Seagate, part 1

Drive families: U Series X, U5, Barracuda I, II, III, IV, V, U Series 7, Barracuda 7200.7 (Alpine/APLUS/PUMA),7200.8, 7200.9 (Tonka2/Tonka40/Tonka15/TLite), 7200.10 (Galaxy2D, NHawk, NHawk Plus); 2.5": Momentus (Neptune), Momentus 5400.2 (Mercury), Momentus 5400.3 (Venus), Momentus 5400.4 (Corsair), Momentus 7200.1 (M72), Momentus 7200.2 (Galileo, Galileo Plus)

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1. List of supported drive families

This utility is designed to work with the following drive families:

3.5"	2.5" Momentus
U Series X / 5400.1 (C1, C2)	Momentus (Neptune)
U5 (U5)	Momentus 4200.2 / 5400.2 (Mercury)
Barracuda I (Durango)	Momentus 5400.3 (Venus)
Barracuda II (Vail)	Momentus 5400.4 (Corsair)
Barracuda III (Aspen)	Momentus 7200.1 (M72)
Barracuda IV (Snowmass)	Momentus 7200.2 (Galileo, Galileo Plus)
Barracuda V (Avalanche)	
U Series 7 (Avalanche)	
7200.7 (Alpine, APLUS, Puma)	
7200.8 (Tonka)	
7200.9 (Tonka2, Tonka40, Tonka15, TLite, TLite1HD, TLite2HD)	
7200.10 (Galaxy2D, NHawk, NHawk PLUS)	

In addition, the U Series X variation offers features that allow limited operations with earlier drive families, such as U4 / U8/10 / U6.

2. Purpose

The utility described in this document is designed to work with Seagate drives belonging to various drive families, mostly those of the Barracuda group. It also supports the U Series X (5400.1) drive family. Due to some specific features of these drives, most operations with the HDD involve using the terminal. Please see the following list of main utility features (unless specified otherwise, each feature works via the terminal):

- ROM reading/writing.
- Reading / writing of data buffers.
- RAM reading.
- Reading/writing of service area surface using PCHS.
- Hex editor for operations with SA objects (using specialized plug-ins).
- Loading of required drive firmware items using the SDLD mechanism.
- Creation and downloading of the so-called “loader” – a set of drive resources required for its initialization if the service area cannot be read in cases where you need to launch Self Test[1].
- Self Test launch and monitoring.
- Terminal for work with HDD in command mode.
- Logical scanning with defect search (via ATA).
- Reallocation of defects revealed by logical scanning and entered manually (including drives belonging to earlier families: U4 / U8/10 / U6).
- Editing of HDD ID parameters.

[1] Not available for U Series X, Barracuda I, and II drive families.

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- Wizard for password resetting (it can also be used to remove passwords from U4 / U8/10 / U6 drives). The utility uses a connection to terminal and ATA for this process.
- For U Series X and earlier drives, such as U4 / U8/10 / U6, the SA objects editor provides plug-ins designed for parsing of the modules table and an editor for CSPT (tests list and Self Test parameters).
- For drives with ATA track overlay structure identical to Barracuda IV (Barracuda I, II, III, IV, U5) the suite includes a track parser plug-in that an operator can use to automatically identify ATA overlay or CERT tables in a track image containing valid data.
- The utility provides an interface to Data Extractor for the creation of a heads map in order to perform address-based reading of data, skipping damaged areas. In some cases access to user data can even be obtained when a drive fails to reach the ATA readiness state.

Specific features of drive families including general PCB layout, most frequent malfunction types and repair methods and general structure of the service data will be explained separately. In addition, an Appendix contains a list of terminal commands for working with the HDD.

Attention! Seagate drives can function via ATA mode, or in the command mode controlled via terminal. Only one mode can be used at a time. The utility takes this into account when basic features are used, switching modes on the connected drive. Please keep in mind that if you need, for instance, to re-read the HDD ID after working in terminal mode, you should run the terminal command for the HDD to restart in order to make the drive switch to ATA mode.

3. Getting started

In order to perform operations with a Seagate drive in the utility, you have to connect it to the computer using an ATA cable (to the PC-3000 board), power supply cable (to the power supply connector of the PC-3000 board or a separate power supply unit, which must be connected case-to-case with the computer), and the cable for terminal connection to the COM port. The drive can be connected to a COM port using the PC-KALOK adapter or the PC USB TERMINAL 2 adapter (in the latter case the connection is actually established via USB, but data transfer is performed using a virtual COM port emulated by the adapter driver). Please find the schemes for drive connection to the terminal below.

3.1. Connection of Seagate 2.5” PATA (Momentus) drives to terminal

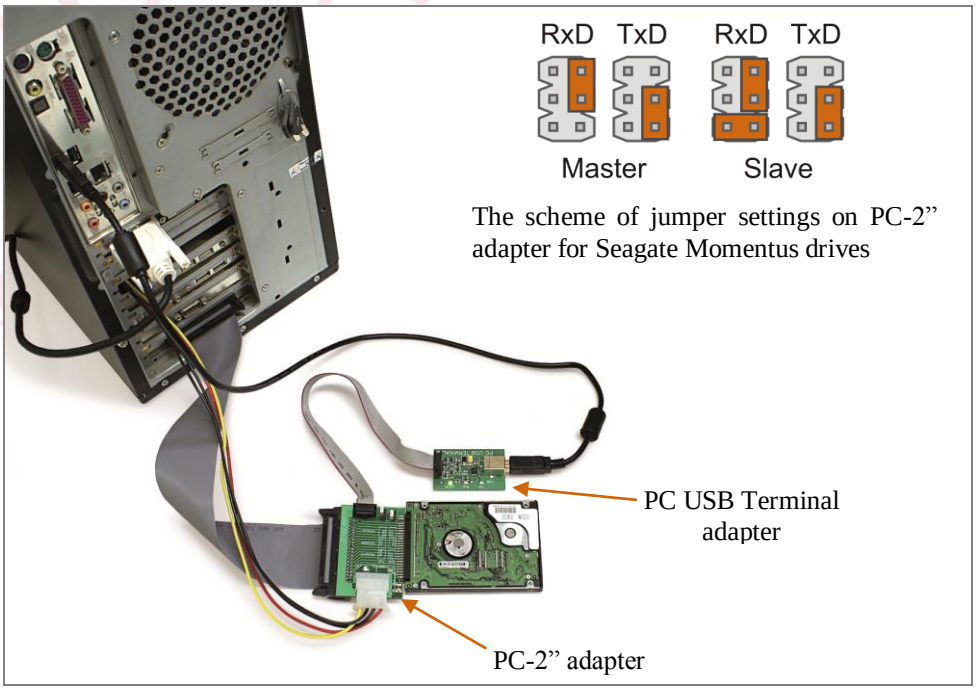

Fig. 3.1.

3.2. Connection of Seagate 3.5” PATA drives to terminal

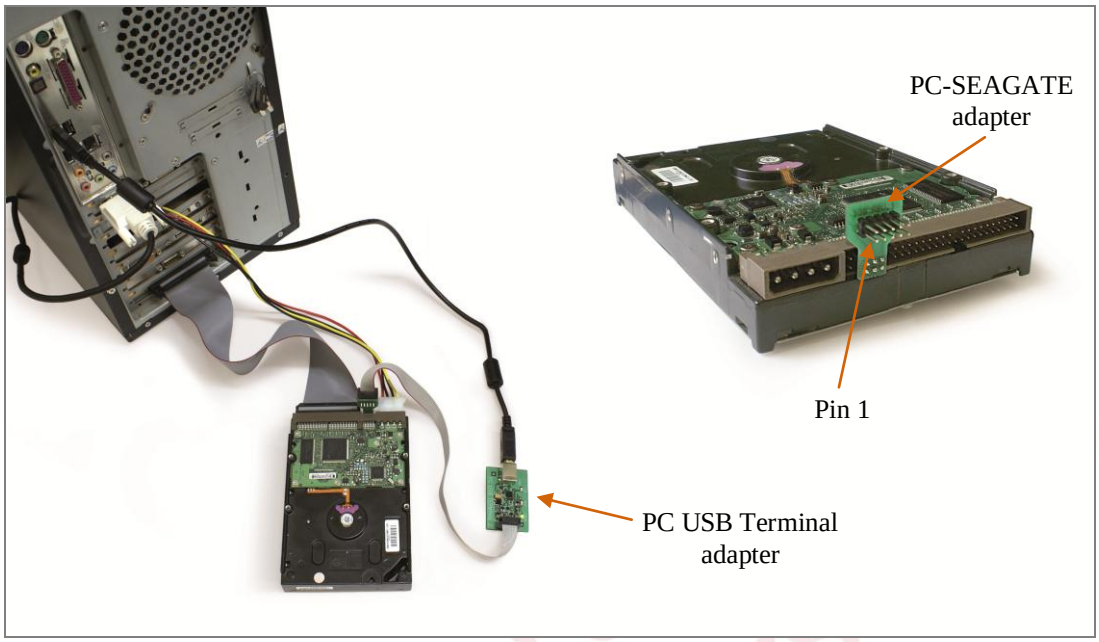

Fig. 3.2.

3.3. Connection of Seagate 3.5” SATA drives to terminal

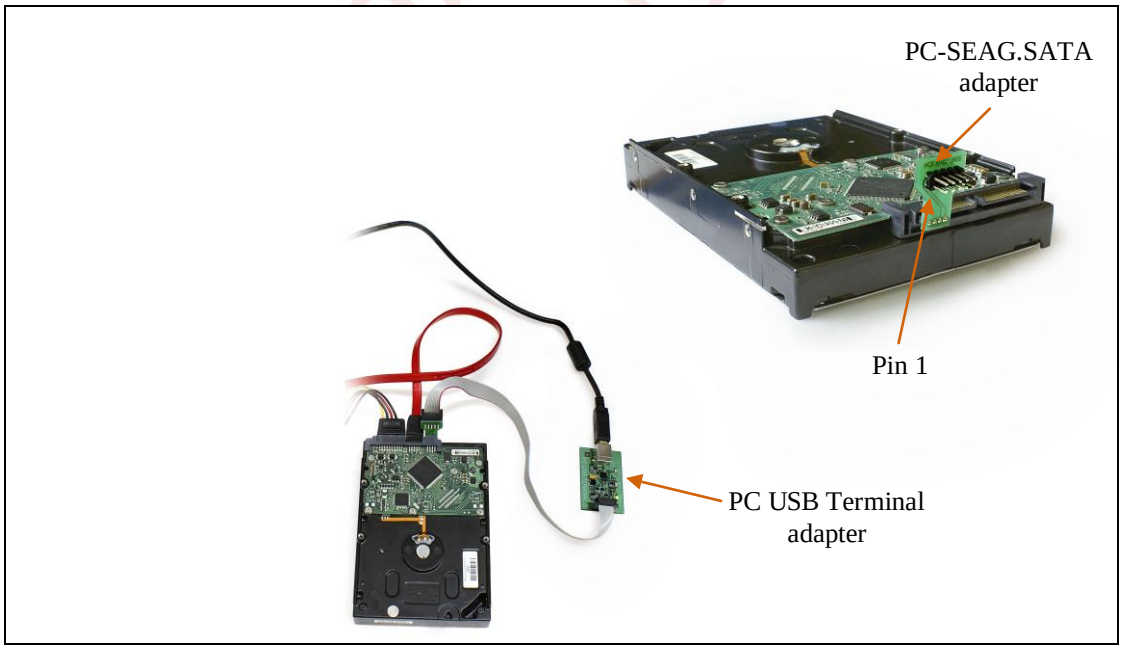

Fig. 3.3.

3.4. PC USB TERMINAL 2 adapter connection

After connecting the adapter with a USB cable to a corresponding motherboard port, run CP2101_Drivers.exe to install the appropriate driver and follow the wizard instructions. The driver installer is available both on the setup CD of the suite and in the update section of customer personal accounts on our update server. After the installation is completed, open Windows Device Manager and ensure that the installation completed correctly. First, check the presence of the main adapter chip driver in the system (please see Fig. 3.4 below).

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Fig. 3.4.

Secondly, make sure that a mini-port of the COM port emulator is installed and functioning (Fig. 3.4). Please keep in mind that the system can assign a COM port number outside the COM1 – COM4 range that the suite uses. In that case you should modify the port number in the settings. After you define the COM port number, specify it in the suite settings dialog (Fig. 3.5).

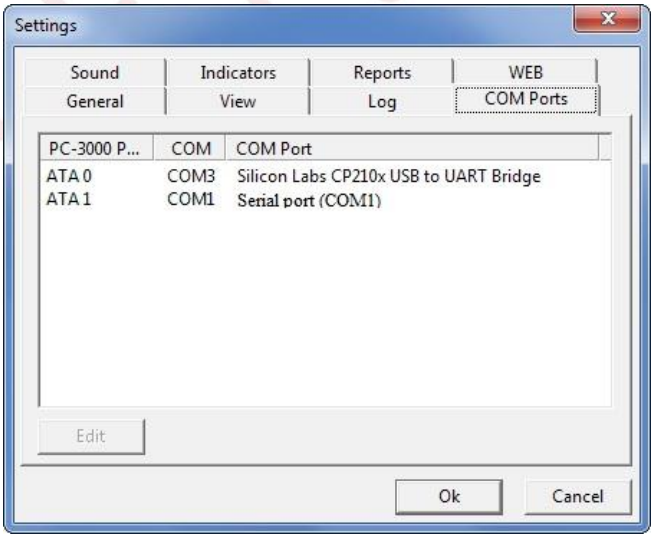

Fig. 3.5.

In addition, you can view a demonstration movie of suite setup including installation of the PC USB TERMINAL 2 adapter at http://update.acelab.ru/video/PC-3000_Installation.avi.

After the above steps are complete, the suite is ready for operation.

To begin working with a drive you are required to connect it to the adapter as described in the corresponding section above (see sections 3.1. Connection of Seagate 2.5” PATA (Momentus) drives to terminal, 3.2. Connection of Seagate 3.5” PATA drives to terminal, 3.3. Connection of Seagate 3.5” SATA drives to terminal).

3.5. Troubleshooting HDD connection via the PC USB TERMINAL 2 adapter

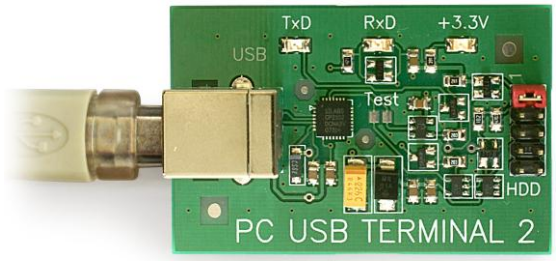

Fig. 3.6.

If a HDD does not react to terminal commands while it is known to be functional, you should check the continuity of its connection to the computer. You can check the PC USB TERMINAL 2 adapter as follows: The adapter, together with its drivers, emulates a fully-featured COM port. Thus, you can use it with any software that employs terminal access through a COM port. In particular, the HyperTerminal program included with Windows can be used for that purpose. For testing purposes, disconnect the ribbon cable plugged into the HDD and set a jumper as indicated in Fig. 3.6.

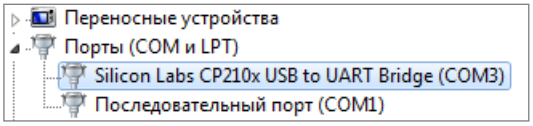

Fig. 3.7.

In system properties, within Windows Device Manager, modify the number of the terminal COM port if necessary. It should be within the COM1 – COM4 range, see Fig. 3.7.

Create a Hyper Terminal connection («Start menu» → «All programs» → «Accessories» → «Communications» → «HyperTerminal»), Fig. 3.8, and select the COM port found earlier, see Fig. 3.9.

Fig. 3.8.

Fig. 3.9.

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Configure the port to work with Seagate drives (Fig. 3.10).

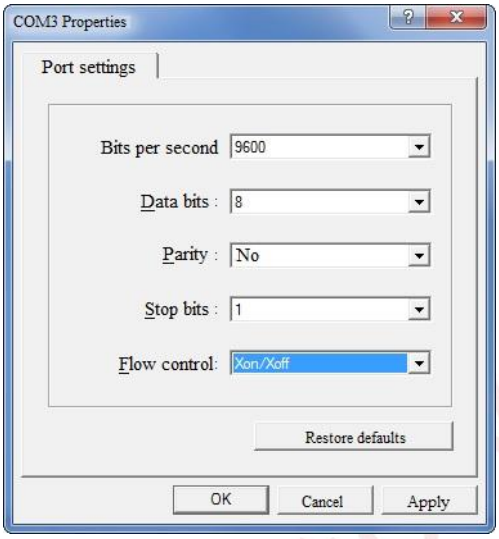

Fig. 3.10.

Once the connection is created input something using the keyboard. If the driver and PC USB TERMINAL 2 adapter function correctly, the input data will appear on the screen. If the data appears, continue testing. Otherwise, skip the next step.

