdivision is conventional, based on data recovery experience of the utility developers):

- ◆ Microcode loading from ROM to the electronic board RAM and its subsequent execution.
- ◆ Polling of connected magnetic heads.
- ◆ Spindle motor start and spin-up to the nominal rotational speed.
- ◆ System head positioning over the service area.
- ◆ Loading of additional microcode (ID=1xh overlays) from the service area.
- ◆ Calibration of all connected magnetic heads.
- ◆ Translator initialization.

Connect the HDD to PC-3000 and switch on power supply to the HDD. At HDD power-up its initialization program starts automatically. Once a drive passes the above stages successfully, it reaches readiness and returns correct identification information (model name, capacity and serial number). Such startup procedure is considered normal; it means that all heads are functional and there are no seriously damaged surface areas. To access drive data, you have to run the WDC Marvell utility, then - Data Extractor. The data recovery task should be created with the enabled option for automatic copying to image<sup>1</sup>. After the task is started, it is recommended to use the «Service» → «Build heads map» menu to map the HDD heads. As soon as the heads map is created, you can determine the head corresponding to the majority of BAD sectors. You may also initiate copying using specified heads.

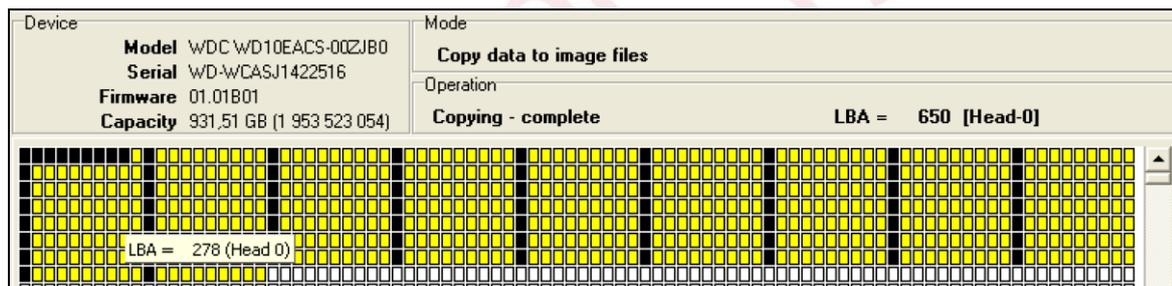


Fig. 2.1.

Now let us discuss the problems which may occur during drive startup and cause inaccessibility of user data.

Drives belonging to various families behave differently when powered on. Before you begin diagnostics, it is advisable to read the classification of Marvell WDC drives and learn their distribution between groups of families.

- ◆ Green colour in the figure below marks the drive families using classic format of module headers. We'll refer to them as MWD-CHS. MWD-CHS drive families use external boot ROM (see Fig. 2.3).
- ◆ Blue colour marks the drive families that use a new module header beginning with the «ROYL» signature but addressing the service area by PCHS coordinates. We'll refer to them as MWD-ROYL-CHS.

The families are not marked in green and blue colour marks the drive families that use a new module header beginning with the «ROYL» signature and addressing the service area by ABA coordinates. We'll refer to them as MWD-ROYL-ABA. In newer MWD-ROYL-ABA families it is built into the processor (though rare exceptions may be encountered), see Figure 2.4.

Boot-up code has its own version, which is always different from the firmware version returned in the identification data (HDD ID). E.g., version 05.04E05 may be returned in the HDD ID while the boot code version is 000500BH.

<sup>1</sup> – The copy may be created as image file (slower method) or as a sector-by-sector copy to another drive connected to standard system adapter (faster method).









### 2.1.4. Spindle motor bearing seizure

The problem can only be resolved by swapping the platter stack from a malfunctioning motor to a normal one. It is essential to preserve in such cases the orientation of magnetic disks relatively to each other with high precision. If magnetic disks are shifted or turned the firmware algorithm switching the magnetic heads will function incorrectly, and the HDD will begin knocking at an attempt to start.

## 2.2. Original ROM is missing

Such situation can be caused by a malfunctioning or damaged electronics board. Installing another board from the same drive family is insufficient to solve the problem. Correct drive start requires matching versions of firmware in drive ROM and overlays within the service data in its HDA, heads map and adaptive settings in ROM module ID=47h for all heads. Let us examine the ROM restoration algorithm further.

### 2.2.1. Step 1. Install a compatible board



Fig. 2.4.

To restore the original ROM content, you have to install a functional board belonging to the same drive family. You can use the number on PCB label to make sure the right board is selected (Fig. 2.4). Once a compatible board is installed, power is switched on and the utility is started, there are 4 possible variants of HDD behaviour.

#### Variant 1

The drive gets identified incorrectly returning its factory alias or «empty» HDD ID (Fig. 2.5); however, it does not stop the motor and after utility start allows to read the DIR module (ID = 01), as the start-up log indicates: «SA dir reading.....: Ok». In that case you may proceed to Step 2.

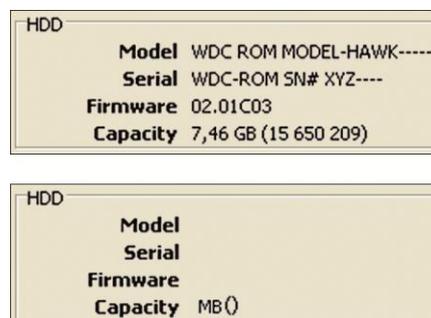


Fig. 2.5. Variations of WDC Marvell HDD identification in case of power-on initialization problems.

#### Variant 2

The drive gets identified incorrectly (Fig. 2.5), it does not stop the motor and after utility start does not allow to read the DIR module (ID = 01), as the start-up log indicates: «SA dir reading : Unknown error. Code(0)». The

problem can be caused by a mismatch between adaptive data that is too large, or firmware incompatibility with the heads controller chip in the HDA<sup>1</sup>. Recording another ROM may help in such case. After recording start the drive again and monitor its behaviour. Continue the selection process until the drive starts acting as described in the variant 1 or 4.

### Variant 3

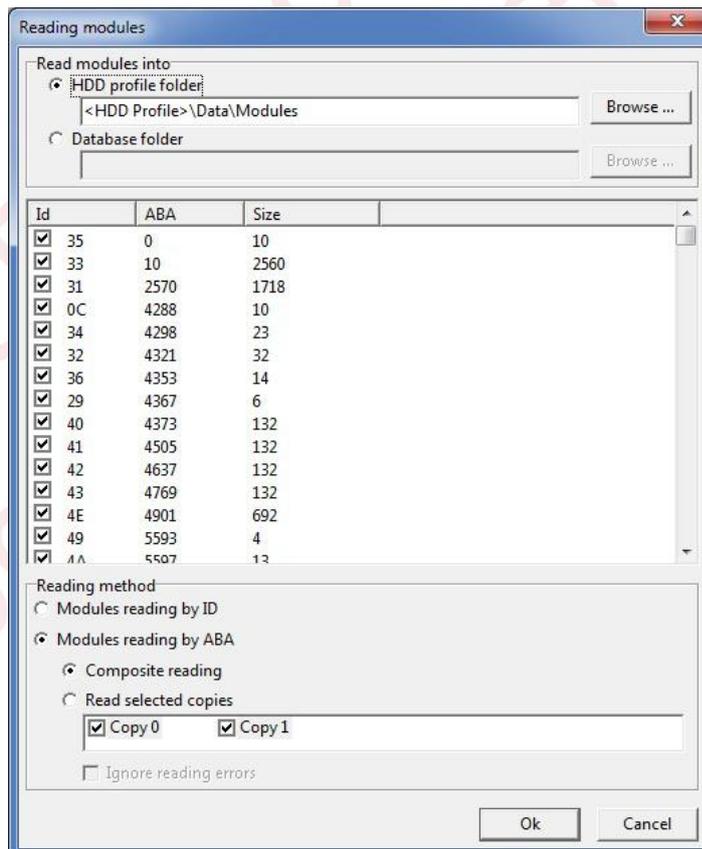
The drive gets identified incorrectly (*Fig. 2.5*) stopping the motor at that. Such behaviour can be caused by a mismatch between the heads map defined in ROM module ID=0Ah and the actual configuration. E.g., it is possible if there is a HDD with one physical head 0 while the installed board is set up for one physical head which is configured, however, under number 1. Drive start then will demonstrate behaviour variant 3. In that case you may try editing the heads map in ROM having started the utility in Kernel mode.

Another reason causing such behaviour can be in a damaged preamplifier chip of the heads stack<sup>2</sup>. You can identify chip damage by two attempts to start the spindle motor (two slight audible clicks occur). For comparison: if magnetic heads are stuck to the surface or spindle motor seizure occurs (e.g., in 2.5" HDD upper rim of the spindle motor can be bent by an indented HDA cover) the firmware performs 5 attempts to start. Replacement of the magnetic heads assembly is necessary to solve the problem.

### Variant 4

Sometimes (quite rarely) a drive may start without obvious problems and provide access to user data. Such behaviour is explained by a match between the firmware versions, adaptive settings close to the original configuration and all magnetic heads being functional and corresponding to the original map. In that case you may proceed to step 2 to restore the original ROM.

## 2.2.2. Step 2. Read modules



*Fig. 2.6 Modules reading by ID.*

<sup>1</sup> – Please note that incompatibility cases are very rare (practically encountered in the McKinley family only).

<sup>2</sup> – Quite often, damaged board electronics is combined with damaged electronic parts inside the HDA: heads controller chip, spindle motor coils, voice coil, etc.