Now, remove the jumper and connect the cable to a Seagate HDD. At power-on it should output a message similar to the following:

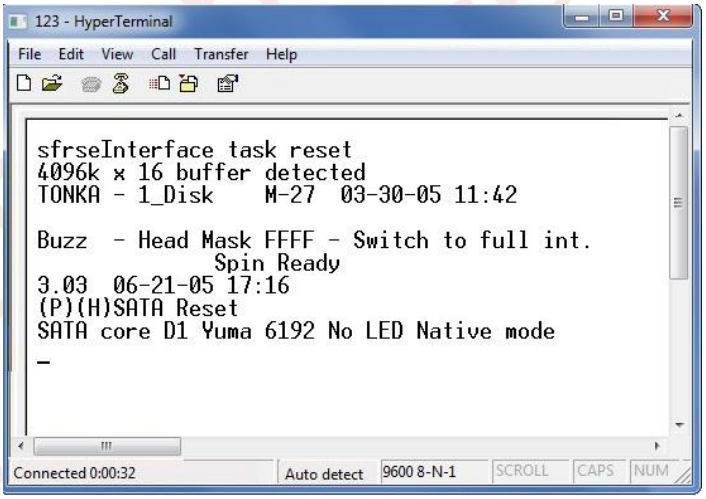

Fig. 3.11.

Pressing the «.» button on the keyboard should invoke a response from the drive.

If problems occur, examine the USB cable (a USB 2.0 cable is recommended) and check whether the USB driver supplied with the motherboard are installed (often issues are caused by universal USB drivers installed from the Windows driver library). If these steps do not solve the problem, use the method described above to check the adapter operation with another motherboard (**which must not be identical to the first one as the problem may be caused by this particular series of motherboard**). You do not need to install PC3000 on the other computer for testing. Installation of the PC USB TERMINAL 2 driver is sufficient.

3.6. Additional preparation for work

During preparation, please pay attention to the drive jumper settings. The utility functions in master HDD mode. To use the suite efficiently please read the documentation for the suite kernel, universal utility and the HEX editor (described in the corresponding documentation sections).

4. Overview of firmware structure in Seagate Barracuda drives

Service data in Seagate drives is recorded in base ROM of the processor chip on the PCB, external ROM on the PCB (there may be none, then its role is performed by shadow ROM in the processor chip) and on the disk surface tracks. Since there is no distinct modules table regulating HDD operation (HDDs use addressing in SA based on offsets precompiled in drive firmware), we do not use the concept of a module for these drives. The suite works with tracks, groups of tracks and groups of sectors within tracks. One exception is represented by some firmware objects added to the loader; their parameters are requested from a drive using various methods during loader creation (please see section *4.6.* Loader (definition), and *6.5.* Features available from the streamlined loading menu). The procedure is based on the notions of cylinder number and track index within the service area. As a matter of fact, in Barracuda drives the numbers of cylinders containing individual firmware objects are hard-coded depending on the number of the initial SA cylinder as follows: the number of a SA object cylinder can be calculated by adding the track index of that object to the number of the initial SA cylinder. Such an approach is adopted because 7200.7 and newer drive models can alter the initial SA cylinder number in the process of drive start, unique to each drive. This makes the cylinder number concept inconvenient when dealing with recording of SA objects from a donor drive.

Barracuda drives can be subdivided into two groups: drives equipped with Parallel Flash and Serial Flash. The first group includes U5, Barracuda I / II / III / IV. The second: Barracuda V, U Series 7, 7200.7, 7200.8, 7200.9, 7200.10, Momentus.

4.1. Firmware architecture in HDD equipped with Parallel Flash

Firmware in these drives consists of the following parts:

- ***Embedded code*** (base code in microprocessor ROM on drive controller board).
- ***Parallel Flash*** on the controller board. Microcode stored there is used to implement the set of basic actions required to boot a drive and also contains the main commands of the terminal mode. It is dictated by the FW version specified on the label; therefore, when replacing a faulty controller board with a borrowed donor board, you must take into account the FW version and the general layout (every drive family uses several different types of boards).
- ***List of SA objects on the disk surface:***
  - ATA overlay (containing the code for processing of ATA commands).
  - S.M.A.R.T. sectors containing S.M.A.R.T. Thresholds, Values and other S.M.A.R.T. logs.
  - HDD ID template sector, Stuff, containing basic information that makes up a HDD ID. Its structure matches the ATA specification for HDD ID. HDD ID provides data block built using Stuff as the basis, though different to it (some fields are changed in accordance with the drive status).
  - Sector containing drive PN and information about HDD ID configuration.
  - Sector containing the drive security subsystem data.
  - Defect list tracks (P-List, Alt-List).
  - Group of sectors containing zone allocation of the user data area on the drive.
  - Tracks containing drive operation logs (their readability is not required for drive operation via ATA).
  - Track containing CERT code – the code block servicing an extended set of terminal commands and Self Test (not required for drive operation via ATA).
  - Group of sectors containing CERT tables – a table of Self Test parameters (not required for drive operation via ATA)/

Caution! Prior to a Hot Swap or board replacement, check family-specific characteristics and take them into account while working with the drive. In particular, for Barracuda II, a Hot Swap from a donor drive can cause ROM reconfiguration on the donor PCB resulting in its inability to function properly. Therefore, ROM backup is advised before the procedure.

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4.1.1. Disabling heads

This firmware architecture allows you to disable heads starting from the end only, i.e. beginning with the highest head numbers. Disabling heads in the middle of a stack is not supported. Disabling is accomplished by decreasing the drive type by an appropriate number. The HDD type can be found in the report returned in response to the «;» command (e.g.: Age=50 **Type=E3** MxCyl=3015 MxHd=1 MxSct=193 BSz=0100 TCode=0000). The HDD type is modified with the «T>Y» command (see *13.1.5* T level (0 level), the main test level, T>Y command uses type 1 data). E.g., «T>YE1» – then two heads with the highest numbers of the original **E3** type will be disabled.

After HDD type modification, the Self Test must be started to perform recalibration and revise surface defects (see section 11. Self Test). After completion of the Self Test procedure (provided the drive completes it successfully and writes the appropriate FW components) you will have to update the HDD ID data to match the number of remaining heads and the capacity table of HDD Seagate models (see the list of supported models). HDD capacity can be corrected in the HDD ID editing dialog.

4.2. Firmware architecture in HDD equipped with Serial Flash

Internal firmware components in Seagate Barracuda HDD with Serial Flash are arranged in a hierarchical order (Fig. 4.1). Drive start invokes the embedded code including, among other functions, routines for copying of the Boot code from external or built-in Serial Flash memory. A portion of that code has a service role in terminal level F. As soon as the code from Serial Flash is copied to RAM and launched, it reads the boot adaptive data (also containing information about the SA cylinder offset during App code initialization – the pointer to Main FW location) and the SA defects list. The firmware then reads, from certain hard-coded cylinders, the so-called Application code (App code). That microprogram portion contains parts of executable code required to start the main portion of the microprogram, i.e. the code part servicing the mail levels of the drive command mode and the start of the ATA subsystem. Its version makes up the FW version number indicated in HDD ID and on drive label.

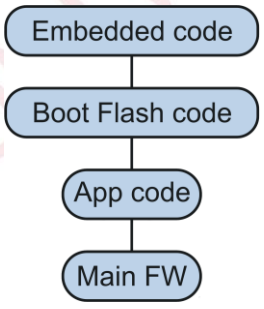

Fig. 4.1.

You can identify a compatible board using the ID data output to terminal when a drive starts. E.g.:

```
Interface task reset
1024k x 16 buffer detected
ALPINE - 1_Disk    S.15  01-16-03 11:51
```

or

```
Interface task reset
1024k x 16 buffer detected
AVALANCHE - 1_Disk    S.30  08-30-02 15:13 rcwood
```

In this example the crucial compatibility aspect will be indicated by the characters that follow x_Disk, i.e. S.xx and the word after the ROM generation date. In the above examples, it is **S.15** and **S.30**, **rcwood** (the last word may be missing). These parameters determine the code, which is also adjusted for the electronic components used, and the variations in the electronic components. To ensure compatibility between two PCBs, both the parameters (shown in bold type in the examples) must match. If that is not so, the boards are INCOMPATIBLE! In some cases this incompatibility can be resolved by overwriting the Flash ROM contents of a PCB.

If an incompatible PCB is installed, the drive will return an error message.

```
Interface task reset
1024k x 16 buffer detected
AVALANCHE - 1_Disk    S.30  08-30-02 15:13 rcwood
Buzz  - Head Mask 0000 - Switch to full int.
          Spin Ready
Application code incompatible with serial flash code
F>
```

Board compatibility is determined by certain aspects. PCB microcode contains information for initialization and management of electronic components including the spindle motor controller. It also stores data required for preamplifier initialization. In other words, the code in the main controller chip and (external or internal) Serial Flash contains the information necessary to work with the drive hardware. The code holds App code coordinates, i.e. allows a drive to find the firmware portion recorded in service area on disk surface.

Attention! Even if FW versions on the labels differ, but the boards appear to be compatible when based on the said criteria, the drive will initialize correctly. That is because various FW versions are started by the App code and use the start-up parameters (boot adaptive data, Reserve track defect list of the SA). Placement of the latter is recorded in on-board data, and consequently the PCB code and App code on disk surface will be compatible.

In addition, the service area contains the following objects:

- ***ATA overlay*** (the code processing ATA commands and S.M.A.R.T. operations).
- ***S.M.A.R.T. sectors*** containing S.M.A.R.T. Thresholds, Values and other S.M.A.R.T. logs.
- ***HDD ID template sector***, Stuff, containing basic information that makes up a HDD ID. Its structure matches the ATA specification for HDD ID. HDD ID actually provides data block built using Stuff as the basis, though incompletely identical to it (some fields are changed in accordance with the drive status).
- ***Sector containing drive PN*** and information about HDD ID configuration.
- ***Sector containing the drive security subsystem data***.
- ***Defect list tracks*** (P-List, Alt-List).
- ***Group of sectors containing zone allocation of the user data area on drive.***
- ***Tracks containing drive operation logs*** (their readability is not required for drive operation via ATA).
- ***Track containing CERT code*** – the code block servicing an extended set of terminal commands and Self Test (not required for drive operation via ATA).
- ***Group of sectors containing CERT tables*** – a table of Self Test parameters (not required for drive operation via ATA), etc.

App code is identified by the so-called Eng Rev. Eng Rev is output to terminal in response to the [Ctrl] + [A] command. The polled drive outputs a string containing information in «Eng Rev = **.F54**» format. An entire description of a HDD FW can be produced by adding together FW and Eng Rev versions, i.e. if drive FW is **3.06**, and Eng Rev = **.F54**, the resulting version will be **3.06.F54**. ROM version should be specified as well in such cases. For instance, for the drive examined above is **S.15**.

4.2.1. Disabling heads

In this FW architecture the procedure to disable drive heads depends on the family and FW version:

- Barracuda V, U Series 7, 7200.7 (ALPINE, except for FW 3.54, 3.76, 8.54, 8.76) – disabling is only possible starting with the highest head number using the type modification command (similarly to head disabling in HDD with parallel Flash architecture, see section 4.1.1. Disabling heads).
- 7200.7 (ALPINE FW 3.54, 3.76, 8.54, 8.76; APLUS; PUMA), 7200.8, 7200.9, 7200.10 – heads can be disabled using the «T>k» command (see section 13.1.5. T level (0 level), the main test level); the command also allows disabling heads in the middle of the stack.

Furthermore, these HDD demonstrate a certain relation between the number of heads and drive serial number (the number of heads is associated with the 2nd and the 3rd characters of the S/N: 3**JV**0NDZE – **JV)**. For each family the appropriate pairs of characters corresponding to certain head numbers are provided in the sections describing the specifics of that family in this document. S/N has to be modified in accordance with the table of characters.

After the modification, Self Test must be started to perform recalibration and revise surface defects (see section 11. Self Test). After successful completion of the procedure and restoration of the appropriate SA objects, you will have to update the HDD ID to match the number of enabled heads and the table of Seagate HDD models. If the scan procedure

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reveals non-standard (lower) capacity, the HDD capacity report (**2>x**) and the reserved space size should be used to calculate the new capacity. HDD capacity can be corrected in the HDD ID editing dialog.

4.3. Identification of parameters for SA objects

Information in this section is necessary when automatic identification of locations during loader creation fails (see section 4.6. Loader (definition)). It can be used to determine the coordinates of objects for manually specified surface reading if you have to work with a HDD from a currently unsupported drive family using a known and supported procedure of data reading from disk surface.

To identify the parameters of drive startup, you have to switch the level of logging to a level for execution of commands performed by the HDD. The task can be accomplished by pressing the [Ctrl]+[N] or [Ctrl]+[D] key combinations. The drive will output the following (or similar) lines: **e c r**, **x x x** . Parameter identification requires switching the drive to x x x = 0 1 0. In this state the drive will report about each subprogram it executes, and the parameters thereof (after procedure completion you have to return the drive to the x x x = 0 0 0 state!). While processing the terminal commands, the drive will output the following (or similar) messages:

cmd 58	*params*	*0047*	*0000*	*0000*	*03B4*	*3C0C*	*03B4*	*0000*	*0000*	*DAAA*	*0001*	*0047*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*

Elements of the string above are explained as follows:

1 – running subprogram (in the above example this is represented by the command to read disk surface in 7200.7 PUMA) . Subprogram numbers do not have to be identical in different drive families!
3 – track number offset relativel to the SA base track (track index)[1]
5 – initial sector;
6 – the number of sectors, which will be read[2];
7 – first buffer of the destination data area, where the reading will be performed;
8 – the number of sectors, which will be copied to the zone defined by the parameter 7.

You will need to decrypt the reports by pressing the « . » and « ’ » keys.

We shall further discuss the procedures for obtaining the parameters of individual SA objects.

Note. Some drive families support the command for output of the SA map («y» on level «T»). To run the command, CERT must be loaded (that is arranged automatically in the User commands menu).

4.3.1. Explanation of the report returned by the «y» command

Sample report generated by the command:

	PhysCyl	***GrayCyl***
First System Cylinder	*0000F7C7*	*000107D0*
First Zero Offset Cylinder	*0000F7D1*	*000107DA*
First App Code Cylinder	*0000F7DC*	*000107E5*
Second App Code Cylinder	*0000F7DD*	*000107E6*
Second Zero Offset Cylinder	*0000F7E8*	*000107F1*
Third App Code Cylinder	*0000F7F3*	*000107FC*
Fourth App Code Cylinder	*0000F7F4*	*000107FD*
First Adaptives Cylinder	*0000F7F5*	*000107FE*
First User Defect List Cylinder	*0000F7F6*	*000107FF*
First Alternate Pool Cylinder	*0000F7FA*	*00010803*

[1] Consider drive family specific features when calculating the cylinder number. E.g., in 7200.8 Tonka and some other drives the track index should be multiplied by 2 before its addition to the SA base cylinder. Therefore, you should check family-specific information first.

[2] The parameter may exceed SPT on SA tracks. In that case, the drive will continue reading either the next cylinder or start using the next head. You can identify possible data continuation by a command to HDD to read two sectors beginning with the last sector of the first track. The HDD will automatically go to the next track, and you will be able to use the “.” command to find its number.

First Cert Code Cylinder	*0000F80E*	*00010817*
First Intf Code Cylinder	*0000F810*	*00010819*
First Intf System Cylinder	*0000F812*	*0001081B*
First SEADEX Cylinder	*0000F817*	*00010820*
First Cert Log Cylinder	*0000F829*	*00010832*
First Decay Cylinder	*0000F839*	*00010842*
First SPLASH Cylinder	*0000F846*	*0001084F*
Last System Cylinder	*0000F846*	*0001084F*

The report allows you to identify the numbers of cylinders of certain important objects.

Report string	Explanation
First System Cylinder	Base SA cylinder (thus, its number in this example is 0xF7C7)
First Zero Offset Cylinder ... Zero Offset Cylinder	Track containing the SA defect list and boot adaptive data and its copy
First App Code Cylinder ... App Code Cylinder	App code copies
First Adaptives Cylinder	Adaptive information for data and zone allocation
First User Defect List Cylinder	P-List track
First Alternate Pool Cylinder	G-List (Alt-List) track
First Cert Code Cylinder	CERT code track
First Intf Code Cylinder	ATA overlay track
First Intf System Cylinder	Vendor track

4.3.2. Identifying the parameters of App code start

Identification of App code parameters requires the following steps:

1) Switch the drive to Safe Mode (please refer to a corresponding section further for details on Safe Mode and methods used to activate it).

2) When the F> prompt appears, enter the «R» command (to read the reserve track defect list, boot adaptive data, App code).

3) As soon as the drive outputs again the F> prompt again, enter the «R4» command (to read App code).

4) Press the « ‘ » key. The drive outputs the following information:

```
Cmd   Cyl   Hd  Sct    Cnt  Stbuf  Segl   Csct  Cbuf  Actv  ErCd   Rtry        Flags
1A   00000  00  00000  0000 0000    00    0180  0080   N     00   FFFF.FF.80  180
```

Please see section 13.1.2 for explanation of that response. Response explanation: loading starts from track beginning (sector 0), block length is 0x0180 sectors, the block is loaded to buffer 0x80.

5) ***Identify the App code track offset.***

Press the «.» key. The drive responds as follows:

```
Pgm=00 Trk=000096FA(000096FA).0(0).180(000) Zn=00
Err=00 ErCt=0000 Hlth=0000 CHlth=0000 Ready LBA=00000000
```

Please see section 13.1.2 Response formats for explanation of that response.Response explanation: loading uses track 0x096FA as the source.
Press the «%» key. The drive responds as follows[1]:

[1] Please see section 13.1.2 Response formats for explanation of that response.

```
:000000010000 AX       "      "000096E5-00009712
```

Response explanation: SA base cylinder number is 0x096E5.

Therefore, the offset is **0x096FA – 0x096E5 = 0x15.**The drive in the example does not use track index multiplication by 2.

Attention! App code must be read in Safe mode, with a preceding «R» command to the drive to load the SA defect list and boot adaptive data. The requirement for using Safe Mode exclusively is determined by the unification aspects and the fact that some drive families allow access to ROM version in Safe Mode only

4.3.3. Identifying the parameters of CERT code

To identify CERT code parameters, you should use the [Ctrl]+[D] key combination to switch the drive to the **0 1 0** command tracing state. Press [Ctrl]+[R] to load CERT code. The drive will then output, to the terminal, a long report including a portion as shown below:

```
[skipped]
cmd 22, params 00C4 0010 0000 0000 0000 0000 0000 0000 0000 0000 0000
cmd 58, params 0047 0000 0000 03B4 3C0C 03B4 0000 0000 DAAA 0001 0047
 VALID Cert Disk Code Detected - Revision # .082
T>
```

Here, «VALID Cert Disk Code Detected - Revision # .082» is a sign of successful CERT code loading. However, in this case we should not actually pay attention to successful reading of CERT code or an error during the procedure. Instead, you should note the command for reading CERT code from disk surfaces. In Avalanche (Barracuda ATA V, U Series 7), Alpine (7200.7), Aplus (7200.7), and Neptune (Momentus) drives, this is accomplished with the 6E command, in Puma (7200.7) drives - 58.

Now we will explain the reading command based on the information from section 13.1.2. Response formats: reading occurs from track at offset 0x47 relatively to the SA base track, CERT code length is 0x03B4 sectors (as we can see, the CERT code in this case uses two tracks).

Then we have to read the two neighbouring tracks using the method described above to identify the track containing the remaining part of CERT code.

4.3.4. Identifying the parameters of CERT tables

Identification of parameters for CERT tables requires the following steps:

1) Use the [Ctrl]+[R] key combination to load CERT.
2) Switch to level 1 (using the «/1» command, to which the drive should respond with the «1>» prompt).
3) Use the [Ctrl]+[D] key combination to switch the drive to the **0 1 0** state.
4) On the first level, enter the «t» command to load CERT tables from disk surface.

The drive will then output to terminal a long report (see a sample report portion below)/ In the report, you can see two sequential read operations in adjacent areas: one sector **0x134** and 0x14 sectors beginning with sector **0x135**. You should be interested in the first block that consists of a single sector. We should note that reading from track occurs at offset 0x48 relative to the SA base track.

```
1>t
cmd 58, params 0048 0000 0134 0001 3C00 0001 0000 0000 5F0D 0000 0048
cmd 58, params 0048 0000 0135 0014 08AA 0014 0000 0000 0000 0000 0048
Cert Table loaded
1>
```

4.4. Identifying the versions of FW components

Information in this section serves as a guideline when searching for the required version of firmware components, in cases when they are damaged in the HDD in question. In order to check the versions of firmware components, you can use terminal commands (see section 13. List of commands with descriptions), or the drive status dialog (see section

6.1.1. Utility status). In the latter case you will need the CERT code loading command to identify the version of CERT code in the drive.

Caution! CERT code loading changes the drive status! During this time, some terminal commands begin working while others cease to function (please see the notes of the list of commands in section 13. List of commands with descriptions and family-specific information).

4.5. The structure of HDD ID template, Stuff (main parts)

This section contains information about some fields used in the HDD ID template. You can edit it using the Hex editor of the «Service information objects» wizard (see section 6.2.1. «Service information objects» wizard). While editing, the 4th sector of the Vendor track should be selected for all currently supported drive families except for U Series X / 5400.1. Please find below word-based addressing of some Stuff fields.

Word number	Description
01	Default number of cylinders (LCHS)
03	Default number of heads (LCHS)
06	Default number of sectors (LCHS)
15	Buffer RAM size
1B	Model name
31	Supported features
3C	Current Max LBA
52	Supported Features/Cmd Set (1 of 3)
53	Supported Features/Cmd Set (2 of 3)
54	Supported Features/Cmd Set (3 of 3)
55	Enabled Features/Cmd Set (1 of 3)
56	Enabled Features/Cmd Set (2 of 3)
57	Enabled Features/Cmd Set (3 of 3)
83	Max LBA restriction
8E	Flash memory size
9E	Drive type (the number here must match the one returned by the drive in response to the «**;**» command in the **Type** parameter; when heads are disabled the original Stuff must be modified to correspond to the new drive type).
9F	Stuff format version
AE	Keys regulating drive AAM. In case of “singing” drives (producing a single or several high-tone sounds at the start) the parameters must be disabled (0000).
EA	

4.6. Loader (definition)

For Barracuda / Momentus drives the utility supports the creation and recording of a so-called loader. A loader is a structured, all-in-one data storage unit containing ROM, App code (for architecture based on Serial Flash only), CERT code, CERT tables, ATA overlays (even two of them for some families), Stuff (HDD ID template), and the sector containing the log of drive hardware configuration. During loader generation the utility attempts to identify all the required parameters of the preserved firmware objects. Therefore, loader creation is the simplest and fastest method that can be used to back up the Boot-Up set of firmware data (for details on work with loader please refer to section *6.5.* Features available from the streamlined loading menu).

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5. Utility start

5.1. Utility settings storage

The utility can display the following message during startup: «*Current utility options are outdated!*». This means that the updated utility version requires certain items missing in its current configuration file. In this case the utility takes the default values from its resources, adding corresponding records to the startup log:

> *Loading default settings!*
> *Use the options dialog to review and save utility settings. Then press OK!*

To update the settings and avoid the message appearing every time the utility starts, open its settings dialog and click the «Seagate U5, Barracuda XX …» button to open the special settings dialog. In the dialog, click OK. Then the utility will save, in its root directory, the configuration file containing updated settings.

5.2. Drive family selection at utility launch

ROM signature	Drive family branch in the utility startup dialog
C1	U Series X
C2	U Series X[1]
U5	U5
Durango	Barracuda I
Vail	Barracuda II
Aspen	Barracuda III
Snowmass	Barracuda IV
Avalanche	Barracuda V или U Series 7[2]
Alpine	Barracuda 7200.7
APLUS	Barracuda 7200.7
Puma	Barracuda 7200.7 PUMA
Tonka	Barracuda 7200.8 Tonka
Tonka2	Barracuda 7200.9 Tonka2
Tonka40	Barracuda 7200.9 Tonka40
Tonka15	Barracuda 7200.9 Tonka2
TLite	Barracuda 7200.9 Tonka2
TLite1HD	Barracuda 7200.9 Tonka2
TLite2HD	Barracuda 7200.9 Tonka2
Neptune	Momentus Neptune
Mercury	Momentus Mercury

When the utility starts you will be asked to select the family of the currently connected HDD. During launch, the utility attempts to identify the necessary family using its list of models pertaining to each family (see the settings dialog). If it fails to find the current model in its list, the utility uses ROM signature for identification purposes. In case of manual selection of drive family you are advised to use ROM signature as basic indicator. HDD interface (PATA or SATA) is irrelevant. Please check the table of correspondences above.

[1] The drive belongs to the 5400.1 family, but operations with it in the utility are possible via the U Series X branch

[2] Selection should be performed according to the HDA label information or model name output in HDD ID.

5.3. Utility start dialog

The dialog appears once the selected utility is launched. It is used for its initial configuration (selection of the main family-dependent settings for work with the drive) and management of the utility and drive status – Safe / Normal. In addition, you can access some commands for operations with the drive. During startup the utility attempts to choose the right family by model name and (if it cannot read the HDD ID) by the parameters obtained from the terminal. Please see the following figure for the on-screen utility start dialog.

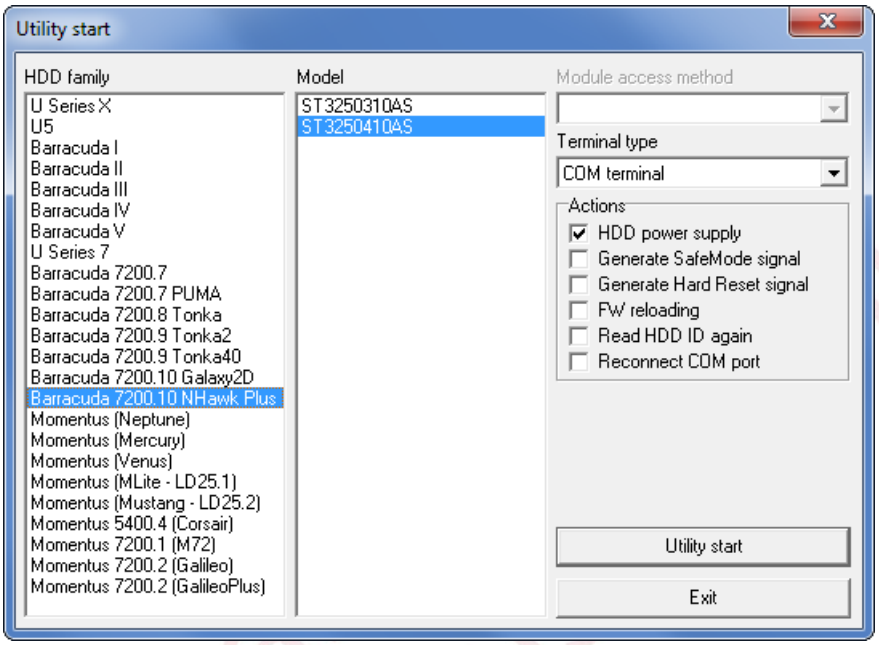

Fig. 5.1.

In the dialog you can select the family of the connected drive (defining specific utility settings for operations with HDD) and terminal type[1] (COM or ATA[2]). You can perform the following operations within the dialog:

- Manage HDD power supply.
- Control the Safe Mode signal generation[3].
- Control the Hard Reset signal generation.
- Control the command to restart the HDD.
- Control the command to read HDD ID and terminal identification information.

[1] For details please refer to the section *8.*Terminal types: COM, ATA.

[2] ATA terminal access is only supported in some drive families. Please refer to the corresponding section of this manual containing family-specific descriptions to check whether your drive supports that mode.

[3] For details please refer to section *7*. Operation modes: Safe mode, Normal mode.

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6. Utility features

Specific utility features can be invoked from the «Tests» and «Tools» → «Utility extensions» menus. All other features are inherited from the universal utility (please see its corresponding manual). The table below contains keyboard shortcuts for specific utility features.

Mode	Keyboard shortcut
Service data objects	[Ctrl]+[Alt]+[1]
Security subsystem	[Ctrl]+[Alt]+[2]

6.1. «Tests» menu structure

6.1.1. Utility status

Selection of the «Utility status» menu item displays a dialog window which reflects the utility status and allows modification of its certain parameters (Fig. 6.1, Fig. 6.2).

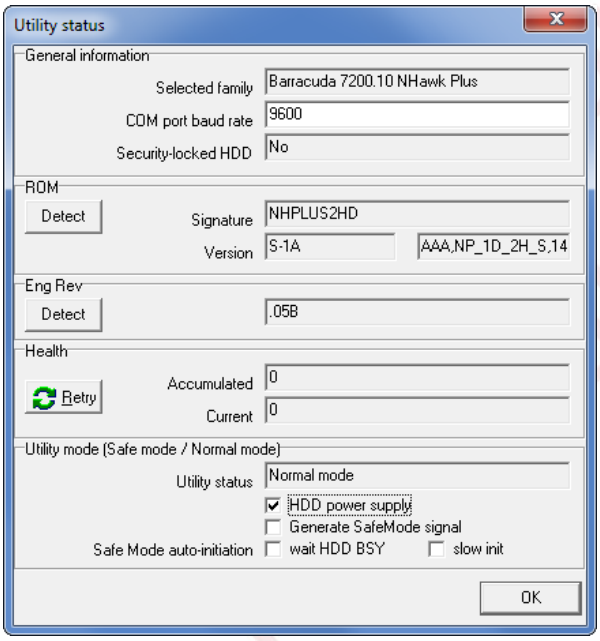

Fig. 6.1. ATA terminal is inaccessible.

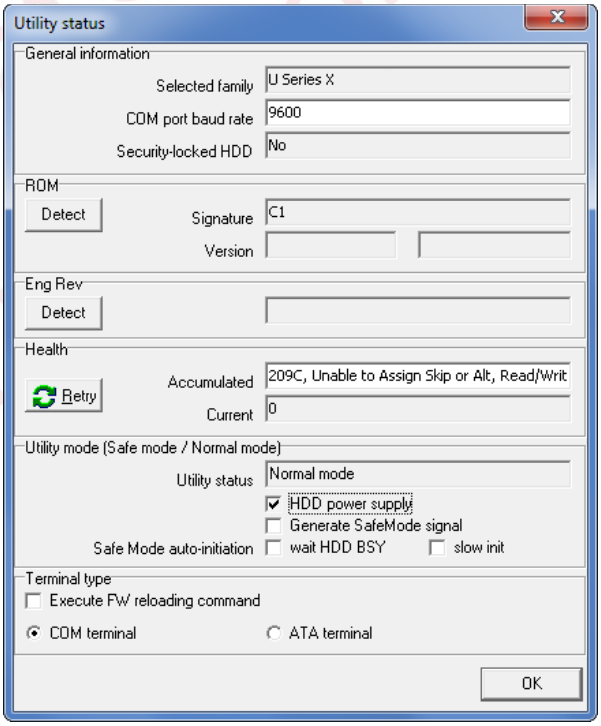

Fig. 6.2. ATA terminal is accessible.

The dialog shows the following information:

- Selected drive family.
- Current rate of data exchange between the utility and the drive via COM port You can change the value using the pop-up menu in the line containing the current rate.
- Password protection on the drive.
- ROM signature.
- ROM version. For HDD equipped with Serial Flash in Safe mode (and for some families in Normal mode, too) the PCB ROM version will be displayed(S.11, S.15, etc.). The information is necessary during selection of a donor drive for PCB replacement. Please see section *4.2*. Firmware architecture in HDD equipped with Serial Flash for details.

- Eng Rev (Engine Revision) – FW version extension for drives using App code (based on Serial Flash architecture). If FW version is 3.54, and Eng Rev .F6, then the complete FW version will be 3.54.F6. It should be used to find necessary donor firmware parts. Pressing the Detect button polls the drive via terminal requesting its Eng Rev. Eng Rev is an App code characteristics available only when App is started, i.e. in Normal mode.

- Current Health status of the drive including its Accumulated and Current characteristics with their explanation (please see section *13.1.3.* Explanation of health bits). Clicking the «Retry» button updates the information about HDD health.

- Utility mode (Safe/Normal) and mode controls.

- Terminal type (COM/ATA) and its associated controls (available only for drives that support operation in the so-called ATA terminal. See section 8). Terminal types: COM, ATA).

6.1.2. HDD initialization

The menu offers items necessary for «HDD initialization with head map changing in RAM» and «Starting LDR». The loader start functionality is described in detail in section 6.5.3 Starting LDR. The description below explains automatic initialization of a HDD involving App code editing.

«HDD initialization with head map changing in RAM» is intended for automatic start of HDDs demonstrating software or hardware problems (Pending-Bug, Overlay 01 not loaded, Not handled software path, Sys sect write err, damaged heads, etc.). Mode functionality matches the operations available in the utility during interaction with Data Extractor (for details see section 10.6 Additional utility features available in tandem with Data Extractor). At the same time, the mode automatically prepares all the necessary data and uses the default settings tailored to cover the widest range of possible HDD problems, thus making the work with malfunctioning drives simpler.

When the mode is invoked the utility automatically reads the loader containing the required FW components (at this stage, App code) from a HDD to its profile (see 4.6 Loader (definition), 6.5.2 Saving LDR from HDD). The utility also reads ROM image to allow full functionality of the mode. The utility reads the loader and ROM image only once after its launch. Therefore, until the utility is restarted it will keep using the resources saved after the initial access, therefore accelerating drive initialization and minimizing the HDD load. When the mode is selected, the utility displays a prompt suggesting to proceed with the default settings or modify them:

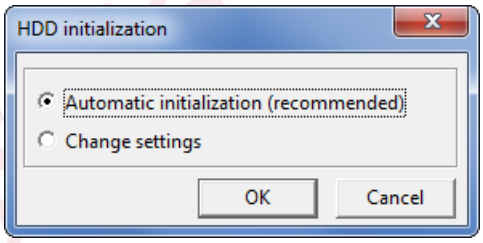

Fig. 6.3.