To restore ROM, you have to read the following modules from the service area:

- ◆ ID=0109h (ROM image). It contains several modules (for example, the heads map with the default settings or firmware version module) but includes no adaptive settings module.
- ◆ ID=0102h (module containing the actual factory-defined heads map).
- ◆ ID=0103h (a copy of adaptive settings from module ID=047h).
- ◆ ID=0105h (a copy of the service area translator from ROM - module ID=030h).
- ◆ ID=0107h (a copy of module ID=00Bh that defines the map of modules present in ROM and the placement of service area copies).

You can initiate reading of the modules from the menu «Tests» → «Service information» → «Work with service area» → «Reading modules» (enable the option «Modules reading by ID» (Fig. 2.6).

If the modules have been read successfully, proceed to Step 2. Assembly of a functional ROM will be impossible if reading of any module fails. You can try picking a ROM from another HDD or «compensate» for the missing modules using the guidelines below and proceed to Step 3.

Module	«Compensation» method
ID=0109h	<p>Missing ID=0109h module can be compensated with the same module from another HDD using the same firmware version. You can check the version in the header of a suitable overlay (ID = 11h, 12h, 14h, 15h, 17h, 19h, 21h, 29h). E.g., the figure below demonstrates the header of the ID=14h overlay, version number is 005C0039. Use the found firmware with the matching version to copy from it the missing module ID=0109h and proceed to Step 3.</p> <pre> 0x0000: 52 4F 59 4C 03 00 30 00 14 00 1C 00 A7 BC 18 94 ROYL..D.....\$h." 0x0010: 00 30 35 43 30 30 33 39 01 03 08 00 00 00 2F 7B 005C0039...../{} 0x0020: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... </pre> <p style="text-align: center;"><i>Fig. 2.7.</i></p>
ID=0102h	Missing ID=0102h module can be compensated with the same module from another HDD using the same map of real (physical) heads.
ID=0103h	Missing ID=0103h cannot be compensated entirely because of the unique data it contains. However, you can borrow the module ID=0103h from another drive of the same family using the same number of magnetic heads. After the ROM restoration procedure you may try selecting the proper ID=47h module if the readability of the user data area remains poor.
ID=0105h	Typically, a missing module can be replaced with one copied from any set of modules belonging to a HDD of the same drive family. That peculiarity follows from the fact that the service area very rarely contains hidden defects in locations critical for drive start.
ID=0107h	A missing module can be replaced with one copied from any set of modules belonging to a HDD of the same drive family.

### 2.2.3. Step 3. Rebuild ROM

To assemble the modules, use the «ROM build from SA data» menu item («Tests» → «Service information» → «Work with ROM» → «ROM build from SA data»). The utility will display an offer to select a profile or database. Choose the location where the modules required for rebuilding have been copied during Step 2. Assembled result will be stored in the «ROM - Build» (Fig. 2.8) subdirectory of the profile; it can be recorded to ROM immediately without proceeding to Step 4 (but that operation is only available in Kernel mode of the utility).



### 2.3.1. Diagnostics using the ROM Head map changing feature

You can use the feature for software disabling/enabling of magnetic heads in a drive to test the functionality of each individual head. That method does not allow access to the user data because sector format includes the appropriate number of a logical head corresponding to each sector. The method is available both in Kernel and in Normal utility modes, but using it in the Kernel mode is specifically recommended. After its selection the utility reads ROM and displays on-screen form, which you can use to edit the heads map.

**Caution!** Make a backup copy of ROM content and ROM modules prior to editing the map.

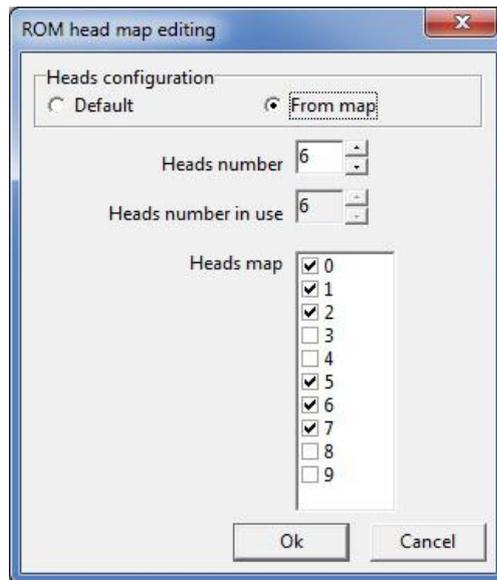


Fig. 2.9.



Fig. 2.10. Physical and logical heads numbering.

«Heads configuration» switch determines the heads map source. When the setting «From map» is selected, the utility reads the numbers of physical heads from the bit map byte in ROM (located in module ID=0Ah), while the «Default» parameter makes the utility identify the active physical heads by actual presence of connected heads. Please note, that the «Default» mode does not allow reading the map produced after the polling of existing heads (generally, you can view the generated map in RAM, but in this case the feature searching RAM for the map will find nothing).



Since you cannot know for sure, which physical head prevents the drive from starting (the map contains numbers of physical heads), try replacing all heads with the zero one (Fig. 2.14).

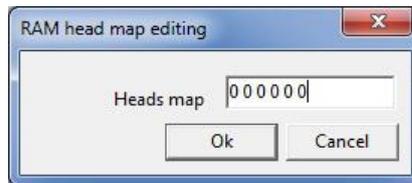


Fig. 2.14.

After the map is corrected, use the «Software Reset» command (the menu «Tools» → «HDD» → «Software Reset»). HDD will start the spindle motor and perform the initialization procedure using physical head 0 only. If it is functional, the drive will initialize successfully and return its correct HDD ID (you can check that by running the «Tools» → «HDD ID» command). If the head is malfunctioning, try changing all heads to number 1. Then again invoke «RAM head map editing» (without exiting the utility), define the original map and send a software reset signal. Now the drive is ready for data recovery.

Start «Data Extractor» and build the heads map («Service» menu → «Build heads map»). Once the heads map is created, you can recover the data using functional heads.

### Example 2. HDD of the HULK drive family

A drive after power-on knocks for a long while and then reaches readiness having stopped the spindle motor. In that case you should perform diagnostics using modification of the heads map in ROM (see section 2.3.1. *Diagnostics using the ROM Head map changing feature*). Let us assume that diagnostics has demonstrated that head 0 causes knocking while the remaining heads are functional. Then you have read all service area modules using head 1. You can check the integrity of the modules using the «Hardware modules checking» feature («Tests» menu → «Service information» → «Work with service area» → «Hardware modules checking»). Procedure:

- 1) Connect the drive with the original ROM where the map contains all heads.
- 2) At power-up the HDD spins up the spindle motor and stops it after a while.
- 3) Launch the utility. Switch the utility mode to Kernel, click the «Autodetect» button and perform «Utility start».
- 4) Select the «RAM head map editing» command («Tests» menu → «Service information» → «Work with ROM» → «RAM head map editing»).
- 5) Fill in the map as «1 1 2 3 4 5 6 7» (Fig. 2.15):



Fig. 2.15.

- 6) Use the «Software Reset» command («Tools» menu → «HDD» → «Software Reset»).
- 7) Read again HDD ID to check that the drive has been identified correctly. Start «Data Extractor» and build the heads map («Service» menu → «Build heads map»).
- 8) Once the heads map is created, you can recover the data using functional heads.



- ◆ Perform «HOT SWAP» without additional preparations (because at this stage you have just the patient's ROM) hoping to read successfully the service area tracks (modules will be unreadable altogether or many of them will be read incorrectly<sup>1</sup>). Use the «Reading service tracks» command («Tests» → «Service information» → «Work with service area» → «Reading service tracks»).

The method should only be used if the first two ways produce no result. It is less advisable because during work with tracks you have practically no way to control the integrity of modules; therefore it will be difficult to reveal after their recording to donor drive the real cause of problems with its start and proper identification.

### Donor selection guidelines for heads replacement

Comparison of the MicroJog value can be employed for the heads replacement as well. During replacement you may either use an unchanged module ID=47h from the donor HDD, or generate a module containing average values for further use.

### Step 2. Identification of the difference in the MicroJog<sup>2</sup> parameter in module ID=47h between the patient and the donor

Start the utility with the planned donor drive and select in the «Tools» menu the command «HDDs resources view and edit». Select in the displayed dialog the «ROM» tab, set the «ROM category data» selector to «ROM Module» and choose the module ID=47h. Now start the «Microjogs editor» (Fig. 2.16).

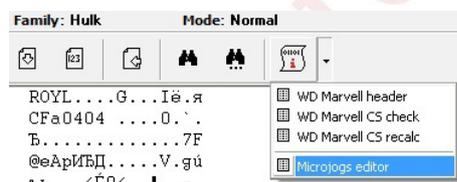


Fig. 2.16.

The dialog (Fig. 2.17) contains the MicroJog values in hexadecimal notation for each logical head<sup>3</sup> (see the footnote on page 21). Our experience tells that a discrepancy of 300 can already be too high so you have to choose a donor having as close values as possible. To estimate a donor drive fitness for a «HOT SWAP» operation, you should write to it a generated «average» module ID=47h and check whether the HDD starts using that module.