If you select automatic start, the utility will check whether the associated modifications are possible and prompt for the heads map to start the HDD with.

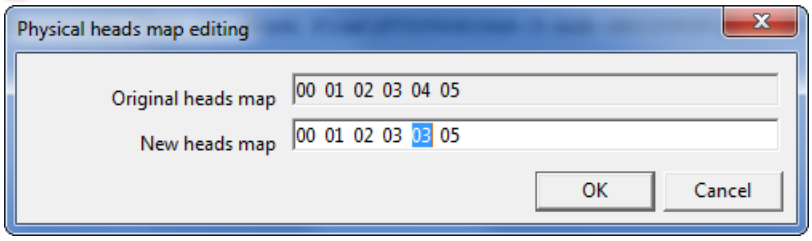

Fig. 6.4.

To establish which heads must be disabled you can use the method described in section 9.8 Testing drive heads, or open the HDA in case of mechanically damaged heads.

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E.g., in this way you can partially extract data from a HDD with scratched non-system head(s). Installation of a donor heads stack is insufficient in such cases as the corresponding heads will be immediately damaged by the scratched surfaces. As a result, no access to data will be be restored. On the contrary, damage will spread further because of the abrasive dust produced by the heads and scratched surface areas. However, if you remove the corresponding heads physically (to prevent any contact with the damaged surfaces) and use the HDD initialization mode having disabled the removed heads in the map of physical heads, you may try recovery of the data from the remaining heads.

The utility will start the HDD and then, provided the service area contain no fatal corruption, logical access to the drive will be possible.

6.1.3. Reconnect COM port

The feature allows you to reconnect a frozen and mechanically reconnected USB terminal, or select another COM port for work.

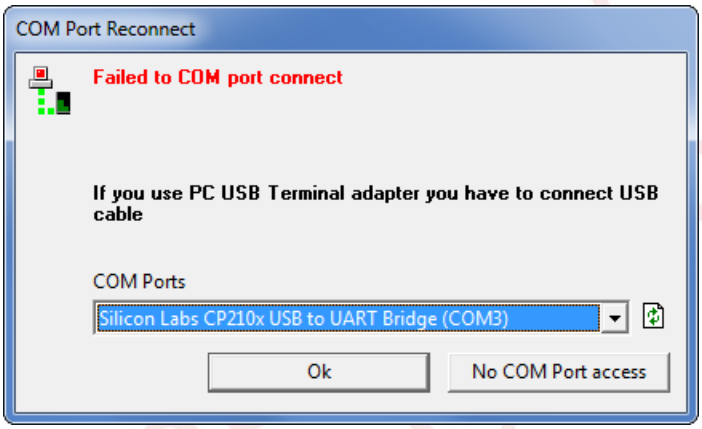

Fig. 6.5.

6.1.4. Initialize Safe Mode

The option allows automatic switching of the utility and the drive into Safe Mode.

6.1.5. Work with terminal

The menu item contains a selection of actions that can be performed with the HDD in the terminal:

- ***Set COM port data transfer rate*** – allows the user to switch the data exchange rate between HDD COM port and PC COM port, or detect the current exchange rate that the connected HDD uses. If you select sub items of the menu the utility attempts to determine the data exchange rate of the drive's COM port. If you change the data exchange rate the utility will command the drive to change the rate to the user-defined value.,then the utility will switch the rate of the PC COM port. If, for some reason, the utility fails to determine the current data exchange rate for the HDD COM port, it will output a respective notification. In that case you should select the right speed using the last menu item which controls the data exchange rate of PC COM port only.

- ***Working with data buffer*** – the menu contains features required for work with HDD memory: reading/writing ROM, data buffers1, reading RAM. Drives equipped with serial Flash chips (see section 4. Overview of firmware structure in Seagate Barracuda drives) allows those operations in Safe Mode only due to their technological peculiarities. Therefore, when this menu item is selected, the utility attempts to switch to Safe Mode automatically. Moreover, ROM writing in Safe Mode is much faster in those drives than in Normal Mode. The ROM writing suite feature combined with access to database contents allows intelligent searching for the required ROM image using filters.

[1] RAM in Seagate drives is subdivided into parts performing special functions. In particular, there is a read buffer, write buffer, etc. At the same time, common addressing in 512-bytes blocks is employed. According to Seagate terminology, manufacturer refers to as "buffers" both to the areas performing specific functions (e.g. "read buffer"), and to 512-blocks making up those areas. You can view the map of drive buffers by entering "?" in terminal.

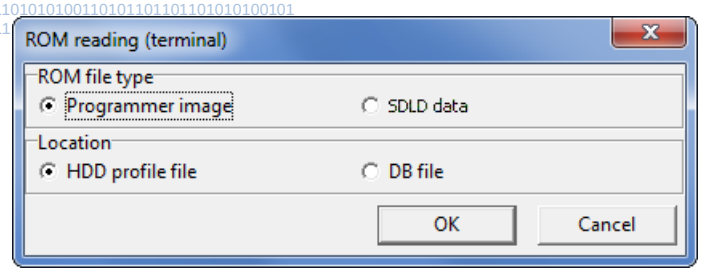

Fig. 6.6. Reading ROM

Here:

ROM file type – ROM in Seagate drives can be read in two formats: «Programmer image» and «SDLD data». In drives based on Parallel Flash memory chips the formats have different internal structure, in HDD equipped with Serial Flash they are identical.

Location – Retrieved ROM image can be added to a HDD profile, or database folder.

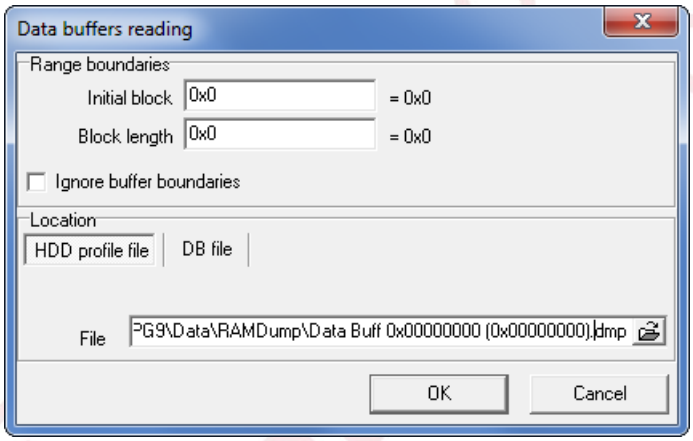

Fig. 6.7. Data buffers reading.

Here:

Initial block – Number of the buffer where reading will start.

Block length – Number of buffers to read.

Ignore buffer boundaries – Check box that disables utility control over user-defined parameters.

Location - HDD profile file – Pressing the button selects reading to a HDD profile. Full path to the image file can be entered in the field provided. The button to the right of the entry line opens the file selection dialog.

Location - DB file – Pressing the button selects reading to the database. You can choose the database folder where the resulting file will be placed and the actual file. The button to the right of the entry lines opens the database folder selection and the file (database document) creation dialogs respectively.

- ***Working with SA surface by PCHS (terminal)*** – the menu contains some features for working with the service area surface via terminal based on physical parameters: «Reading SA surface» and «Writing SA surface» allows reading from, and writing to, a specified PCHS zone of the service area; «Reading tracks group» and «Writing tracks group» allows the user to read or write a range of tracks in the service area having specified the initial and final tracks and SA SPT. Please see below a sample surface reading dialog (Fig. 6.8).

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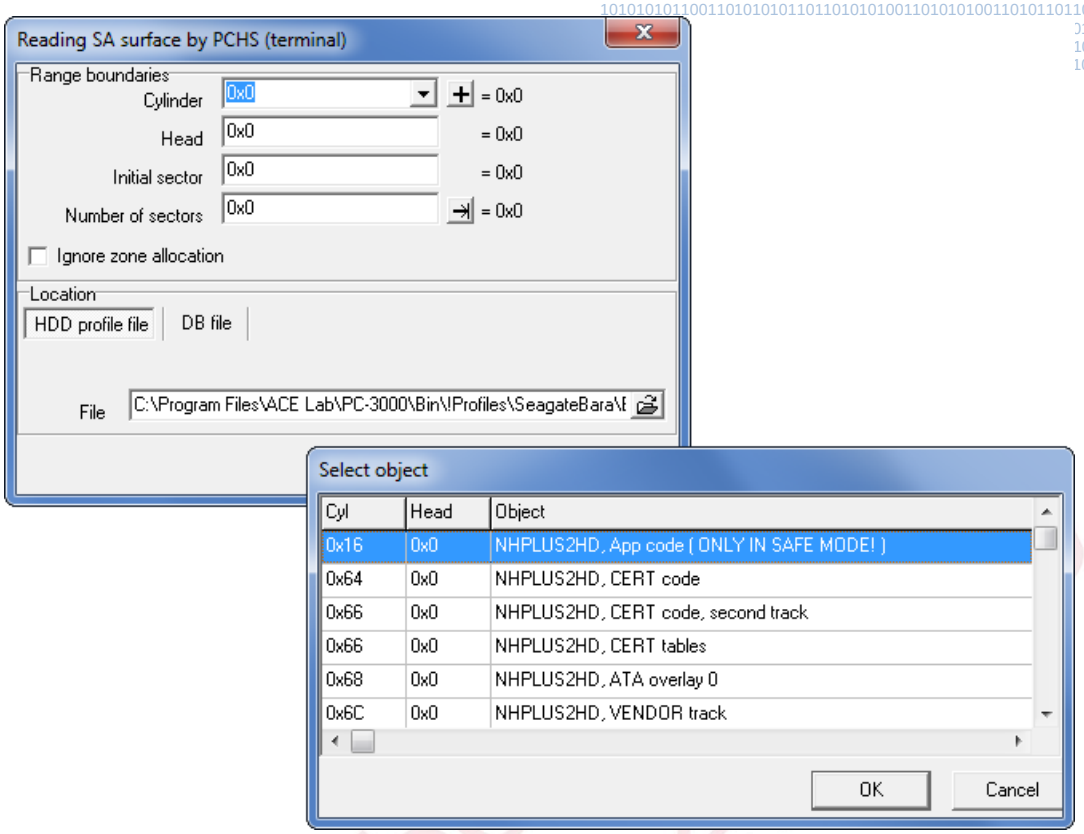

Fig. 6.8. Surface reading.

Here:

Cylinder – The value defines the number of the physical cylinder to read.

Right part of the entry line contains the button. Press it to display a reference dialog containing the list of service information objects. You can edit the list in the utility settings. As soon as you select an item from that list, information about it will be substituted into the fields of the surface reading dialog.

The button to the right of the cylinder number input line adds the SA base cylinder number to the number in the entry line. This feature allows convenient manipulation with relative cylinder numbers as it is implemented in the drive itself.

Head – Number of the physical head that will be used for reading.

Initial sector – Number of the physical sector where reading will start.

Number of sectors – Number of sectors to read.

The button to the right of the «Number of sectors» line inserts the number required to read the track from the «Initial sector» specified above to the end.

Ignore zone allocation – Check box that disables utility control over user-defined parameters.

Location - HDD profile file – Pressing the button selects reading to a HDD profile. Full path to the ROM image file can be entered in the field provided. Clicking the button to the right of the entry line opens the file selection dialog.

Location - DB file – Pressing the button selects reading to the database. You can choose the database folder where the resulting file will be placed. The button to the right of the entry lines opens the database folder selection and the file (database document) creation dialogs respectively.

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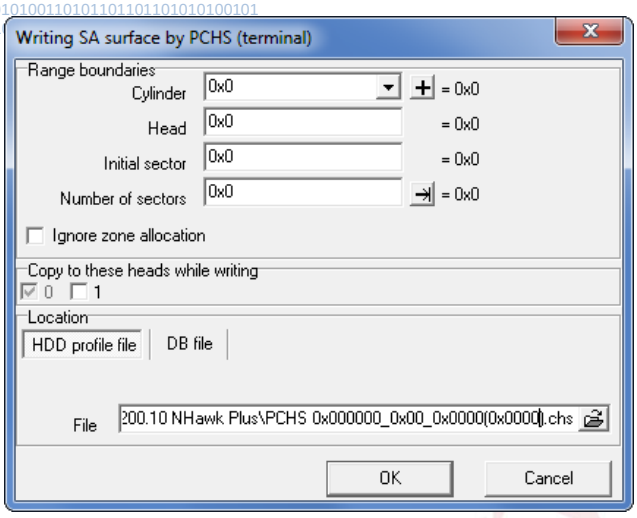

Fig. 6.9. Surface writing. «Copy to these heads while writing» field allows using several heads at once for writing.

Attention! There is a peculiarity related to track recording to alternative coordinates. Firstly, you should specify the data source file, and then select the SA object where the data should be recorded. This step is required because, during file selection, its coordinates are substituted from its properties automatically.

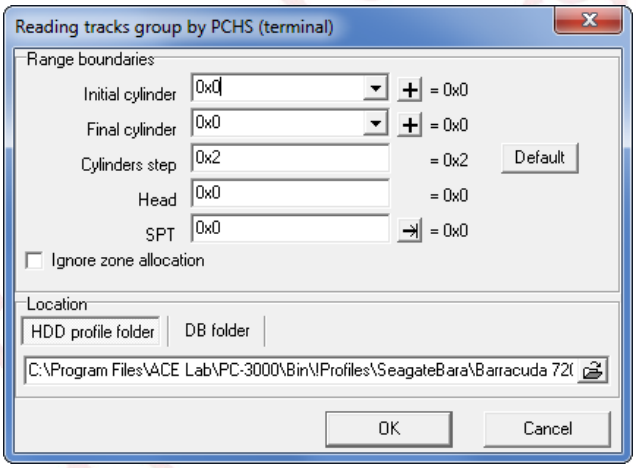

Fig. 6.10. Reading a group of tracks.

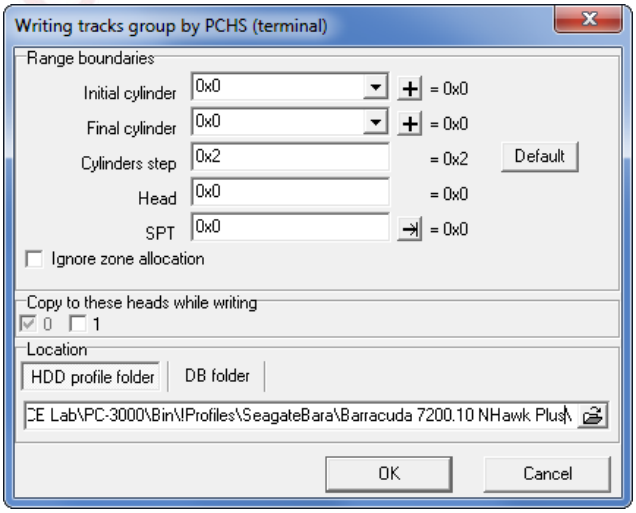

Fig. 6.11. Writing a group of tracks.

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During the procedure the utility generates file names automatically based on the data input by the operator. If there is no corresponding file in the selected folder, it will record nothing. An error message will be displayed instead. Thus, recording is only possible to the specified location. The names and file properties for the database should match the recording location.

- ***Flow loading***[1] – the submenu contains a set of commands that allow for loading to drive memory, via the SDLD protocol, firmware objects as Flash (written to ROM), App code, ATA overlays, CERT code, CERT tables (for details on on commands of the flow loading menu see sections 4.6. Loader (definition) and 6.5. Features available from the streamlined loading menu).

6.1.6. Defect lists

The menu item allows the operator to add LBA defects to a HDD P-List manually. When you have finished entering LBA defects, use the right-click menu to select the «Translation to PCHS» command (Fig. 6.12).

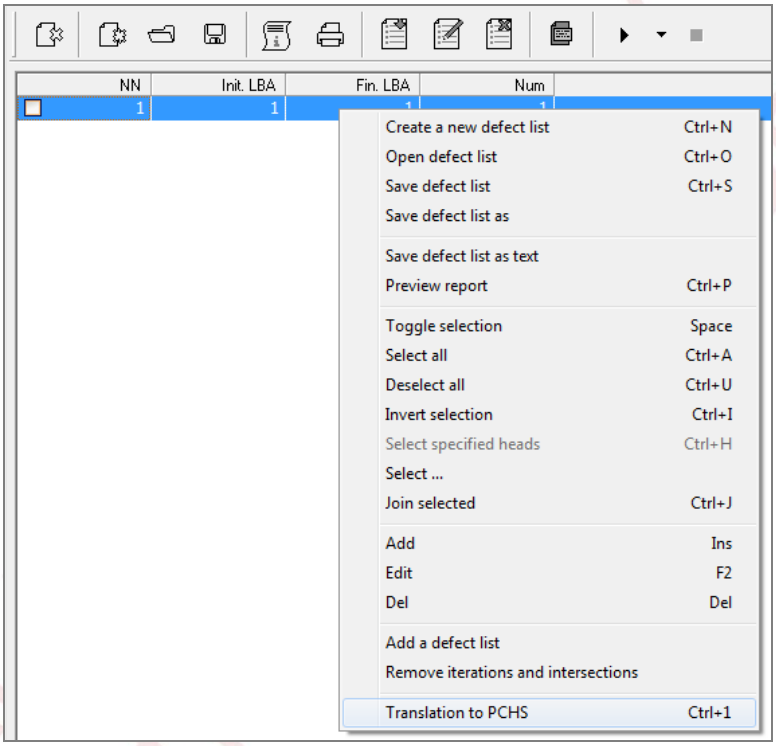

Fig. 6.12.

The utility will perform LBA translation to PCHS using internal HDD methods and output the resulting defects list into a new editor window. In this window the following operations are possible: list sorting, statistics output, and actual defect assignment using internal HDD methods.

6.1.7. Changing HDD ID data

This menu item allows you to work with HDD ID. It contains the following actions: – «Editing HDD ID data» and «Initialization of HDD ID»[2]. The latter («Initialization of HDD ID») copies, from the microprogram body, a block of default HDD ID data. The feature is necessary when restoring drives with «STUFF unreadable» errors and after Self Test. The editing dialog (Fig. 6.13) also allows you to modify such HDD ID fields as model name, Max LBA (together with the Max LBA limit), LCHS parameter, bit map of supported drive features (support for HPA, security subsystem, LBA48, S.M.A.R.T. Self Test and Error Logging). Integration with the internal utility reference can be used to fill in the model name and maximum capacity.

[1] The submenu is available for the group of Barracuda drive families similar to the models using Serial Flash chips (see section 4. Overview of firmware structure in Seagate Barracuda drives).

[2] In some drive families the initialization command is not implemented on the drive level (see family-specific information).

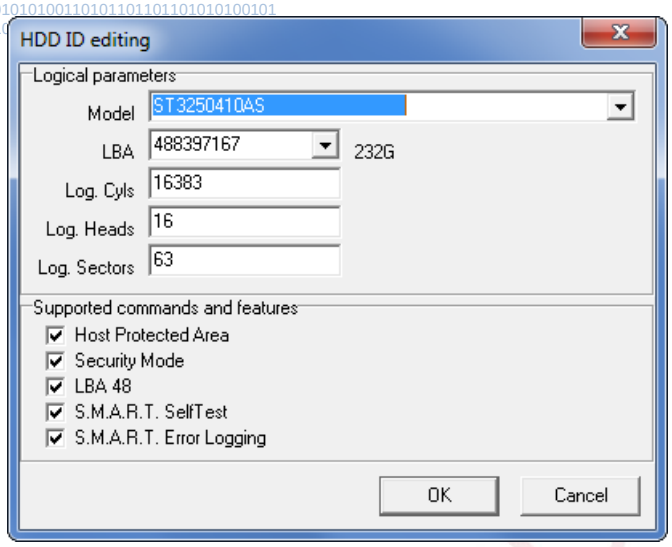

Fig. 6.13.

Attention! The utility takes original data from HDD ID obtained via ATA. It modifies HDD ID parameters using an ATA modification of the SetStuff command. Thus, HDD ID editing requires that the drive must be able to reach readiness. If a drive fails to enter the readiness state because of an incorrect HDD ID template (Stuff sector) as manifested with the «Stuff Unreadable» message, it (Stuff) should be restored by editing[1] or overwriting it with a copy borrowed from the corresponding model, or by initialization[2].

6.1.8. Reading/writing key modules

The submenu allows reading of user-defined modules to a profile folder or database (from models belonging to families, which support terminal access to firmware modules (RSM) using the so-called key, i.e. module number) for subsequent storage or analysis. If an error occurs during reading of the modules, the utility allows reading of the remaining data portion to restore access to the command mode.

6.1.9. Logical test

The menu item invokes the tool for logical surface testing (ATA plug-in) which is available in the universal utility of the suite. After completion of the test, the utility will open the list of revealed defects in defect editor for reviewing, modification and assignment to P-List (see section 6.1.6. Defect lists).

6.1.10. User commands

The submenu includes custom commands entered from the utility settings menu.

6.2. The «Tools» → «Utility extensions» menu

This menu allows access to the following utility features: «Service information objects» wizard and «Security subsystem» wizard.

6.2.1. «Service information objects» wizard

The interactive wizard allows the operator to read from a HDD, modify in Hex editor (including modifications using respective plug-ins) and record back to drive various service data objects of Seagate HDDs (see further). As soon

[1] If the problem is caused by disabled heads, the editing means appropriate correction of the Type field in the Stuff sector.

[2] Not recommended because, during initialization, many specific features optimizing HDD operation via ATA are disabled by default.

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as you select the required object and press OK, the utility retrieves the necessary data from the drive and displays it in Hex editor.

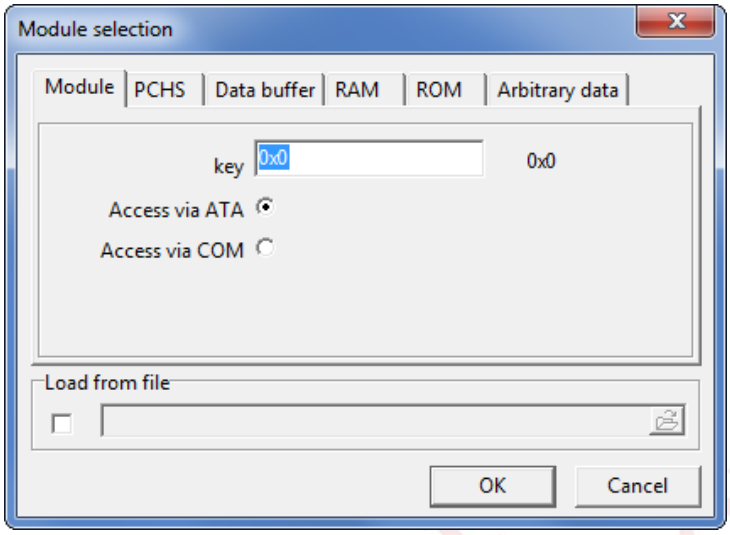

Fig. 6.14.

- Service data module (RSM), Fig. 6.14. The tab is available for drive families that support operations with modules. Their list includes U Series X, 5400.1. You can use the tab to work with modules of earlier drive families, such as U4, U6, U8, and U10. In all cases, manipulation of modules becomes possible after selection of the U Series X family. In order to receive access to module data, you will have to specify the module's key. Modules can be accessed both via ATA or terminal.

  Here:

  Key – Key, module «number».

  Access via ATA – Module reading and writing will be performed via the ATA interface.

  Access via COM – Module reading and writing will be performed via the terminal.
  Attention! At present the utility only supports, for U Series X drives, module loading to RAM in terminal without recording to the disk surface!

  Load from file – During first launch the information will be read from the specified file instead of the drive.

  Attention! If you have selected to work with modules via ATA, make sure that the drive is not in terminal command mode during module manipulation! Seagate drives do not process ATA commands in command mode! To switch a drive in command mode you can switch its power supply off/on, or use the terminal command for microcode reloading – [Ctrl]+[R] (just for U Series X, 5400.1, U4, U6, U8, U10 and identical models).

- PCHS, Fig. 6.15. The tab allows the viewing and modification of data within the surface portion containing the service area. The start-up tab with mode controls is identical to the dialog with the settings for SA surface reading using physical parameters.

- Data buffer, Fig. 6.16. The data buffer tab allows viewing and modification of information in HDD data buffers. The start-up mode control tab is identical to the dialog with settings of HDD buffer reading parameters. You can obtain the map of HDD memory buffers by entering «?» in terminal.

- RAM, Fig. 6.17. The RAM tab allows reading of HDD RAM and certain manipulations with the read data, including processing with corresponding Hex editor plug-ins.

- ROM, Fig. 6.18. The ROM tab allows reading of HDD ROM and modification of the ROM dump. The current version supports access to ROM via «COM (mem)» only. ROM access via ATA or COM by key for U-type drives is not implemented, and for Barracuda-type models it is impossible.

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- Arbitrary data, Fig. 6.19. The arbitrary data tab provides for the necessary SDLD protocol framework (streamlined loading / unloading of data blocks). Before opening the Hex editor, the utility allows loading of a data block with a respective image from a properly initialized drive. This means that you have to send , in terminal, a command for data manipulation which uses SDLD blocks, and then either load data to editor or download it to the drive.

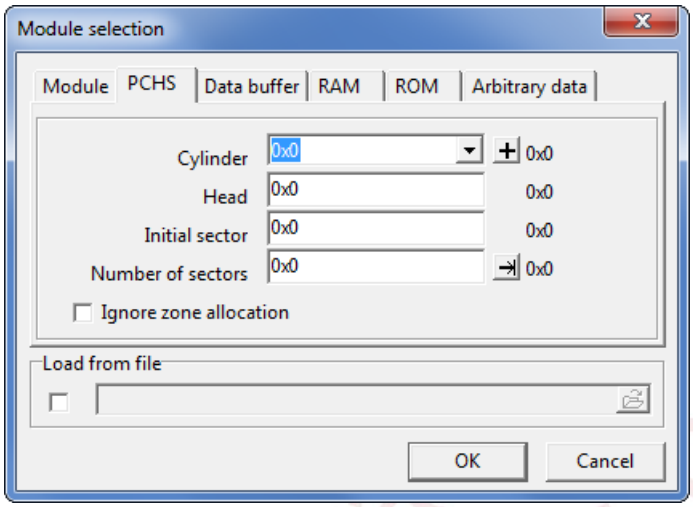

Fig. 6.15.

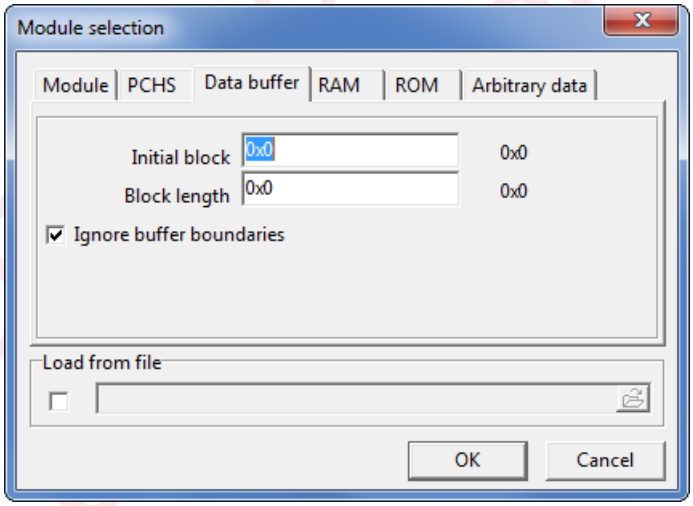

Fig. 6.16.

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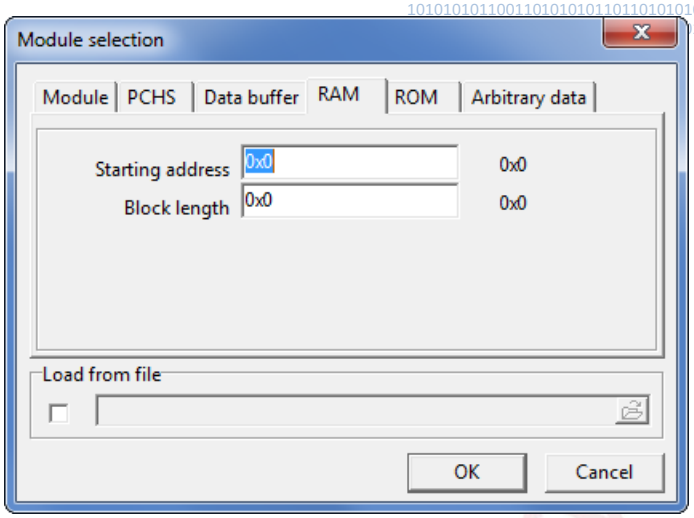

Fig. 6.17.

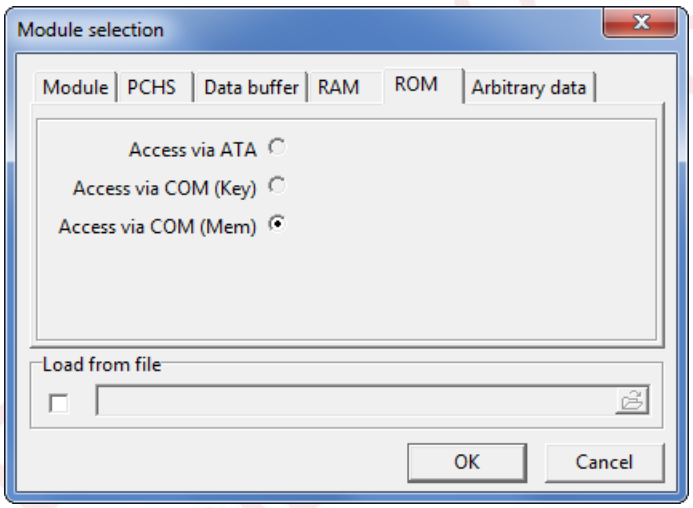

Fig. 6.18.

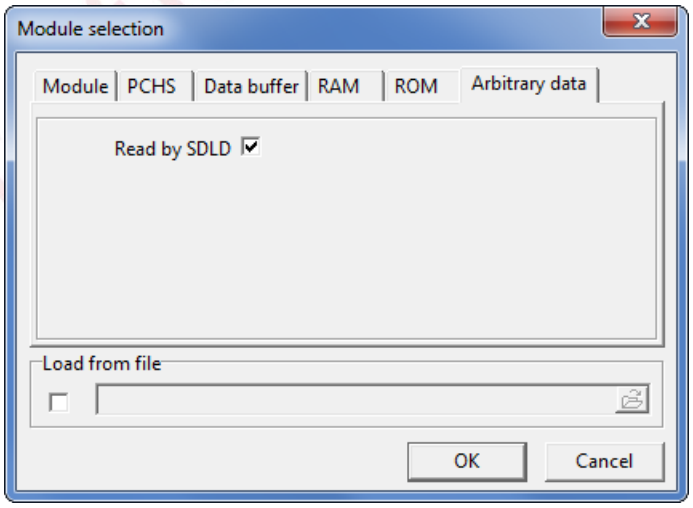

Fig. 6.19.

If the «Read by SDLD» check box is enabled, the utility will attempt to retrieve information from the HDD using the SDLD protocol. The protocol itself is intended for data exchange, i.e. in order to use it you should first send to the drive a data transfer command to the drive.

Furthermore, instead of reading a specified object from HDD, you can load it from a profile. The utility will then continue operation as if the data has been read from the drive.

The figure above demonstrates editing of the STUFF and HDD ID template (sector 4 of the Vendor track). The upper right part of the screenshot contains the open plug-ins menu, which allows certain manipulations with the data.

- ***Bytes sum (All data)*** – one of the checksum variations. The utility sums up all data bytes displayed in Hex editor in a word type variable and displays the sum with the value supplementing it to zero.
- ***Words sum (All data)*** – one of the checksum variations. The utility sums up all data words displayed in Hex editor in a word type variable and displays the sum with the value supplementing it to zero.
- ***SDLD, block Check Sum*** – checksum calculated for data using the SDLD algorithm. Data size must be divisible by the sector if the data size is below 128k, by two sectors if the data size is below 256k, and by four sectors if it is below 1Mb.
- ***Invert Text Bytes (Sel Only)*** – the utility copies the selected text to buffer and swaps even and odd bytes. The result is displayed in the window. The feature is convenient when you need to review structures similar to HDD ID template.
- ***Edit as CERT tests parameters*** – the feature is available for the U Series X drive family only. It displays a dialog which allows editing data as CSPT module – «CERT SEQUENCE and PARAMETERS TABLE» – it is the module containing Self Test parameters (see section 6.3. Edit as CERT tests parameters). Explanation of the parameters is provided for the U6 drive family. Parameters for other families have not been decrypted yet due to insufficient reliable data.
- ***Parsing U-like HDD module table*** – the feature is available for the U Series X drive family only. It allows you to search and parse the modules table for U4/U8/U10/U6/U Series X drive families. The utility outputs the parsing result to its log (see section 6.4).
- ***Barracuda IV like HDD ATA ovl track parser*** – the feature is available for the U5, Barracuda I, II, III, and IV drive families only. It allows you to parse a correct track containing ATA overlay in the mentioned drive families and extract ATA overlay or CERT tables, whichever the user selects (they are located within the same track in those drive families).