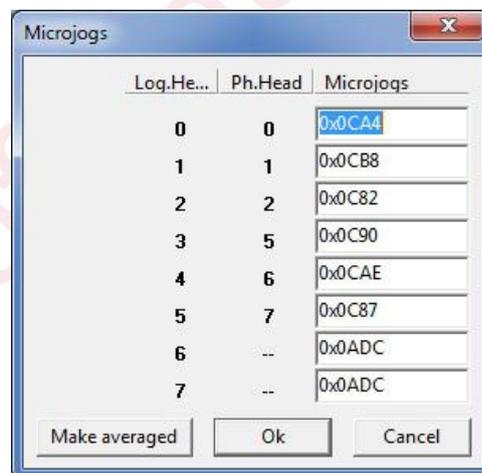


Fig. 2.17.

<sup>1</sup> – The step is determined by the fact that quite often different HDD use various locations of modules in the service area.

<sup>2</sup> – You can easily check how important the MicroJog parameter is, by changing its value in a completely functional HDD (e.g., to 100). As a result, the head used for such modification test will stop reading data although the drive will not start knocking when that head is accessed.

<sup>3</sup> – Please note that the value applies specifically to a logical head (not a physical one). E.g., if you disable in the heads map in ROM the 0 head, MicroJog values will be shifted for all heads and the value specified originally for head 0 will be used then for head 1 and so on. Deviations in drive operation will not be noticeable because the values are typically quite close.



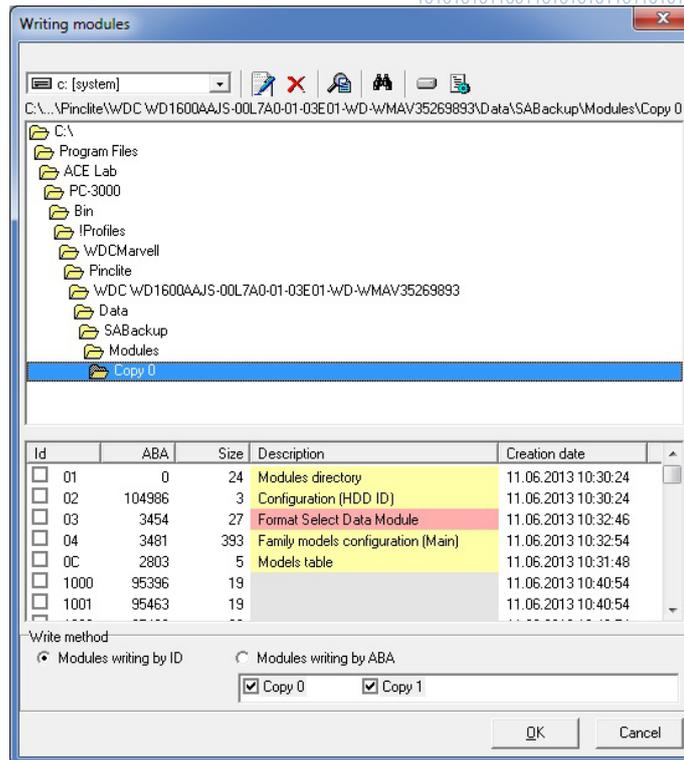
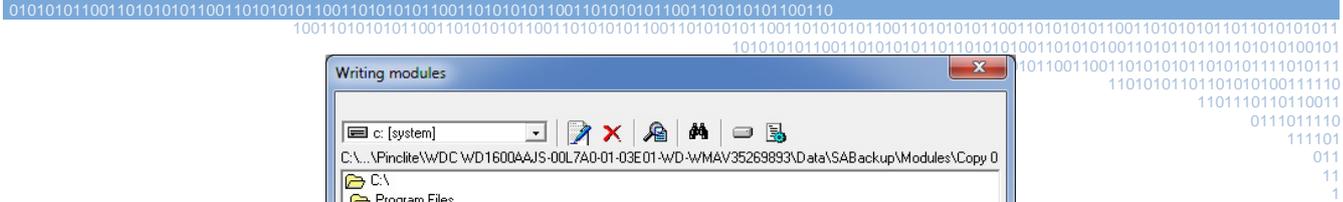


Fig. 2.18.

As the figure above demonstrates, recording is performed with the enabled «Modules writing by ID» option. After recording toggle the drive power supply off and on again and restart the utility. In this example the HDD will be identified properly after restart, but a situation is possible when a drive following the restart may be identified incorrectly (Fig. 2.5). That is caused by firmware incompatibility. You can ignore the problem.

After the module ID=01h is recorded, the drive and utility are initialized using the sizes and coordinates of the modules matching the patient drive. Now you have to record all other modules (except for ID=01h) with the enabled option «Modules writing by ID».

If you turn the power off and on again after recording modules, the drive will not start. The peculiarity follows from the fact that the service area in patient drive contains a different overlay version. Let us assume that the overlay version matches the ROM version. In that case the situation will be even worse - the HDD at power-on will turn off the motor and fail to reach readiness (because the donor and patient drives have a different number of heads). To avoid these troubles, you should either record patient's ROM to the donor board or use the patient's native board.

Restart the drive. In this example the donor starts correctly using the adaptive settings module of the patient drive, i.e. the «average» ID=47h module is not required.

**Example 2**

Patient:

Model: WDC WD10EACS-00ZJB0  
 Drive family: Hulk  
 Heads map.....: 0,1,2,3,4,5,6,7  
 Firmware version: 005C0039

Donor:

Model: WDC WD10EACS-00ZJB0  
 Drive family: Hulk  
 Heads map.....: 0,1,2,3,4,5,6,7  
 Firmware version .....: 005C0032

**Step 1:** The drive has a malfunctioning head; therefore it does not start, remains unable to reach readiness for a long time, after a while turns off all the bits in the status register.

- ◆ Launch the utility. HDD ID is not readable, ignore that and start the utility.
- ◆ Toggle the utility mode switch to Kernel and click the autodetect button. Now you can see that the HDD is ready. Start the utility.
- ◆ Read drive ROM and ROM modules to HDD profile.



recording, you should write the native ROM modules ID=0Ah and ID=47h because ROM contains the heads map and adaptive settings. Procedure:

- ◆ Back up the original ROM and the modules it contains.
- ◆ Record another ROM having a different version.
- ◆ Record the original ROM modules ID=0Ah and ID=47h.

As a result, you can accomplish readability of drive modules by ID. In that state you can also perform hardware integrity verification of the modules («Tests» menu → «Service information» → «Work with service area» → «Hardware modules checking»). To access data, you may employ editing of the heads map in RAM or the HOT SWAP method.

### Starting a HDD if the heads map in RAM is not found

Sometimes searching for drive heads cannot find their map in RAM but the service area remains readable without noticeable problems and another HDD using the same firmware version can find the heads map in RAM. You can check the service area readability by disabling one of the heads or recording another ROM version (using the methods described above).

The concept of this approach implies «substituting on-the-fly» an incompatible ID=11h with a compatible one. To start such drive, the following steps are required:

- ◆ Obtain access to the service area (e.g., by editing the heads map in ROM).
- ◆ Record the module ID=11h from a drive using another firmware version. During this stage you are very likely to encounter a situation where the length of the original module and the one being recorded do not match. You will have to use the hex editor to decrease (or increase) the module you are recording and recalculate its checksum.
- ◆ Return the original ROM to ensure the heads map is complete.
- ◆ After HDD restart the heads map will be present in RAM and available.
- ◆ Now record the original module ID=11h and while the HDD is still on, edit the heads map in RAM. Send the «Software Reset» command («Tools» menu → «HDD» → «Software Reset»).

## ■ 2.5. Correct HDD identification followed by an ABRT error at an attempt to read any sector

The situation means that the firmware is initialized incompletely. Initialization may be prevented by problems while loading a critical module or calibration of a magnetic head. In that case you should create first a backup copy of drive ROM and service area, then try the following methods (arranged by the implementation complexity):

- ◆ Switch the heads map configuration from the «From map» option to the «Default» setting.
- ◆ Recalculate the translator («Tests» menu → «Service information» → «Work with service area» → «Translator regeneration»).
- ◆ Edit the heads map in RAM (the method is described in section 2.3.2. *RAM head map editing*). The difference is in the fact that you do not need the Kernel mode of the utility to perform the procedure.
- ◆ HOT SWAP (see section 2.3.3. *HOT SWAP procedure*).
- ◆ Combination of two firmware versions (the method is described in section 3.2.5. *Firmware overlays*).

## ■ 2.6. Indicators do not display the ready status

HDD starts the motor producing regular recalibration sound, but virtual indicators do not display the ready status. Such behaviour can be caused by incorrect settings of the HDD configuration jumpers (for normal operation all jumpers must be disabled) or by a PCB malfunction (e.g., one of the pins in the IDE connector may be broken off). You should check whether the electronics board is connected properly and functional.



### 3.1.1. Module 0Ah

The module contains the heads map which must correspond to the heads in use, otherwise the HDD will not start and will not provide access to user data. To edit the map, select the «Tests» menu → «Service information» → «Work with ROM» → «ROM Head map changing».

### 3.1.2. Module 47h

Information in that module (boot adaptive data) is used to configure the electronic components for work with the service area. The module is critical for drive start and unique for every HDD. The utility allows work with the module in the «Microjogs editor» plug-in for the hex editor.

**Warning!** Module checksum must be recalculated after modification of the values.

### 3.1.3. Module 30h

The module contains the coordinates of defective sectors within the service area (SA translator). Typically it contains no defects, but you may encounter exceptions.

### 3.1.4. Module 0Bh

The module contains the map of module locations in ROM. It is usually the same for all HDD within the same family.

### 3.1.5. Module 0Dh

Contains the firmware version and various flags (present in drives beginning with the Unicorn family).