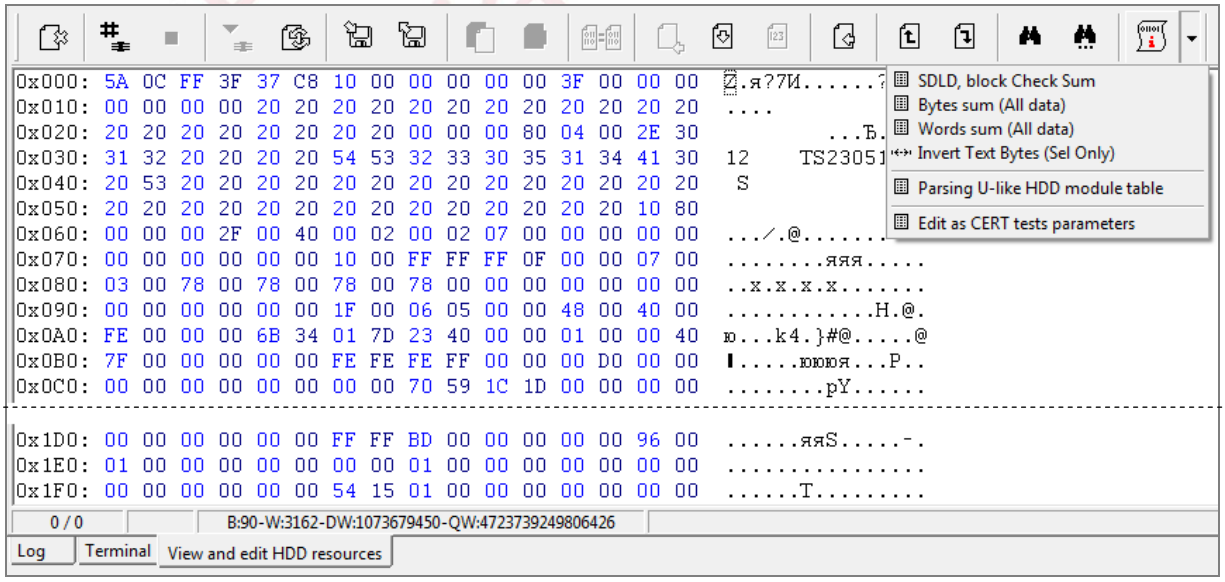

Fig. 6.20.

6.2.2. «Security subsystem» wizard

The interactive wizard allows the operator to read and reset the current enabled password. Please see the screenshot of the wizard form below (Fig. 6.21).

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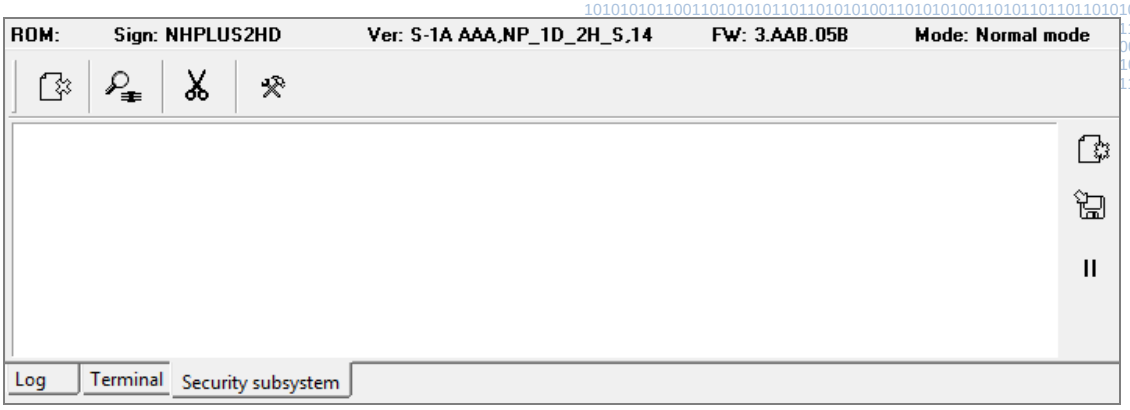

Fig. 6.21.

 – Close button. Exits the interactive mode.

 – View password information button. Allows viewing of the current Master and User passwords in ASCII and hex formats.

 – Erase USER password button. The feature retrieves information about User password via terminal. It then attempts to reset the password with a standard ATA command (the drive must be connected via both COM and ATA).

 – Additional settings button. Displays advanced wizard settings. The button allows for switching of the settings to reset passwords, not only for drives belonging to the currently selected family, but for others as well. The displayed settings panel contains sample settings for different families and supports the entry of custom parameters.

Advanced settings are hidden by default when the wizard launches. They are configured automatically based on the current selected drive family. You should only change the settings if a drive belonging to another family has been connected to the system. In particular, the utility supports resetting of passwords for drives U4, U8/10, and U6 drives using the U Series X branch. The advanced settings panel screenshot is shown in the figure below:

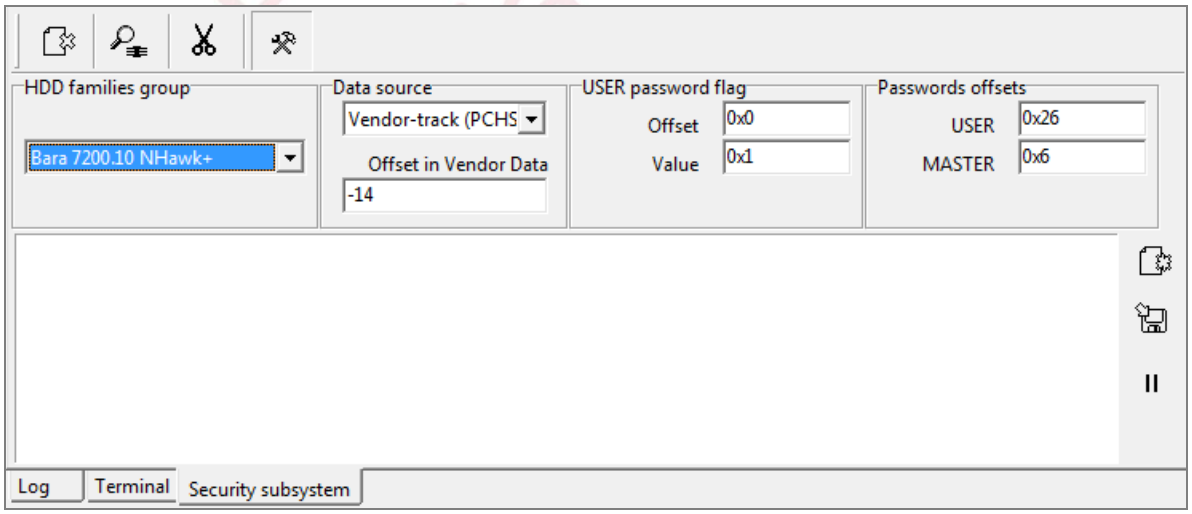

Fig. 6.22.

Here:

HDD families group – The list allows for selection of a standard algorithm available for resetting of passwords in the listed drive families and identical drives. When you select a drive family, the utility substitutes values in the panel automatically.

Data source – Source of the password information – Key module (key-based access via ATA for U4/U8/U10/U6/U Series X... families), Vendor-track (Gx) (data access uses the T>Gxxxx

command), Vendor-track (PCHS) (data access uses surface reading by PCHS).

Offset in Vendor Data – Offset relative to the initial data sector within the Vendor track (Vendor track beginning is reserved for HDD needs).

6.3. Edit as CERT tests parameters

The plug-in can be invoked within the Hex editor from the «Service information objects» tool under the U Series X utility branch (Fig. 6.23). The editing dialog allows you to remove, add or change the order of tests and their sequence.

Here:

Add test – Add one of the tests from the available list to the list of tests to run.

Delete test – Delete a test from the list of tests to run.

Move up – Shifts the current test up.

Move down – Shifts the current test down.

Reread – Discards editing results.

ID – Module identifier obtained from its header (data).

Key – Key, module “number” obtained from its header (data).

Length – Module length obtained from its header (data).

Check sum – Current module checksum obtained from its header (data).

Recalc. chk.sum. – Command used to read module checksum again after editing.

Available CERT tests – Tests included into the list of available tests in the CSPT module.

Test parameters – List of parameters for the currently selected test.

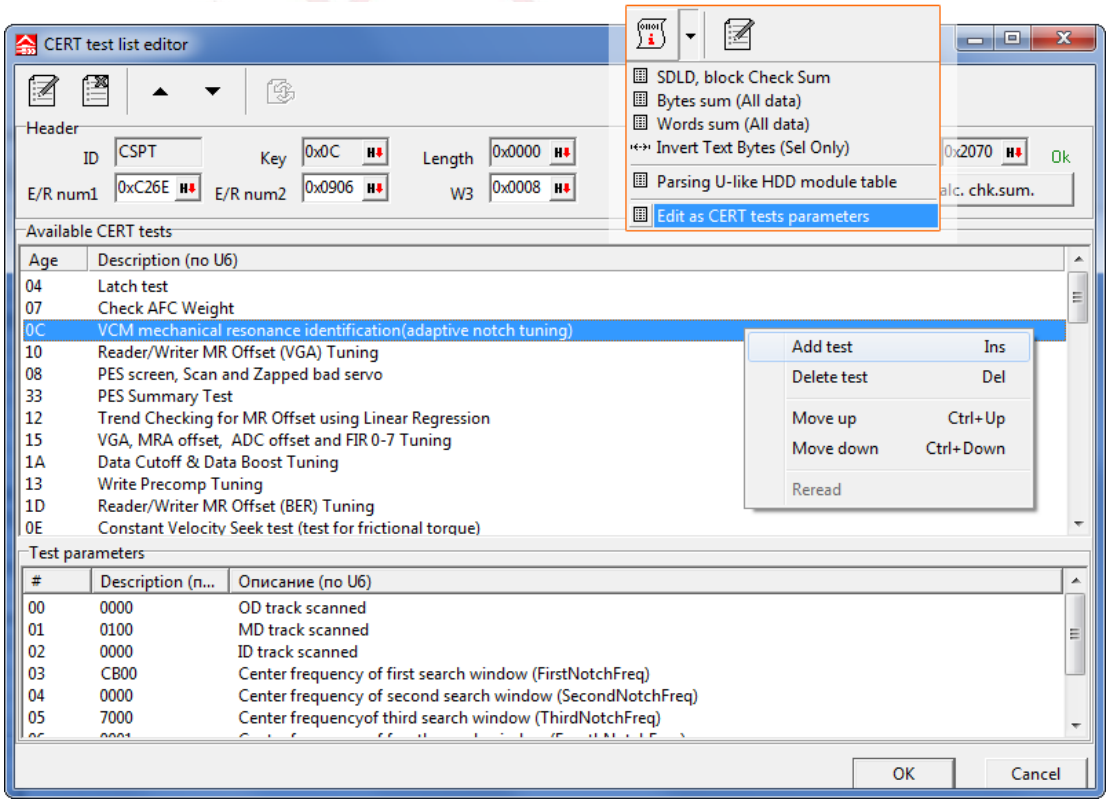

Fig. 6.23.

Attention! Since some tests in the series depend on each other, i.e. use the results produced by earlier tests, you should exercise caution while editing the table. On-going research of that aspect is in progress.

In order to add tests to the list, the utility displays the following dialog (Fig. 6.24).

To decrypt the CSPT module, you first have to load it to the «Service information objects» editor. Please find below the table of module key numbers for the CSPT module in different drive families:

HDD family	Key
U Series X	0xC
U4	0x4
U8/10	0x6
U6	0xB

Attention! The plug-in was originally designed for CSPT editing in U6 drive family only! Therefore, correct names of the tests and decrypted names of their parameters are not guaranteed for other families. At present, collection of data for decryption of names in other drive families is in progress.

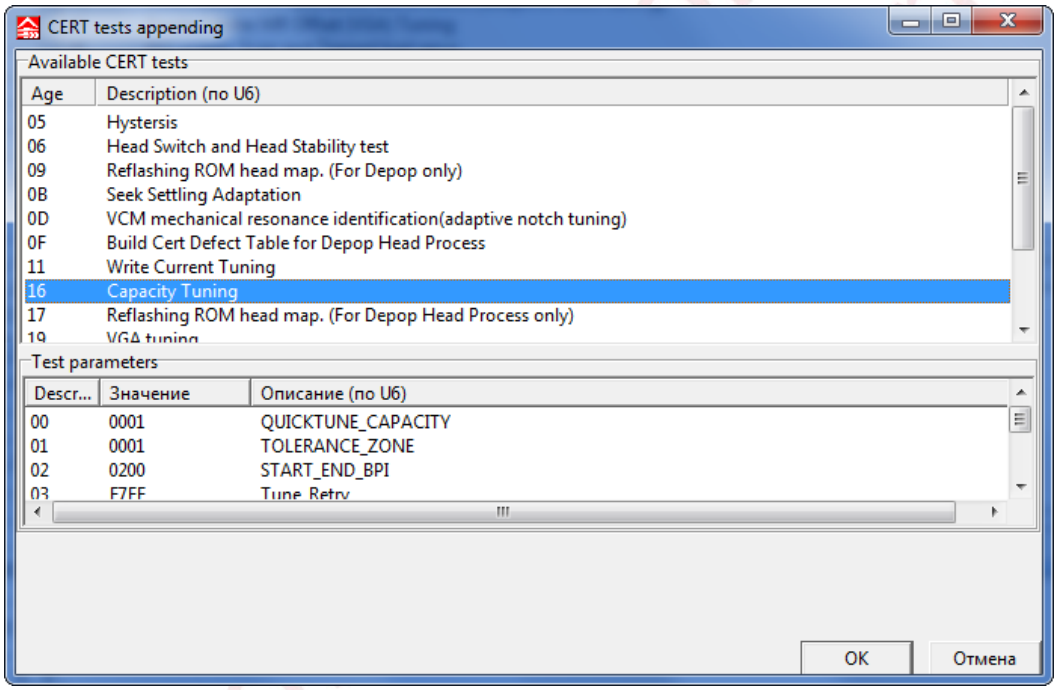

Fig. 6.24.

6.4. Parsing U-like HDD module table

The plug-in can be invoked from within the Hex editor from the «Service information objects» tool under the U Series X utility submenu. To use it, you first have to employ some method of loading into the Hex editor the data containing a drive's modules table. Please see the table below of such data sources:

HDD family	Source
U Series X	RSM0 module, key = 0x0D
U4	RAM dump in the ROM addresses area
U8/10	Flash module, key = 0x0
U6	Flash module, key = 0x0[1]

[1] For the U6 family the key = 0 module contains an invalid ROM image (one of its segments contains a portion of RAM content instead of actual ROM data), but it is sufficient for modules table parsing because the required information is preserved in its correct part.

Appearance of the configuration dialog for the modules table parser is demonstrated in the screenshot below:

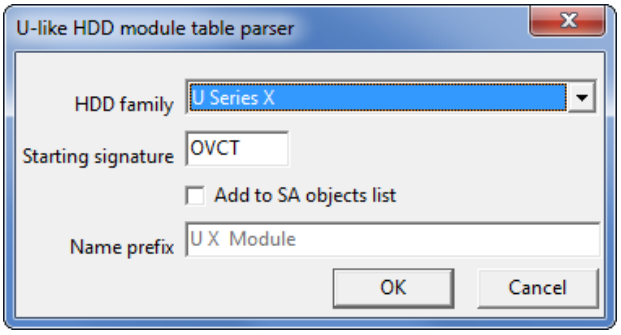

Fig. 6.25.

Here:

HDD family – HDD family for which parsing will be performed. You can choose U4/U8/U10/U6/ U Series X.

Starting signature – Signature of the first module record. It is substituted automatically during HDD family selection, but the operator can modify it.

Add to SA objects list – While parsing the modules table, the utility will add found descriptors of modules to the list of service information objects (see section 6.6. Specialized utility settings).

Name prefix – Prefix of the object name to supplement the list of service data objects (see section 6.6. Specialized utility settings).

Sample module tables for different drive families are provided below in a compact format.