### 3.1.6. Module 4Fh

The module is present in drives beginning with the Pinnacle family. It is likely to contain just the firmware version. The module is informational; its content does not affect logical access.

## 3.2. Service area modules critical for HDD start

Service area of a HDD is subdivided into modules, i.e. portions of binary code with a header, unique identifier and checksum. Some modules are necessary for HDD operation while others are used in the manufacturing process.

### 3.2.1. Module 01

Modules table. It contains the list of all modules including their sizes and coordinates. There are several structure types, which such modules may use. Hex editor features a plug-in for viewing of the module data (Fig.3.3).

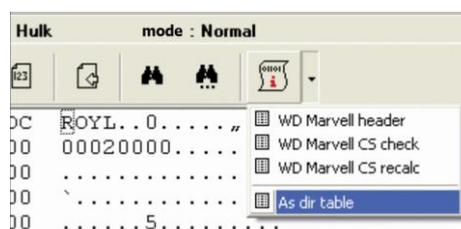


Fig.3.3.

The command for ID-based operations works in accordance with the DIR module loaded to RAM, i.e. if you try recording a module with a different length, the command will return an error. That is why you have to record first just the DIR module, restart the drive and then write the remaining modules in cases of complete replacement of drive modules using only the command for ID-based operation.



The utility supports reading and recording of the entire service area region. To do that, use the «HDD's resources view and edit» feature from the «Tools» menu (the «ABA range» tab). You can use the mode to record the whole service area for heads other than the system ones without disrupting the operation logic of the service area translator<sup>1</sup>.

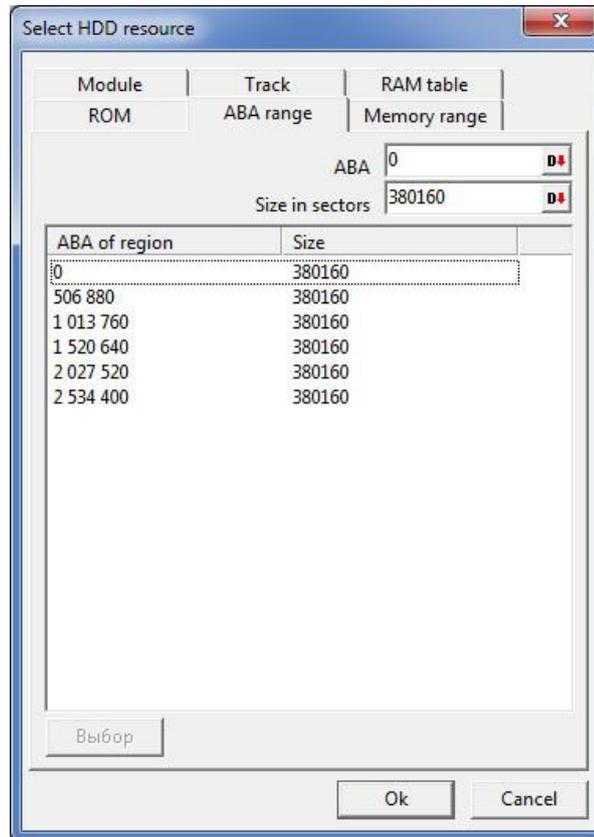


Fig. 3.6.

### 3.2.2. Module 02

Drive configuration module. It contains the HDD ID (model, serial number) and some other settings. Sometimes you may encounter a malfunction resetting the module to the default values; then such drive returns «WDC-ROM SN# XYZ----» instead of its serial number. Hex editor features a plug-in for viewing of the module data (Fig.3.7).

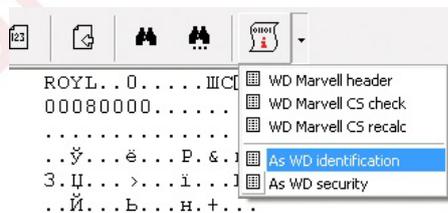


Fig. 3.7.

### 3.2.3. Module 03

This module is present in some drives only. It was introduced in the Zeus drive family. Before that the zone allocation table was built in the firmware and remained permanent for each specific firmware version. Now that the recording density depends upon the quality of magnetic heads installed in each individual drive, practically every HDD has its own zone allocation table. If the original table and the table recorded in service area do not match, a drive will either freeze during start or it will be unable to read the user data. If the module gets lost, restoring it or picking from another drive does not seem possible.

<sup>1</sup> – If you transfer the service area to another head using tracks, the hidden defects may not be taken into account and so the HDD may fail to start.



### 3.2.10. Modules 40h - 43h

Modules containing adaptive settings. Depending upon the zone allocation profile selected during manufacture, the appropriate module corresponding to that profile is used.

### 3.2.11. Module 49h

Module containing the «Mag Cal» adaptive settings.

### 3.2.12. Module 4Ah

Module containing the «MR Head Linearity» adaptive settings.

### 3.2.13. Module 4Dh

Module containing adaptive settings.

### 3.2.14. Module 50h - 53h

Acoustic profile. It is used with the command changing the HDD «noise level».

## 3.3. Modules employed during HDD manufacture only

Modules belonging to this category do not affect access to user data, but they can be used for HDD repair.

### 3.3.1. Module 33h

P-List defects list. The list is used to generate the drive translator during the «Tests» → «Service information» → «Work with service area» → «Translator regeneration» or «Tests» → «Format» procedure.

### 3.3.2. Module 28h

Module containing the factory program for internal drive testing (Self Test). To start it and monitor the results, the utility features «Tools» → «Self Test» functionality.

Module ID, hex	Description	Module ID, hex	Description
E6	Log module for the performed factory self test commands	E1	Log module for surface defects \ head 1
E7	Factory self test settings module	E9	PE Data \ head 1
EE	RRODataLog	E2	Log module for surface defects \ head 2
FA	ButterflyLog	E9	PE Data \ head 2
2D	DebugLog	E3	Log module for surface defects \ head 3
37	GainCallD GainCal Data File	EB	PE Data \ head 3
B5	WRROLogID WRRO Log File	E4	Log module for surface defects \ head 4
B8	TestClampDataID	EC	PE Data \ head 4
35	RP List File \ defect list for the service area	E5	Log module for surface defects \ head 5
46	User ARCO File	ED	PE Data \ head 5
B8	SPT Communication File	F0	Log module for surface defects \ head 6
108	IBI packet	F2	PE Data \ head 6
E0	Log module for surface defects \ head 0	F1	Log module for surface defects \ head 7
E8	PE Data \ head 0	F3	PE Data \ head 7
		8000 – 805B	Life cycle simulation test logs



Of course, we can find scripts with the other layout tests, but the essence of the division into stages does not change.

On many drives are additional scripts factory self-tests that are in modules 3B, 3C, 3D, 3E, 3F. We can view their contents with Hex-editor feature «Self test script».

## 4.2. Editing the test control record

The test control record consists of the following settings:

- ◆ **Test ID** - test number. It also matches the ID of an appropriate service area module containing the program code for the test.
- ◆ **Fnc Id** - test function number.
- ◆ **Args** - a set of arguments for the test.
- ◆ **Next** - step number where the test should proceed in case of successful completion.
- ◆ **Error** - step number where the test should proceed in case of error.
- ◆ **Fatal** - step number where the test should proceed in case of a fatal error (emergency termination).

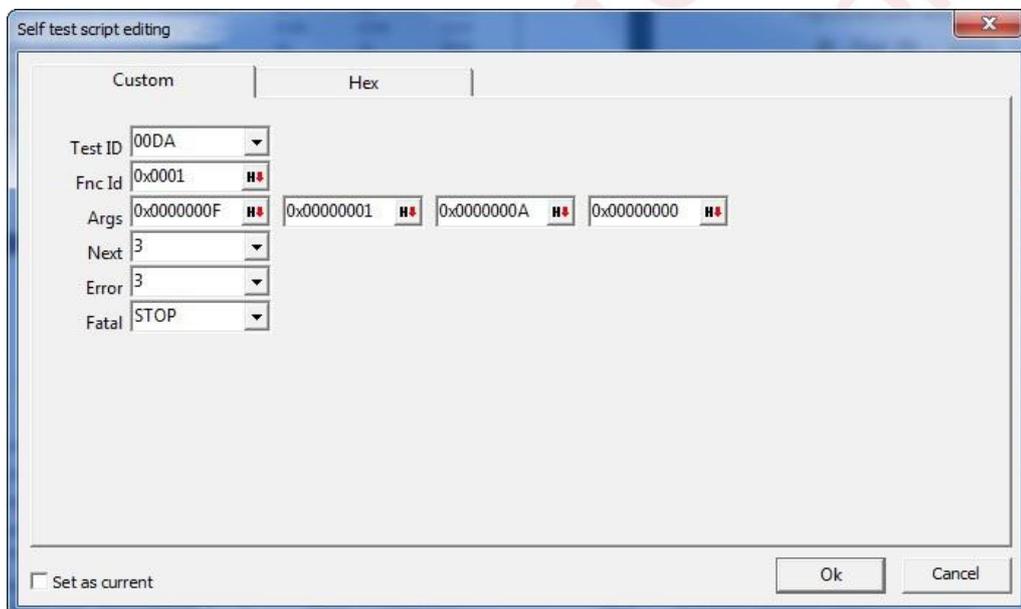


Fig. 4.2.

All bytes of the test control record are editable in the «Hex» tab. Step number marked as «STOP» is a step number variable set to 0xFFFF or -1 in int-notation.

## 4.3. Starting the factory self-testing procedure

**Warning!** Start of the factory self-testing routine will cause destruction of user data.

Before the procedure begins, the utility displays the start settings shown below (Fig. 4.3). First DC test usually expects for several minutes after start (the duration depends upon drive family and the test settings in script) before it actually begins working.



## 4.4. Monitoring current status

When status monitoring of factory self-testing is started, the «Operation» panel displays the following information (Fig. 4.4):



Fig. 4.6.

Here (left to right): ID of the current test, function number in the current test, cylinder, head, PCB temperature, read/write heads temperature.

Clicking the arrows below the displayed parameter values brings up 15 preceding values.

Actual factory testing is performed in thermostatic conditions at 50.

Since a drive does not return the current step number from the self-testing script, unambiguous detection of the current test position in script is only possible if the test's ID is used within the script just once.

## 4.5. Stopping the factory self-testing procedure

To stop self-testing, select the command to «Interrupt status monitoring» from the right-click context menu. The corresponding dialog will appear (Fig. 4.7):

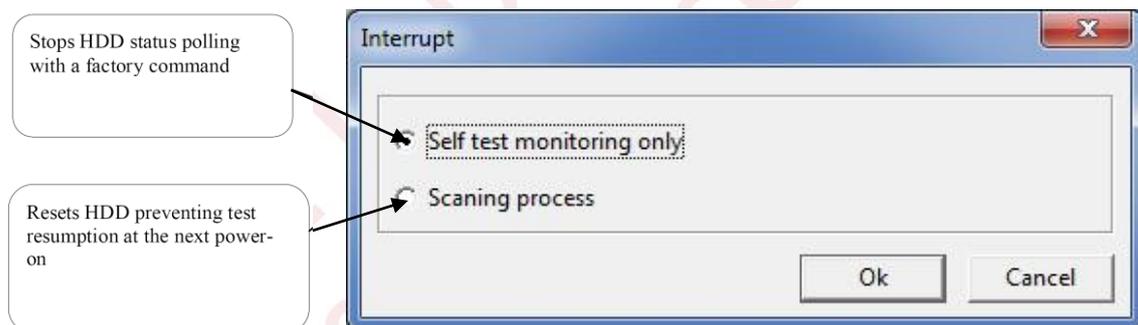


Fig. 4.7.

Switching the power off and on does not make a HDD exit the factory self-testing mode; after the power is switched on, the HDD ID will not be returned and the factory mode key sent to the HDD while starting the utility will just make such drive freeze. An alternative way to make a HDD exit the self-test mode is to send the software reset command from the menu «Tools» → «HDD» → «Software Reset».

**Attention!** When factory self-diagnostics stops, turn the drive off and on again. Failure to do so will cause the drive to respond with an «ABRT» error to all attempts to access the user data area.



## 4.7. Search the DB for compatible resources

Quite often you have to check the versions of modules available in your database. You can do that using the following methods.

### 4.7.1. Method involving utility start

You can export a specific firmware version from the database by selecting «Tests» → «Service information» → «Work with DB» → «HDD resources export». The Search button opens the search settings dialog where you can review the list of all versions in the DB (see Figure 4.11.)

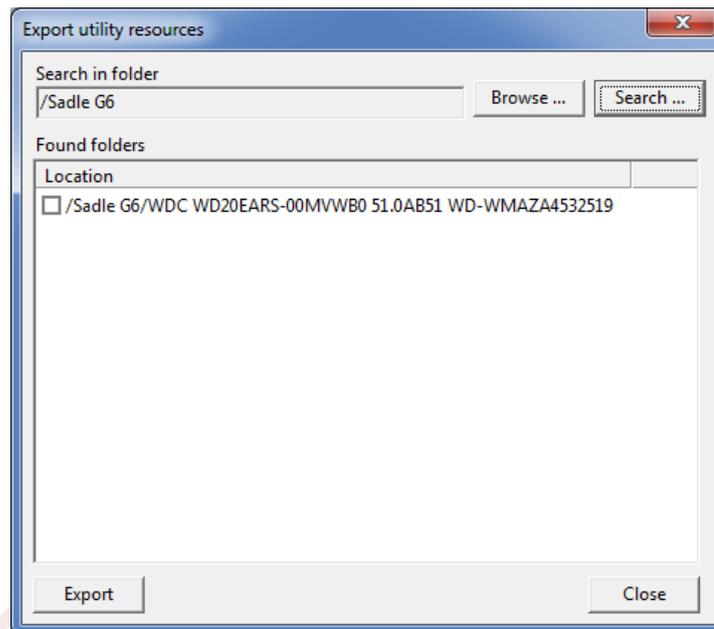


Fig. 4.10.

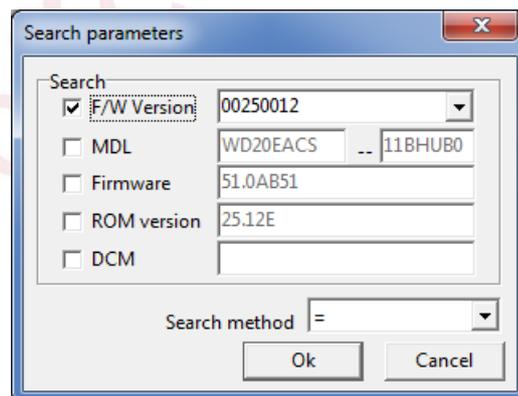


Fig. 4.11.

#### 4.7.2. Method involving the universal DB editor

Start the DB editor in the utility selection mode from the «Tools» → «Database» menu. Select the necessary manufacturer and drive family in the tree and click the Search button. The search dialog will appear (Figure 4.12). In that case the suite will search for modules matching ID=02 and Firmware version 000500AS.

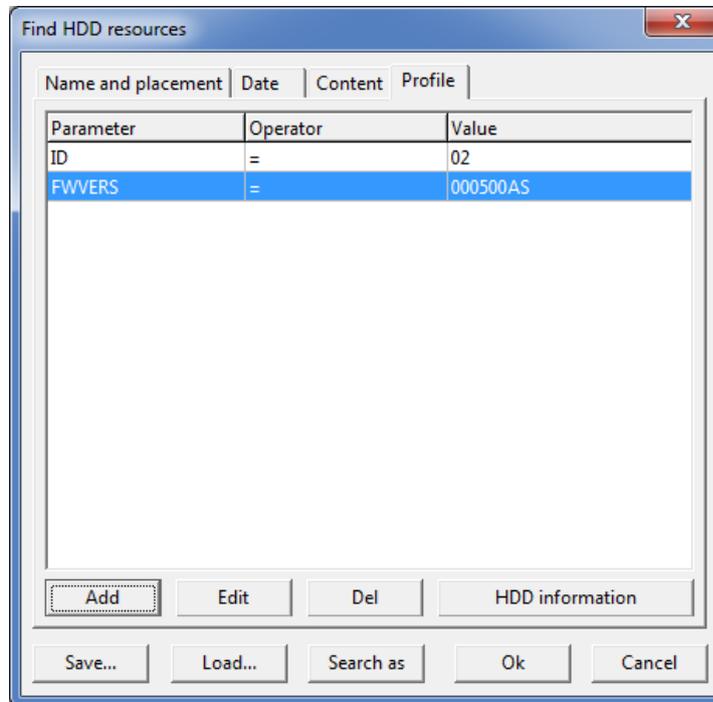


Fig. 4.12. Adding a search parameter.

#### 4.8. Automatic password removal

If a HDD is password-protected, a suggestion to disable the protection will appear when the utility starts (Figure 4.13)

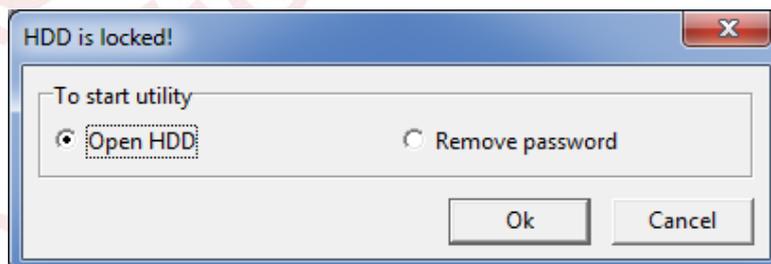


Fig. 4.13.

## 4.9. DIR editing

DIR editing is useful while solving two tasks: module relocation from an area containing defects to free space and triggering of selective loading from the service area in order to skip specific data. The mode can be invoked from the «Tools» → «Utility extensions» → «Dir editor». A module can be relocated to a free cylinder or an area in ABA range.

The utility in this mode reads and writes DIR using the command working with modules based on their ID.

## 4.10. Version control

During start the utility compares the versions of ROM and the 11th overlay. If they don't match, version will be highlighted in red (Figure 4.16). Typically, version mismatch is the reason causing incorrect HDD start. In new drive families version mismatch is a quite frequent situation; however, such drives still start correctly. It means that the versions are compatible, they are just designated differently.