U4

Key	ID	Initial sector	Length (sectors)	Numbers of cylinders
0x01	RW00	0x30	0x11	0x6F, 0x72
0x02	ATST	0x60	0x03	0x71, 0x74
0x03	SMRT	0x70	0xFF	0x71, 0x74
0x04	CSPT	0x4C	0x04	0x70, 0x73
0x05	CT_C	0x30	0x18	0x70, 0x73
0x06	CT_A	0x50	0x18	0x70, 0x73
0x07	FLS	0x48	0x04	0x6F, 0x72
0x08	DEF0	0x10	0x20	0x6F
0x09	DEF0	0x10	0x20	0x72, 0x73, 0x74
0x0A	RES0	0x00	0x02	0x64, 0x65, 0x66, 0x67, 0x68, 0x69, 0x6A, 0x6B, 0x6C, 0x6D, 0x6E, 0x6F, 0x70, 0x71, 0x72, 0x73, 0x74
0x0B	DIAG	0xA8	0x18	0x6F, 0x72
0x0C	SYS1	0x00	0x02	0x72, 0x73, 0x74
0x0D	SYS2	0x02	0x02	0x72, 0x73, 0x74
0x0E	SKIP	0xEA	0x01	0x6F, 0x72
0x0F	F_CT	0x00	0x100	0x6F, 0x72
0x10	F_AT	0x00	0x100	0x70, 0x73

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U10

Key	ID	Initial sector	Length (sectors)	Numbers of cylinders
0x01	RW00	0x10A	0x013	0x6F, 0x72
0x02	ATST	0x009	0x003	0x71, 0x74, 0x75
0x03	SMRT	0x080	0x106	0x71, 0x74, 0x75
0x04	CSPT	0x110	0x004	0x70, 0x73
0x05	OCCT	0x120	0x018	0x6F, 0x72
0x06	OACT	0x138	0x018	0x6F, 0x72
0x07	OCN1	0x150	0x018	0x6F, 0x72
0x08	DEF4	0x1A0	0x044	0x6F
0x09	DEF4	0x1A0	0x044	0x72, 0x73, 0x74, 0x75
0x0A	RES4	0x000	0x002	0x64, 0x65, 0x66, 0x67, 0x68, 0x69, 0x6A, 0x6B, 0x6C, 0x6D, 0x6E, 0x6F, 0x70, 0x71, 0x72, 0x73, 0x74, 0x75
0x0B	OAN1	0x168	0x018	0x6F, 0x72
0x0C	SYS1	0x004	0x002	0x72, 0x73, 0x74
0x0D	SYS2	0x006	0x002	0x72, 0x73, 0x74
0x0E	SKIP	0x10C	0x001	0x70, 0x73
0x0F	F_CT	0x009	0x100	0x6F, 0x72
0x10	F_AT	0x009	0x100	0x70, 0x73
0x11	OAT1	0x180	0x018	0x6F, 0x72
0x12	OVL6	0x1A0	0x018	0x70, 0x71
0x13	OVL7	0x1B8	0x018	0x70, 0x71
0x14	OVL8	0x1D0	0x018	0x70, 0x71
0x15	OVL9	0x118	0x018	0x70, 0x73
0x16	OVLA	0x130	0x018	0x70, 0x73
0x17	SCRT	0x019	0x001	0x71, 0x74, 0x75
0x18	VEND	0x01C	0x064	0x71, 0x74, 0x75

U6

Key	ID	Initial sector	Length (sectors)	Numbers of cylinders
0x01	OCCT	0x120	0x080	0x67, 0x6D
0x02	OACT	0x120	0x080	0x69, 0x6f
0x03	OCN1	0x150	0x080	0x67, 0x6D
0x04	RSV0	0x000	0x002	0x5E, 0x61, 0x64, 0x67, 0x6A, 0x6D, 0x70, 0x73
0x05	FTY0	0x204	0x080	0x67, 0x69, 0x6D, 0x6F
0x06	USR0	0x290	0x020	0x67, 0x69, 0x6D, 0x6F
0x07	LZT0	0x285	0x00A	0x67, 0x69, 0x6D, 0x6F
0x08	RW00	0x106	0x013	0x67, 0x6D
0x09	SYS1	0x002	0x005	0x6B, 0x71, 0x73
0x0A	SYS2	0x007	0x002	0x6B, 0x71, 0x73
0x0B	CSPT	0x102	0x004	0x67, 0x6D
0x0C	VBPI	0x102	0x00A	0x69, 0x6F
0x0D	F_AT	0x002	0x100	0x69, 0x6F
0x0E	F_CT	0x002	0x100	0x69, 0x6F
0x0F	ATST	0x011	0x001	0x6B, 0x71, 0x73

0x10	SCRT	0x020	0x001	0x6B, 0x71, 0x73
0x11	VEND	0x1A0	0x064	0x67, 0x6D
0x12	SATT	0x021	0x001	0x6B, 0x71, 0x73
0x13	STHR	0x022	0x001	0x6B, 0x71, 0x73
0x14	SDIR	0x023	0x001	0x6B, 0x71, 0x73
0x15	SERR	0x024	0x001	0x6B, 0x71, 0x73
0x16	SCMP	0x025	0x005	0x6B, 0x71, 0x73
0x17	SSLF	0x02A	0x001	0x6B, 0x71, 0x73
0x18	SCRT	0x02B	0x014	0x6B, 0x71, 0x73
0x19	SHLT	0x03F	0x065	0x6B, 0x71, 0x73
0x1A	SDRV	0x0A4	0x001	0x6B, 0x71, 0x73
0x1B	SHST	0x0A5	0x200	0x6B, 0x71, 0x73
0x1C	WRPT	0x2A5	0x001	0x6B, 0x71, 0x73
0x1D	CNGN	0x010	0x002	0x6B, 0x71, 0x73
0x1E	SLST	0x003	0x028	0x75
0x1F	2TST	0x030	0x001	0x75
0x20	6TST	0x031	0x001	0x75
0x21	SCID	0x2A6	0x001	0x6B, 0x71, 0x73
0x22	SCIY	0x2A7	0x001	0x6B, 0x71, 0x73

U Series X

Key	ID	Initial sector	Length (sectors)	Cylinder numbers
0x01	OCVT	0x00A	0x100	0x67, 0x7B, 0x8F
0x02	OVAT	0x120	0x100	0x67, 0x7B, 0x8F
0x03	EXCT	0x00A	0x040	0x6F, 0x75, 0x85
0x04	EXAT	0x120	0x040	0x6F, 0x75, 0x85
0x05	EMTY	0x000	0x000	
0x06	FTY0	0x0CA	0x080	0x69, 0x73, 0x7D, 0x87, 0x91
0x07	USR0	0x154	0x020	0x69, 0x73, 0x7D, 0x87, 0x91
0x08	LZT0	0x14A	0x00A	0x69, 0x73, 0x7D, 0x87, 0x91
0x09	RW00	0x17C	0x00A	0x69, 0x7D, 0x91
0x0A	SYS1	0x00A	0x005	0x6B, 0x7F, 0x93
0x0B	SYS2	0x00F	0x002	0x6B, 0x7F, 0x93
0x0C	CSPT	0x174	0x008	0x69, 0x7D, 0x91
0x0D	RSM0	0x000	0x004	0x67, 0x6D, 0x73, 0x79, 0x7F, 0x85, 0x8B, 0x91, 0x93
0x0E	VBPI	0x1EA	0x004	0x69, 0x7D, 0x91
0x0F	VEND	0x186	0x064	0x69, 0x7D, 0x91
0x10	ATST	0x012	0x001	0x6B, 0x7F, 0x93
0x11	CRCT	0x00A	0x060	0x69, 0x7D, 0x91
0x12	CRAT	0x06A	0x060	0x69, 0x7D, 0x91
0x13	CRC2	0x00A	0x060	0x73, 0x83, 0x87
0x14	RETY	0x027	0x002	0x6B, 0x7F, 0x93
0x15	SLBA	0x029	0x001	0x6B, 0x7F, 0x93
0x16	SATT	0x00A	0x001	0x6D, 0x81, 0x95
0x17	STHR	0x00B	0x001	0x6D, 0x81, 0x95
0x18	SDIR	0x00C	0x001	0x6D, 0x81, 0x95
0x19	SERR	0x00D	0x001	0x6D, 0x81, 0x95

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0x1A	SCMP	0x00E	0x005	0x6D, 0x81, 0x95
0x1B	SSLF	0x013	0x001	0x6D, 0x81, 0x95
0x1C	SCRT	0x014	0x014	0x6D, 0x81, 0x95
0x1D	SHLT	0x028	0x065	0x6D, 0x81, 0x95
0x1E	SDRV	0x08D	0x001	0x6D, 0x81, 0x95
0x1F	SHST	0x00A	0x200	0x65, 0x79, 0x8D
0x20	WRPT	0x023	0x001	0x6B, 0x7F, 0x93
0x21	CNGN	0x011	0x002	0x6B, 0x7F, 0x93
0x22	SLST	0x08E	0x028	0x6D, 0x81, 0x95
0x23	2TST	0x024	0x001	0x6B
0x24	6TST	0x025	0x001	0x6B
0x25	SCRT	0x020	0x001	0x6B, 0x7F, 0x93
0x26	SCID	0x021	0x001	0x6B, 0x7F, 0x93
0x27	SCIY	0x022	0x001	0x6B, 0x7F, 0x93
0x28	RSM1	0x000	0x006	0x69, 0x6F, 0x75, 0x7B, 0x81, 0x87, 0x8D

6.5. Features available from the streamlined loading menu

6.5.1. Packet flow loading

As we have mentioned before, Barracuda drives support a number of commands for fast binary streaming of data to HDD. The data is loaded from the tracks previously read from a HDD. If the data is being written from the database, you can search within it for the required data using the filter. The utility supports the mechanism for the following objects:

- Flash;
- CERT code;
- CERT tables;
- App code (for drives equipped with Serial Flash only, see section [1]);
- ATA overlay (for drives equipped with Serial Flash[2] only due to some specific peculiarities of the track containing ATA overlay).

The order in which the objects are loaded and started is determined by the firmware structure (see section 4. Overview of firmware structure in Seagate Barracuda drives). Commands to load CERT code, CERT tables, ATA overlay are executed on level T, which is provided for by the loaded and running App code. App code can be loaded by the drive itself, ie from the disk surface, or it can be loaded from the streamlined loading menu dialog. The dialog appearance is shown in Fig. 6.26.

[1] See section 4. Overview of firmware structure in Seagate Barracuda drives.

[2] See section 4. Overview of firmware structure in Seagate Barracuda drives.

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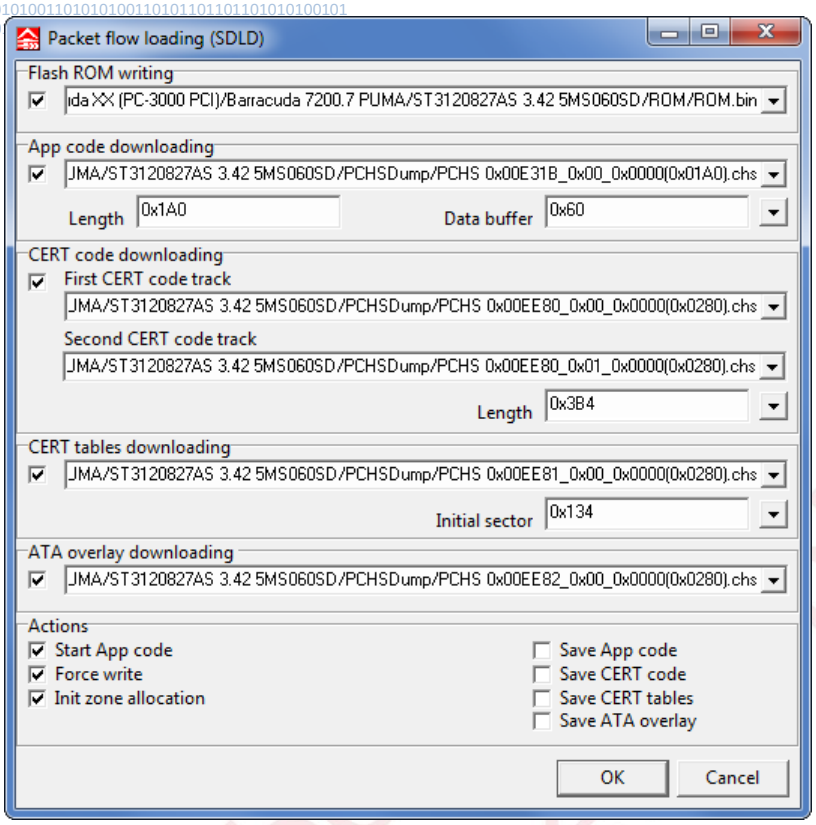

Fig. 6.26.

The dialog contains additional parameters for the «App code», «CERT code», and «CERT tables» objects required to load them. These include, respectively, the length and source buffer for App code, CERT code length and initial sector for CERT tables. These parameters are filled in from the search filter when you select track files in the database or, if you are writing from a profile, you can fill them in by selecting the required object in the dialog that opens after clicking the drop-down list box to the right of the parameters. In both cases, the choice occurs within the list of SA objects which can be edited in the specialized utility settings dialog. These settings need no corrections unless you encounter a nonstandard situation resulting from the modification of drive boot-up parameters. The method necessary to check and specify these parameters is described in section 4.3. Identification of parameters for SA objects.

In addition to the above, the dialog allows for saving to the disk surface of SA objects already loaded to RAM such as App code, CERT code, CERT tables and ATA overlay. Saving features are available for drives with a loaded running MOS command handler and initialized subsystem for operations with the service area. App code acts in this case as such a handler. If App code is loaded from the dialog using the SDLD mechanism, SA items can only be saved after Self Test. This is because the latter performs all of the procedures required for SA calibration and initialization. Alternatively, you can first perform a command to load System Sectors from disk surface.

In a typical situation there are two steps required for a drive with defects after Self Test launch: ATA overlay loading and ATA overlay saving. After that, you will have to record sector 4 of the Vendor track containing the HDD ID template (Stuff), as it has been mentioned above. You can load the ATA overlay before the second Self Test routine starts (Age = 2), then recording of the overlay the disk surface will be performed by test 2.

Attention! In some drives the command loading ATA overlays terminates abnormally after CERT code loading (please see the descriptions of family-specific peculiarities)!

6.5.2. Saving LDR from HDD

You can use the «Saving LDR from HDD» menu item to read, in automatic mode, a set of resources such as ROM, App code, CERT code, CERT tables, ATA overlay (two overlays for some drive families), Stuff (HDD ID template) and sector containing the drive hardware log from a HDD. The dialog shown in the screenshot below allows you to select the which objects will be saved to the loader and its location (Fig. 6.27). The feature can be conveniently used to save all objects in common storage completely automatically without user participation. The utility saves only the selected firmware part reducing the time required for loader creation.

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Attention! Drives using Parallel Flash memory chips have no such object as App code; consequently, operations with it are blocked.

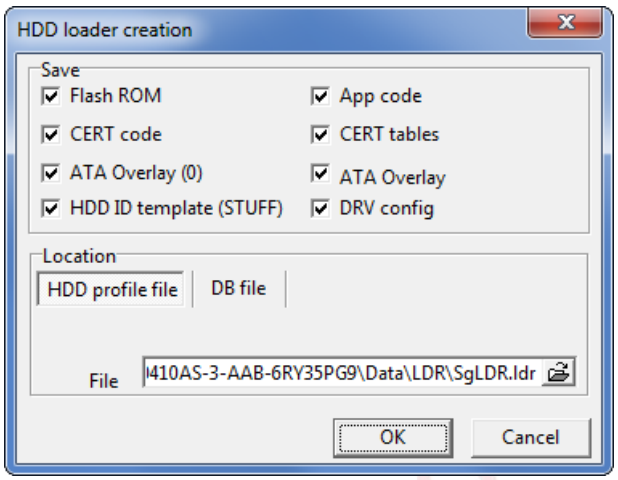

Fig. 6.27.

During loader creation the utility attempts to automatically identify the parameters of the objects it saves using the methods described in section 4.3. Identification of parameters for SA objects. It outputs respective messages to its operation log. Once the procedure is complete you are advised to run a test loader download to the HDD without saving of the parameters.

Caution! ROM loading and HDD ID template recording should not be performed during the test.

The DRV config object is the sector containing the drive hardware configuration log. It is the initial Vendor data sector (the Vendor track contains a Vendor data area, which follows firmware data located approximately at sector 0x15. You can check the number precisely tracing the «T>G0» command and using the «.» command). If the sector is in use, it contains approximately the following (or similar) information:

NumAttr=019
FIRMWARE_VER=3.01
DOM=20041228
BIRTH_DATE=20041220
HSA_DC=23
HSA_REV=C
HSA_PN=100358574
HSA_MC=8
MEDIA0_CODE=WM
MEDIA0_DC=4326
MEDIA1_CODE=WM
MEDIA1_DC=4346
MOTOR_PN=100335655
MOTOR_CODE=A
MOTOR_DC=0
MOTOR_REV=00
PRE_AMP_CODE=3
PRE_AMP_DC=42
PRE_AMP_REV=B
PART_NUM=9Y7383-R0

The information is recorded by the vendor. It allows identification of drive hardware for its analysis in order to find a donor drive when necessary.

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6.5.3. Starting LDR

The «Starting LDR» menu item allows you to download, to a HDD, objects from a previously created loader.