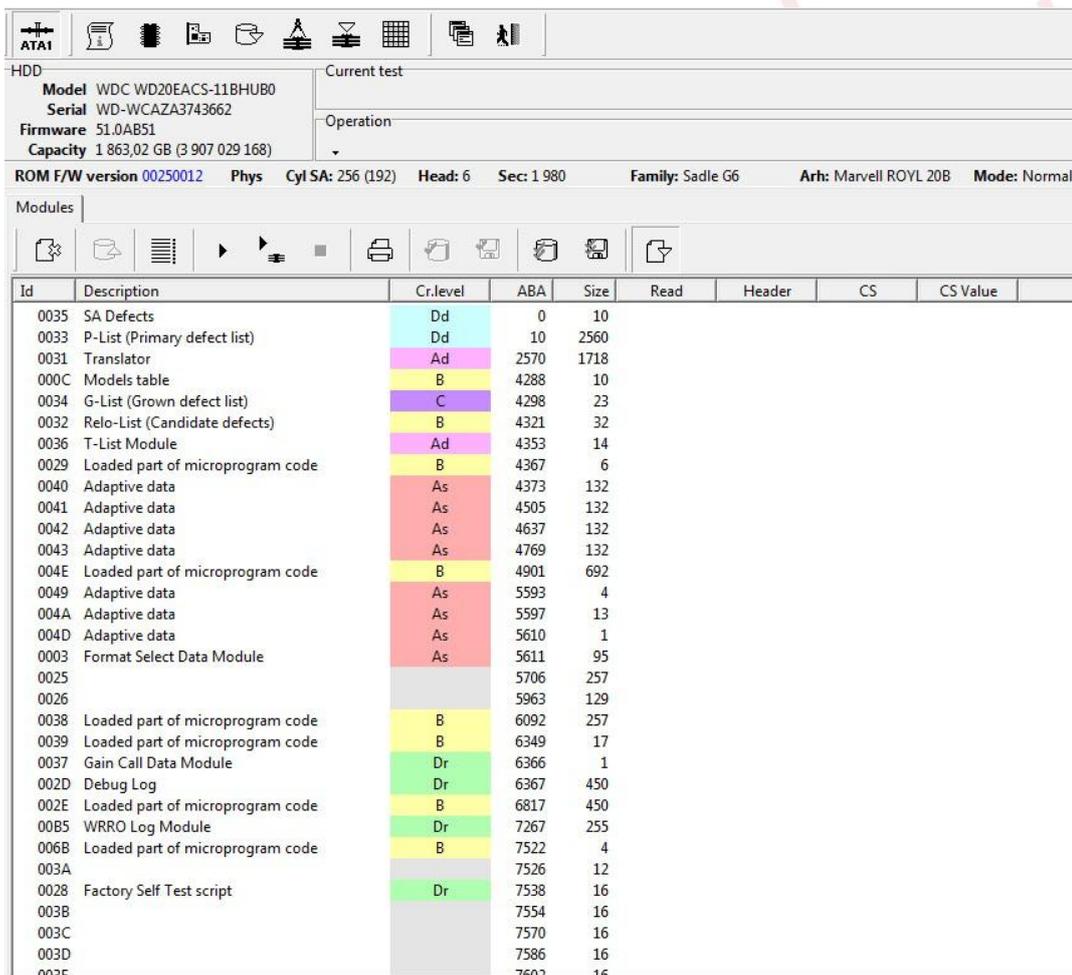


Fig. 4.14. Window appearance in the mode.

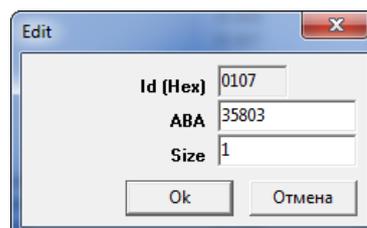


Fig. 4.15. Location editing dialog.



## 5. WD Marvell ROYL-20B architecture

*Table 1. Drive families using the 20B architecture.*

Drive family	Drive family code	Form factor
Pinnacle	B3, B4, B5, B6, B7, E2, F0, F1, F2, H4	3.5
Tahoe	M9, N0, N1, N2, N3, V0, V1	3.5
Midori	L0, L1, L2, K9	3.5
Pinclite	L6, L7, L8, L9, M0, M1, N9, J2, J3, J5, R1	3.5
DragFly1	M7, M8, N7, S9, U7	3.5
DragFly2	M2, M3, M4, M5, P6, U8	3.5
Pinnacle PATA	J3	3.5
DragFly3	Z5, P8, P9, R0	3.5
DragFly4	S1, S2, S8, T3, U1, U2, R6, H5, H7, P3	3.5
Tahoe 2D	E3, Z8	3.5
Dragon	J99	3.5
Tahoe LT	1C, YZC, UU3	3.5
Sadle G6	MVW	3.5
Shasta	K6, A02, A1J, A1N, A28	2.5
Mariner	A05, A06, A1C, A0L, A0R	2.5

WDM-ROYL HDDs with the module ID=20Bh in ROM use basically different structure of the service area. Therefore, these drives require other restoration methods. We'll refer to them collectively as WDM-ROYL-20B. Please note that in some families (e.g., Pinnacle) you may encounter firmware of the new WDM-ROYL-20B generation, as well as regular WDM-ROYL.

The main peculiarity of the new firmware generation is the fact that ABA location of the DIR (ID=01) module is no longer fixed. In all WDM-ROYL HDDs DIR always starts with ABA = 0. The module's location is specified in module ID=0Bh or in ID=20Bh. WDM-ROYL-20B firmware always contains both these modules. The opportunity for modification of the DIR module location can be used to make a freezing drive start up. However, experience has shown that sometimes this method may cause a HDD to corrupt its DIR after successful start. Therefore, it is recommended to rather perform drive diagnostics and restoration using the method described in *section 1.1*.

Another difference exists with regard to the head map editing in RAM. WDM-ROYL-20B drives require a loader, otherwise the heads map cannot be found in RAM. This peculiarity results from the fact that the command used to work with RAM is no longer present in the ROM code. It is now located in the overlay ID=11h (loader).

When the utility starts, it displays the DIR location from the active module in ROM. In the example below DIR is located in ROM modules, thus indicating the new generation of WDM-ROYL-20B firmware:

ROM Modules:

```
Flash ROM dir reading..... Ok
Flash ROM dir (ext) reading..... Ok (Active)
Modules directory address..... 377 657 (24)
```

In this case, however, DIR location is fixed, thus indicating the regular WDM-ROYL firmware:

```
Flash ROM dir reading..... Ok
Flash ROM dir (ext) reading..... Ok (Active)
Modules directory address..... 377 657 (24)
```

Please note that enabling heads in ROM one by one, to identify the normal and malfunctioning heads, is no longer possible. When a HDD detects a mismatch between the number of connected heads and the number specified in the zone allocation table, it fails to start, acting just as if the enabled head is malfunctioning.



start the utility in Normal mode and select «Tools» → «Utility extensions» → «Module search in SA». In the displayed mode window, use the toolbar to «Start search».

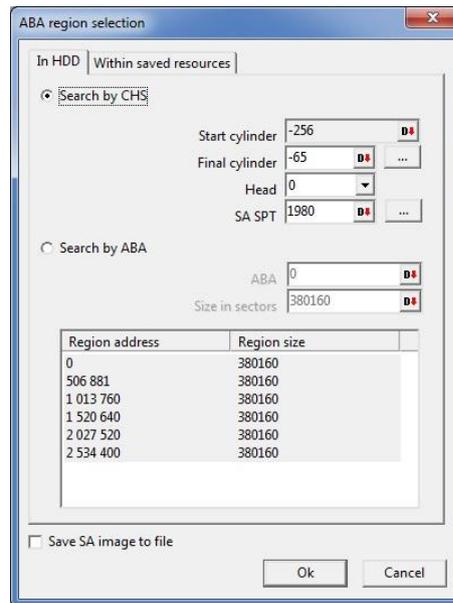


Fig.5.2. Search settings dialog.

In the displayed settings window, toggle the selection to «Search by CHS». The SA SPT will then be substituted incorrectly because it has not been identified during utility start. To identify SA SPT automatically, click the «...» button. After the search the utility displays the list of found modules. Select one of them and use the shortcut menu to «Save module 11».

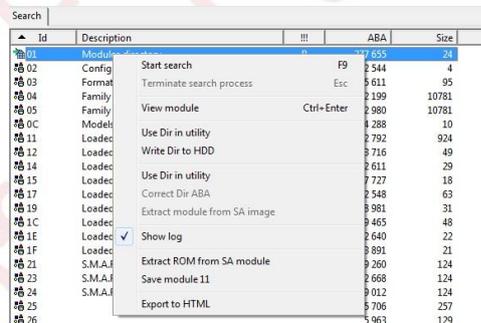


Fig. 5.3. Module search result and the shortcut menu.

**Attention!** Peculiarities of loader start. Why is setting the Kernel mode jumpers and starting a loader not possible? Setting of the jumpers prevents initialization of the appropriate executive electronic components along with the content of ROM modules. When a drive enters Kernel mode on its own upon a fatal error, it usually performs the initialization procedure and its service area becomes accessible after loader start. Sometimes, if loader start is activated internally in Kernel mode, it may freeze. The situation can be reproduced easily: disable a head in ROM or scramble the checksum for module ID=03h in both copies and restart the drive. It will enter Kernel mode and respond to loader start either by freezing, or return back to kernel mode.

- After loader start the service area will be available via ABA. The HDD itself has not loaded the DIR module. Therefore, the module search procedure should be performed in the service area. To perform the module search procedure, use the menu «Tools» - «Utility extensions» - «Module search in SA». Click the «Start search» button. Once the search is completed, click the «Use Dir in utility» toolbar button. It will enable correct operation of many features available in the utility. The DIR application operation does not write anything to the drive.

```

0100110101001101010101100110101010100110101010101001101010101010011010101010011010101010100110
101010101001101010101010011010101010011010101010100110101010101001101010101010011010101010100110
101010101001101010101010011010101010011010101010100110101010101001101010101010011010101010100110
1101010101010101001111110
110110110110011
0111011110
111101
011
11
1

```

Id	Description	!!!	ABA	Size
01	Modules directory	B	377 655	24
02	Configuration (HDD ID)	B	92 544	4
03	Format Select Data Module	As	5 611	95
04	Family models configuration (Main)	B	12 199	10781
05	Family models configuration (Alt)	B	22 980	10781
0C	Models table	B	4 288	10
11	Loaded part of microprogram code	B	92 792	924
12	Loaded part of microprogram code	B	93 716	49
14	Loaded part of microprogram code	B	92 611	29
15	Loaded part of microprogram code	R	377 777	18

Fig. 5.4. Results of ABA-based module search in the service area.

Once the DIR data is applied in the utility make a backup copy of the service area modules. Backing up ROM contents together with the modules is not advisable because the SA regions in ROM are modified. Therefore, you should use the ROM backup copy made during the step 1, i.e. before all modifications.

- 6) Having saved the entire service area, you can now attempt to identify the causes of malfunction. Running the «Solve “slow responding” problem» procedure usually helps to restore the functionality of the service area.

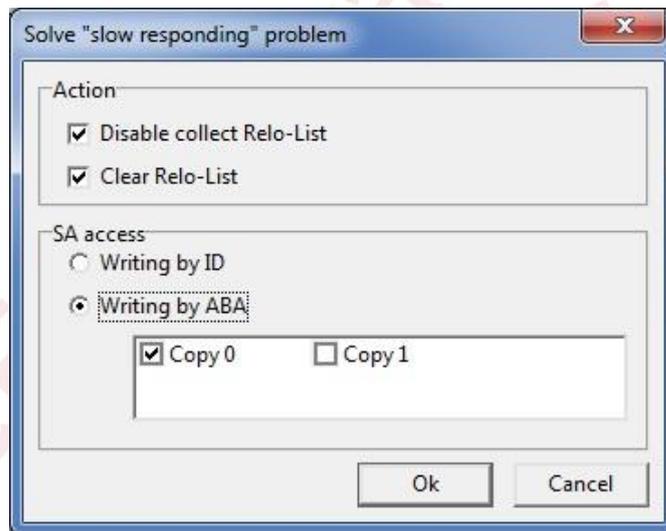


Fig. 5.5. «Solve “slow responding” problem» settings.

Prior to starting the procedure, make sure that recording to the service area functions correctly. To test this you can use the heads test or modify, in the hex editor, an unnecessary modulesuch as ID=62h, by writing it and then reading it. If the changes are recorded writing functionality is working correctly. A drive may fail to start properly for other reasons than firmware issues, such as a problem in module 03 or slow operation of a system read/write head.

Examples of the methods described above are provided below:

### 5.1.1. Example of restoration of a freezing Dragfly1 500GB

Procedure:

- ◆ Start the drive in Kernel mode.
- ◆ Use the regions editor to shift the beginning of regions 0 and 1 by 1 sector.
- ◆ Start the loader of an appropriate ROM version. An incomplete match is possible, in which case the last character in the version number may differ.





## 2.5" HDD

The situation is more complicated with 2.5" drives. In fact, a soft reset causes such HDDs to freeze completely. The problem needs to be solved in an alternative manner. In the settings of PC-3000 suite, set the «HDD Timeout» to 100 sec.

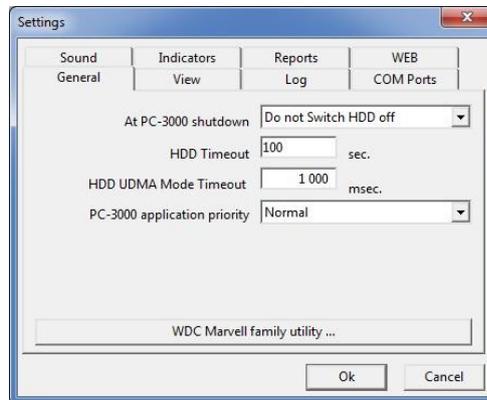


Fig.5.9.

Start the utility and wait until it reads the HDD ID. Perform automatic identification, switch the utility to Kernel mode and start it. Enter the utility and run «Tests» → «Work with service area» → «Solve “slow responding” problem».

You may also try using a different start method: lift the PCB of the 2.5” drive, wait until it reaches readiness, then lower the board and send the soft reset signal.

## 6. Board installation

What happens when another board with a matching number is installed on a WD drive instead of its native PCB?

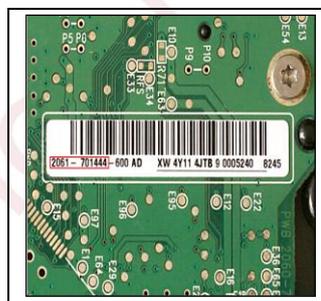


Fig. 6.1. PCB identification number.

Configuration discrepancy occurs, namely:

- ◆ Mismatch of firmware version in ROM and the service area
- ◆ Adaptive settings in ROM module ID=47h are either incompatible with the preamplifier in the had, or differ considerably from the appropriate values. When the settings are compatible with the preamplifier and differ only marginally, SA reading/writing is possible.
- ◆ Different head maps may exist in ROM (ROM module ID=0Ah)
- ◆ Differences between the service area translators (ROM module ID=30h)
- ◆ Differences in the location of SA regions and their sizes (module ID=0Bh or ID=20Bh)
- ◆ Differences in the location of the DIR module (ID=0Bh or ID=20Bh)

In drive restoration we can distinguish between two different cases of installations of a non-native board. We'll refer to them as simple and complex cases.













The HDD will not react to any command in the «busy» state. To access the service area, you have to activate the kernel mode. There is no way to enable the kernel mode only by software means, but you can physically disconnect the PCB from the preamplifier and heads positioner by inserting insulating material between the electronics board and the HDA connector (Fig.8.1Fig.8.). It is essential to leave the spindle motor contacts connected during the procedure to prevent the HDD from freezing during the motor start routine.

After inserting the insulator, switch on the power supply and, after approximately 20 seconds, the drive will reach the ready state, provided the electronic components are at least partially functional.

Launch the utility, click the «Autodetect» button and select «Utility start». The utility is started in Kernel mode. Now read the HDD ROM and save it to a profile. Open «Work with ROM» → «SA regions editor». The editor will display the content of the active module in the ROM map (ID=0Bh or ID=20Bh). Click the «Do it now...» button and select «Block SA access» in the displayed menu. Click «OK», switch off the HDD power supply, remove the insulator and attach the PCB back onto the HDA.

### Step 2

Switch on HDD power supply. Similarly to the previous step, start the utility in Kernel mode. Select the menu item «Work with service area», and view information from module ID=90h. As you can see in the utility log, information cannot be retrieved, i.e. the service area is unreadable. To restore the drive to the original condition, switch the HDD power off and on and select «Tests» → «Set kernel mode». Then select «Work with RAM» → «LDR file loading». During this step please keep in mind that you need to have a firmware copy from a HDD with the same ROM version stored as a record in the firmware database of your PC-3000 suite, or as a file. Select loading from database and click the search button. The firmware version will be substituted in the search settings. Select the found resource and click «LDR uploading». After a while the utility will display the message: «LDR has been uploaded successfully».

### Step 3

Exit the utility and reopen it. Click the «Autodetect» button and start the utility in Normal mode. After a few initialization steps you will see a dialog requesting the SA parameters (Fig. 8.3).

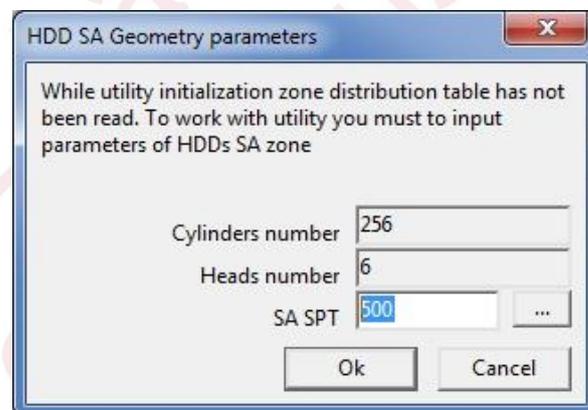


Fig. 8.3. SA parameters dialog.

Click the «...» button to detect the number of sectors in the service area. If the utility succeeds in reading the data, the actual number of sectors will appear in the SA SPT line instead of the default value of 500. Click «OK», the utility will complete the initialization procedure. Read the service area by selecting «Tests» → «Service information» → «HDD resources backup». Deselect the «tracks» option, as reading them takes quite a while and these items are not required during restoration. Typically, if a drive freezes because of one or more malfunctioning heads, the backup copying procedure completes successfully and copies all modules.

### Step 4

Check the service information structure. In the example used, all modules are displayed as intact after the test. HDD freezing is then related to problems in the automatic subsystem which searches for defects and stores them in module ID=32h. To address the problem, select «Service area» → «Solve “slow responding” problem». During the start of the procedure the utility will display the following settings window (Fig. 8.4). The solution consists of disabling shadow scanning of the disk surface and clearing of already found surface defects.

To make SA modification safer you can change just the zero copy, selecting the command to write using ABA and leaving only copy 0 selected. Then, click «OK» and monitor the progress of the procedure via the log.

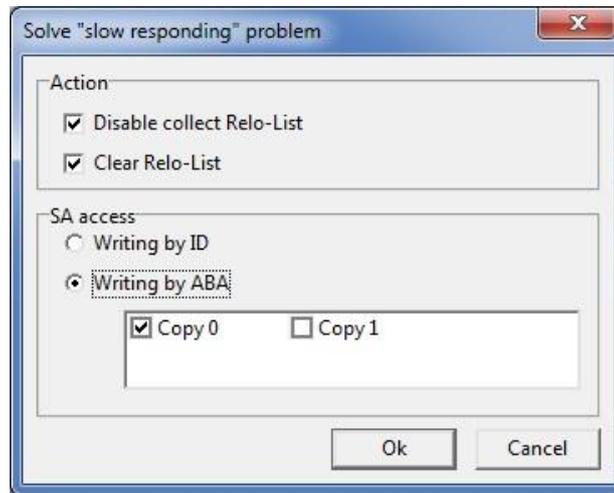


Fig. 8.4. Settings window for the slow response problem solution.

### Step 5

Now you have to allow access to the service area, which was blocked in the first step. Select «Work with ROM» → «SA regions editor», select region 0, press [F2] and restore its original location by deducting 1. Click «OK». Thus, the drive will only see copy zero of the SA containing the necessary corrections. In the example being used, drive restart resulted in it starting up correctly, providing an opportunity to copy user data. As was discovered later, the drive had been damaged approximately in the middle of the user data area, this being the cause of problems as the subsystem was hiding defects on the fly.

## 8.2. Restoring a 3.5" Saddle G6 drive

Observations: at power-on the drive fails to report on readiness. Approximately one minute after power was switched on the DRD & DSC register lights go out and the spindle motor stops. No heads knocking is audible. A malfunction of one or more heads is assumed.

### Step 1

Start the utility, having disabled HDD ID reading. The utility start mode switch will automatically be set to Kernel mode. Click «Autodetect», the utility recognizes the drive as Saddle G6 and starts up. During start up it returns the error «Debug Stop Code: HOST DEBUGSTOP RESET TIMEOUT». Read the HDD ROM and save it to a profile. Select the menu «Work with ROM» → «SA regions editor». The editor will display the contents of the active module in ROM map (ID=0Bh or ID=20Bh). Click the «Do it now...» button and select «Block SA access» in the displayed menu. Click «OK» and switch off the HDD power supply. After a short while switch the power back on and restart the utility.

### Step 2

Start the utility in Kernel mode and select «Work with RAM» → «LDR file loading». During this step please keep in mind that you need to have a firmware copy from a HDD with the same ROM version stored as a record in the firmware database of your PC-3000 suite, or as a file. Select loading from database and click the search button. The firmware version will be substituted in the search settings. Select the found resource and click «LDR uploading». After a while the utility will display the message: «LDR has been uploaded successfully». After the procedure select «Tools» → «HDD» → «Recalibration». An error will be returned during the calibration process, but the goal will be achieved: access to the service area will be available. To verify this, select the menu item «Work with service area», and view information from module ID=90h. The first two access attempts will trigger an error, but the third attempt will return the information about the number of heads and versions of some essential modules, meaning that the service area is accessible.



**Step 5**

Now you have to allow access to the service area, which was blocked in the first step. Select «Work with ROM» → «SA regions editor», select region 0, press [F2] and restore its original location by deducting 1. Click «OK». Thus, the drive will only see copy zero of the SA containing the necessary corrections. In the example being used, drive restart resulted in it starting up correctly, providing an opportunity to copy user data. As was discovered later, the drive had been damaged approximately in the middle of the user data area, this being the cause of problems as the subsystem was hiding defects on the fly.

**8.3. Restoring a 3.5" Saddle BK drive**

Observations: at power-on the drive fails to report on readiness. Approximately one minute after power was switched on the DRD & DSC register lights go out and the spindle motor stops. No heads knocking is audible. A malfunction of one or more heads is assumed.

**Step 1**

Start the utility, having disabled HDD ID reading. The utility start mode switch will automatically be set to Kernel mode. Click «Autodetect», the utility recognizes the drive as Saddle BK and starts up. During start up it returns the error «Debug Stop Code: HOST DEBUGSTOP RESET TIMEOUT». Read the HDD ROM and save it to a profile. Select the menu «Work with ROM» → «SA regions editor». The editor will display the contents of the active module in ROM map (ID=0Bh or ID=20Bh). Click the «Do it now...» button and select «Block SA access» in the displayed menu. Click «OK» and switch off the HDD power supply. After a short while switch the power back on and restart the utility.

**Step 2**

Switch the drive's power supply on. Similarly to the previous step, start the utility in Kernel mode. Select the menu item «Work with service area», and view information from module ID=90h. As you can see in the utility log, information cannot be retrieved, i.e. the service area is unreadable. Searching for a LDR with the same version returned no results, so we have to try restoring the drive without it.

**Step 3**

Edit, in RAM, the module containing the map of regions. To do this you have first have to check the utility log generated during utility start to identify the active map module. The message «Flash ROM dir (ext) reading..... : Ok (Active)» means that the active module is ID=20Bh. Otherwise (just the message «Flash ROM dir reading..... : Ok») the active module is ID=0Bh (Fig. 8.7.).

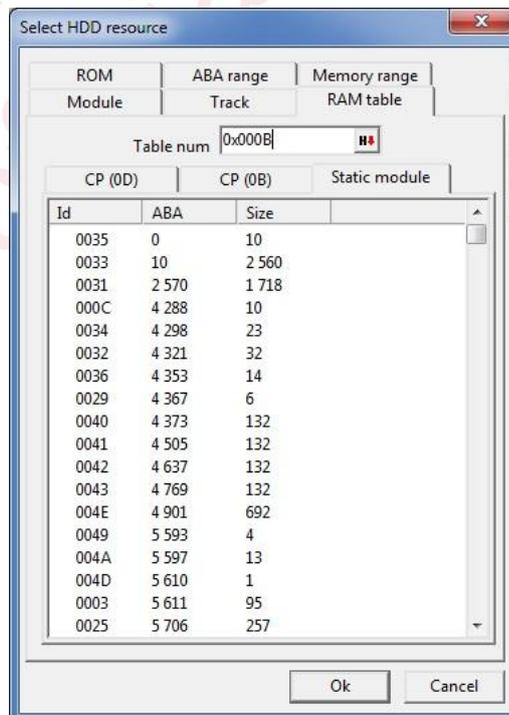


Fig.8.7. ID=0Bh module reading from RAM.



**Step 5**

In the open hex editor window containing the module ID=01h, use the commands to «Select all» and «Copy». Select «View and edit HDD resources» → «RAM table» and input 01 in the «Table num» entry line (Fig. 8.). Insert, into the read data, the copied content of the module ID=01h and save the changes. Send the HDD recalibration command.

**Step 6**

Check to ensure that the previous step completed successfully. To do this, try to read modules using their ID, for example, module ID=02h (Fig. 8.9, just input 02 instead of 90). Restart the utility in Normal mode. Make a backup copy of the modules, accessing them by ID.

**Attention!** Operations via ABA or CHS are not available.

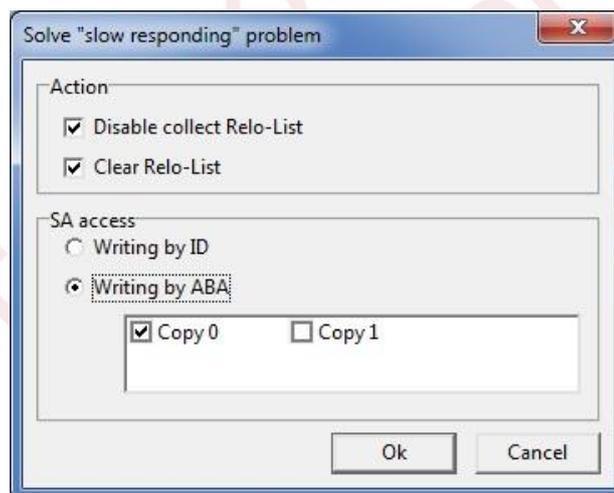
**Step 7**

Now we have the original LDR file (11.rpm) and starting from it can be attempted.

After loading of the file l the calibration command is sent. Typically, the calibration procedure completes with an error, but the disk continues to function. Operations via ABA and CHS are now available.

**Step 8**

Check the service information structure. In the example used, all essential modules are displayed as intact after the test. HDD freezing is then related to problems in the automatic subsystem which searches for defects and stores them in module ID=32h. To resolve the problem, select «Service area» → «Solve “slow responding” problem». During the start of the procedure the utility will display the following settings window (Fig. 8.10).



**Fig. 8.10.** Settings window for the slow response problem solution.

The solution consists of disabling shadow scanning of the disk surface and clearing of already found surface defects.

To make SA modification safer you can change just the zero copy, selecting the command to write using ABA and leaving only copy 0 selected. Then, click «OK» and monitor the progress of the procedure via the log.

**Step 9**

After a restart the drive still fails to start correctly. We start the LDR file (11.rpm) again. After starting with the loader we send the calibration command and discover that the drive has started up correctly. As confirmation we send a soft reset signal and gain reading access to the entire surface of the user area (LBA access).

We should note that not all Sadle G6 drives follow this behaviour pattern. Many drives return error 0101 when starting with a LDR file during step 7. However, if during step 5 a software reset command is sent instead of calibration, the drive will load, from the service area, the 11.rpm overlay and stop the loading procedure. This is because overlay initialization will trigger loading of the module ID=0Bh (or ID=20Bh) from drive ROM making the service area inaccessible for the drive again. However, the utility will be able to function without problems via ABA, providing you with a way to make the necessary corrections (e.g., address the slow response problem).