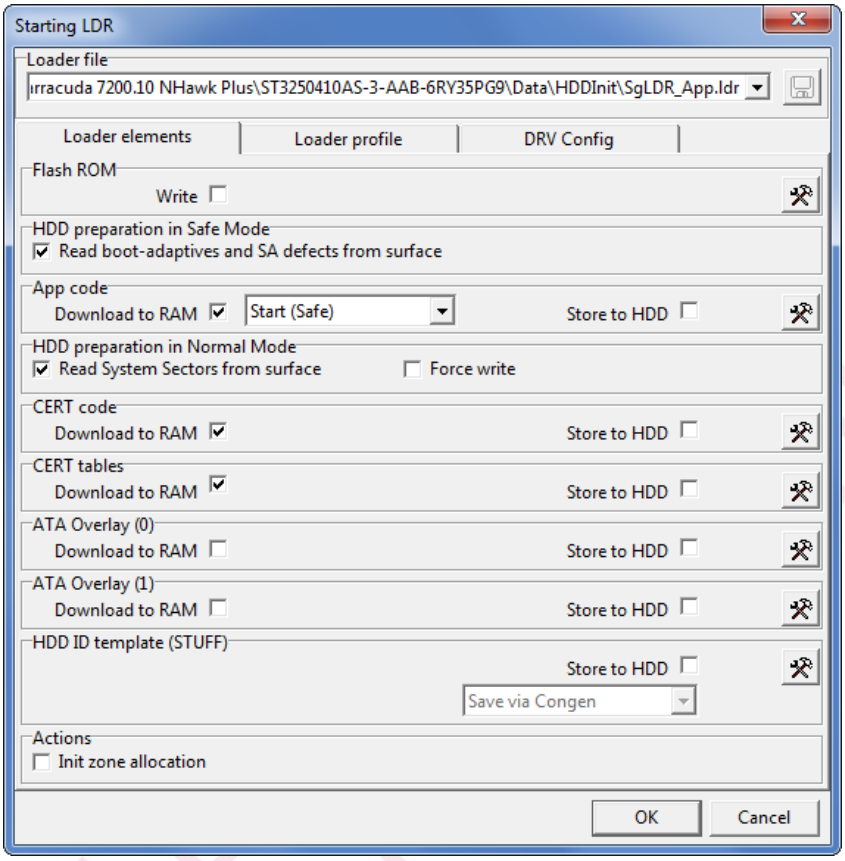

Fig. 6.28.

You can choose the loader to use from a profile or database. In the latter case you can employ an intelligent search for the required loader using filters. A loader may allow saving, to a drive with unreadable service area, a set of data required to initiate Self Test and analyze HDD condition, namely: App, CERT code, and CERT tables.

The «Loader file» line contains the complete file name (including its path) of the selected loader. The buttons to the right serve as loader selection and saving of a modified loader.

- The  button allows you to modify the content of the selected object. Pressing the button displays a dialog containing the Hex data editor and the object properties editor.
- The flash ROM section contains the ROM recording control.
- The HDD preparation in Safe Mode section contains an option to load, from disk surface, boot adaptive data and SA defects list. Enable the checkbox if you plan to use the current drive settings for reading from the surface or writing to it.
- The App code section contains the controls for management of the boot-up sequence, App code start and saving. Possible startup methods:
  - Skip start;
  - Start (Safe) –at App start the drive will skip reading System Sectors from disk surface (often useful when Self Test is initiated with the default settings);
  - Start (Init) –during initialization the HDD will read, from disk surface, all the data it needs.
- HDD preparation in Normal Mode contains an option to load System Sectors from the disk surface. During a standard start-up (e.g., because of a damaged head or App code / ATA ovl data) a drive often enters a permanent freeze state or produces endless knocking sounds. To avoid that, the utility reads, from disk

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surface, boot adaptive data, SA defects list, loads the App code from loader and starts it in Safe mode, reads System sectors and then checks drive heads and firmware.

- The Loader profile tab contains information about the HDD from which a loader has been read (Fig. 6.29).
- The DRV Config tab contains a table of the hardware components used to assemble the source drive, read from the appropriate firmware sector (see section 6.5.2. Saving LDR from HDD).

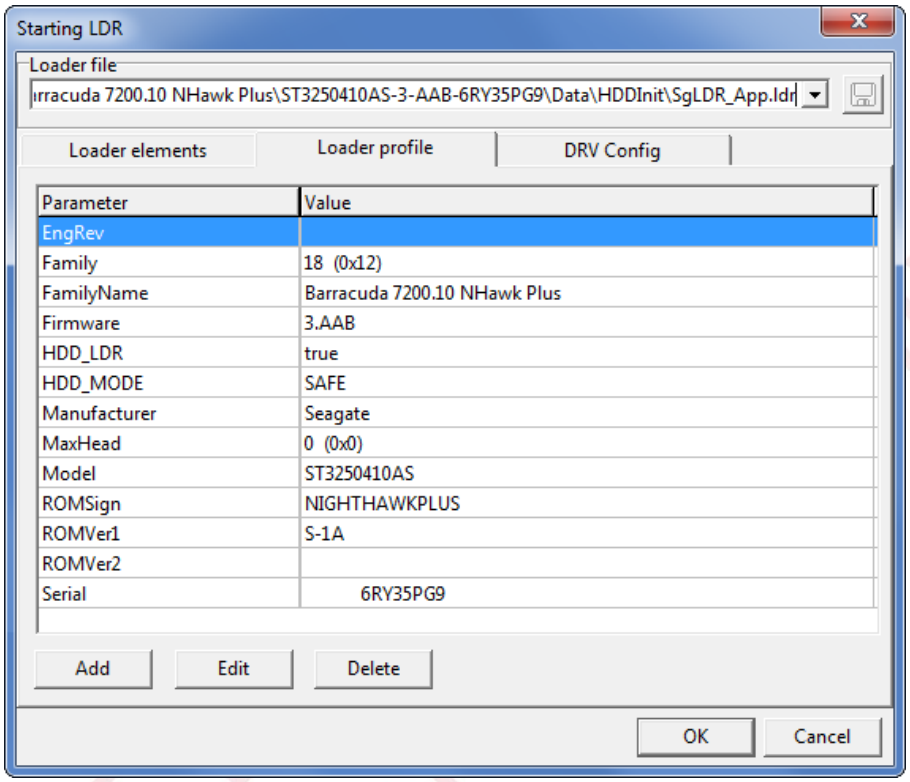

Fig. 6.29.

6.6. Specialized utility settings

In the «Tools» → «Settings» menu you can use the «Seagate U5, Barracuda XX utility» button to open a dialog of special utility settings, such as the list of SA objects existing in a given drive family, the list of drive models with parameters for that family and the list of custom commands. All parameters are family-dependent, i.e. selection of a certain drive family in the utility start menu allows editing of the utility settings pertaining to functions with the drives of that family. The Commands tab helps create batch command blocks. Each line of commands should either start with a certain key word or, if there isn't one, with an actual drive command. Sample tasks can be found in the utility configuration dialog within the User commands tab.

Key word	Description
COMMENT	Comment ignored during execution.
ESCAPE	Sends, to a drive, the character specified as ASCII code following the ESCAPE key word. Combinations of the [Ctrl]+[Latin letter] type can be entered as «^» + «Latin letter». Example – downloading CERT: «ESCAPE 18» or «ESCAPE ^R».
INP	Displays a prompt to enter a string parameter. The line entered after the INP key word will be output to the dialog title. The entered parameter can be used further in the terminal command transferred with the SENDP key

	word. You can use up to 16 requests to provide the text argument before sending the SENDP key word, which resets the argument counter to zero.
ALERT	Request for confirmation in «Are you sure?» style. Use it as a warning before a potentially destructive command.
LEV	Switches to terminal level specified after the LEV key word.
SEND	Sends, to a drive, the string following the SEND key word.
SENDP	Sends, to a drive, a string with parameter entered earlier using the INP key word. The parameter in terminal command must be replaced with «%s». E.g.: «s%s,0». You can use up to 16 text options. The SENDP key word resets the argument counter.
GET	Forces waiting until the drive outputs the string specified after the GET key word. Maximum wait period is 15 seconds.
FIX_PREAMP_BIAS_BUG	**This is a utility command (not a drive command)!** It makes the utility perform a few steps for correction of allowed BIAS table in HDD memory. It is necessary when a drive produces during Self Test the following message: «Preamp Sent Greater than Max Allowed Bias (xx-yy)». It is implemented for a few (not all) drive families.
TIMEOUT	Allows you to specify timeout for operations with the terminal.

7. Operation modes: Safe mode, Normal mode

Seagate drives can function both in regular mode (**Normal mode**: when a drive, during startup, reads its firmware (microprogram) and data from disk surface and initiates the user interface) and in **Safe mode.** In the latter case, the drive does not spin-up the spindle motor and does not read the service information, instead switching to terminal command mode. Although the selection of features available through the terminal in Safe mode is rather limited, it provides the minimum set of actions required for work with a HDD that produces knocking sounds. In particular, you can set the flag for initialization of adaptive data and overwrite service data partially, or completely[1]. Safe Mode has to be applied when a drive does not report on readiness in normal mode, e.g., because its heads are hitting a limiting stopper, or because the drive is freezing. To switch to Safe mode, you have to send the Safe mode signal to the drive and then power it up. The drive must immediately switch to terminal command mode. You can switch a drive to Safe Mode from the utility startup dialog and from the utility status dialog. Automatic switching is available in the main menu and the utility toolbar («Initialize Safe Mode» option).

[1] In Barracuda drives equipped with Serial Flash memory chips access to disk surface requires loading and starting of the App code.

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8. Terminal types: COM, ATA

Some Seagate drives which are based on Barracuda architecture can function both in COM and ATA terminal modes. The list includes U5, Barracuda I–IV. At power-on these drives immediately switch to work via the COM port. While running in COM terminal mode the drive has to be connected to the PC COM port via the PC-KALOK adapter, or to a USB port via the PC-USB-TERMINAL adapter (the PC-USB-TERMINAL driver is included into the software package). USB connection allows for better stability and much faster data transfer rates than the PC-KALOK adapter (up to 921000 Kbaud in 7200.7 and U series 7). The drives begin operating in COM terminal mode as soon as the power supply is turned on. You can enter the actual command mode by pressing [Ctrl]+[Z] in terminal. The drive will respond with «T>» prompt, at which point you can enter terminal commands.

While operating in the ATA terminal mode a drive has to be connected to the PC with a standard ATA cable used for all data transfer purposes. The HDD enters the ATA terminal mode after receipt of a respective factory (techno) ATA command. Therefore, to enter the ATA terminal mode, the drive has to report on readiness via its ATA interface. ATA mode should provide for a considerable increase in data transfer rate. Still, as we have noted above, some peculiarities in drive microprogram operation can cause the transfer rate to remain at the transfer rate typical of COM terminal running at 57600., Drive designers discontinued using the ATA terminal, optimizing instead the microprogram and improving the sustained rate of transfer via COM port.

8.1. Switching between COM and ATA terminal types

You can switch between the two terminal types in the «Utility status» dialog. There are some peculiarities related to switching between those modes.

Let us first describe switching from COM to ATA terminal. You can switch a drive to ATA terminal mode by using a special ATA command. However, a Seagate drive running in terminal command mode is unable to receive ATA commands, so you will have to exit the command mode first by restarting its microprogram. The task is accomplished by sending the command to restart microprogram. After the restart, you can change the mode of the drive and utility operation by selecting the ATA terminal type.

Now we can discuss switching from ATA to COM terminal. Here, a restart of HDD microprogram is also required. However, you cannot switch the utility to COM terminal mode immediately after sending the command to the drive because all start-up messages will be output to ATA terminal until the microprogram restarts completely, and the drive will keep waiting until all characters leave its buffer. The system is designed to remain in waiting mode until all characters are read from the drive buffer, i.e. a drive will never restart if you switch the utility to COM terminal mode immediately. It is quite easy to identify the moment at which microprogram restart is over and, consequently, you can finally switch the utility to operation via the COM port. In ATA terminal mode the utility reads data from drive using a command which does not function in regular mode. Therefore, when the microprogram completes the restart, you will see an error LED blinking on indicator panel of your PC-3000 system. According to our observations, it should be sufficient to wait until the «ATReset» notification appears in terminal, and switch modes after that.

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9. Diagnostics of malfunctions

Diagnostics of Seagate drives is performed on the basis of the messages which are output to terminal when a malfunction manifests itself. If a drive fails to report on readiness, you should take note of the terminal messages output at drive power-on. Please keep in mind that at HDD power-on the terminal functions at a data exchange rate of 9600. We shall describe typical HDD malfunctions arranged in a common list first, and then individually for each family.

9.1. Oxidization of the contact pads on the connectors between the PCB and HDA

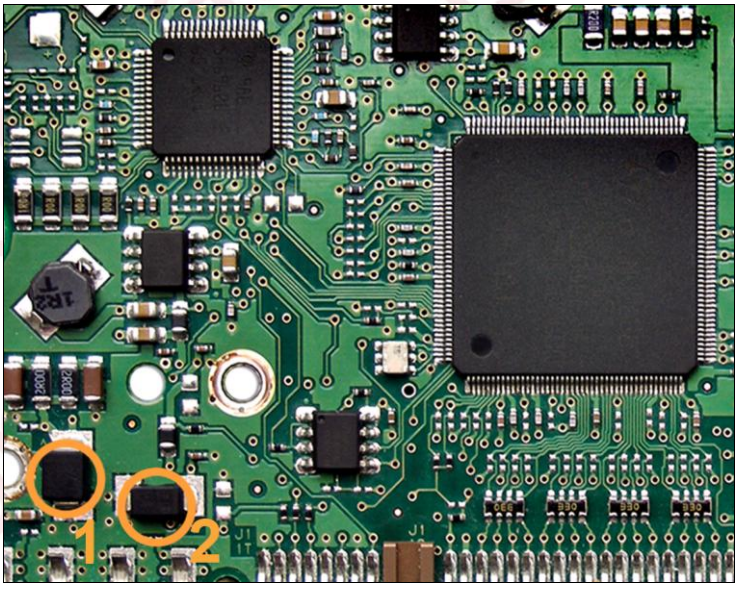
The problem can cause a lot of related issues and it can manifest itself in different manners. Therefore, when a drive arrives for diagnostics, a check of the contacts and their restoration, if necessary, must be one of the first steps. A common rubber eraser can be used for this purpose.

9.2. Protection triggered on the power supply unit at drive power-on

Such situations should be avoided by testing the drive's power supply lines before its power-on. If a short circuit is revealed, it might have been caused by burnt-out protective diode.

Power circuits in Seagate drives include components intended for protection of the PCB against damage resulting from overvoltage. They may be found on both 5 V and 12 V supply lines. Their original marking is TRANSIL, Transient Voltage Suppressors. Elementary diagrams of some PCBs, indicating the position of these components, can be found in the latter sections describing individual drive family peculiarities.

If one of the protective components burns out, but the remaining circuit remains undamaged, it is sometimes just a matter of desoldering the burnt component to restore drive operation. If future use of the drive is planned, we recommend replacing the component with an operational one to improve fail-safety of the drive in question.



1 – TRANSIL on +12V, 2 – on +5V.

Fig. 9.1. Protective components in Seagate 7200.10 HDD feed circuits.

9.3. No response in terminal at power-on

This situation means that PCB is either damaged or hanging because of a malfunctioning commutator chip. You can use the native board to check this by doing the following – insert insulating material over the commutator chip connector, install the PCB on the HDA and switch power on. If messages appear in terminal, there is a problem with the commutator. You can use a donor board, but please check the HDA first for a short circuit on the contacts of

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commutator power supply and heads positioning device controller. If a short circuit is revealed, replace the magnetic heads assembly together with the commutator.

9.3.1. Serial Flash data corruption

Corruption of data in HDD Flash memory is a rather common occurrence. In Seagate HDD families equipped with Serial Flash (see section 4. Overview of firmware structure in Seagate Barracuda drives) you can do without a programmer device, unlike the families based on Parallel Flash. To do this, you have to switch the drive to Safe Mode and then rewrite Flash in the utility in Safe Mode. In the simplest case you will have to send a Safe Mode signal in the utility (from its start-up dialog or from utility status dialog) and the switch on the drive's power supply (or use the Safe Mode initialization toolbar button for automatic switching). The HDD, at that point, must switch to terminal level «F>», then you may proceed with ROM rewriting. In a more complicated situation (e.g., when area containing the interrupt table is damaged) a drive may enter an endless loop while outputting the contents of controller register and will not react to the Safe Mode signal. To solve this problem you have to short-circuit pins 4 and 5 of the Serial Flash chip (Fig. 9.2).

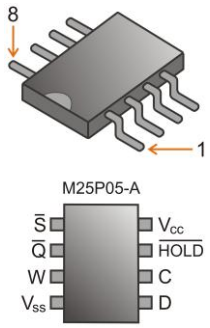

Fig. 9.2.

9.4. Endless «Head Mask ...», «HM …» output in terminal

This malfunction can be caused by a burnt-out commutator chip or lack of correct power supply on the commutator connector. In the case of such s problem you should examine the drive, checking it for signs of a short circuit by probing the commutator connector between the PCB and HDA. Compare, during the procedure, the resistance values between the power supply contacts of the commutator and ground and the corresponding values for a normal drive. Then, check the drive with a known functional PCB. You can also check whether +/- 5V power is supplied to the commutator connector of the drive PCB. You can find out the exact contacts where it should be present using a functional board, or by tracing the power supply components on the board.

9.5. The "unknown preamp type" or "preamp not supported" messages

These messages are caused by one of the following reasons:

- damaged commutator;
- non-native board;
- erased content of the Serial Flash ROM on the PCB. You can check whether the ROM is erased by reading it.

9.6. Lack of spindle rotation

Spindle rotation may be prevented by one of the following malfunctions:

- damaged PCB (in particular, the spindle motor controller chip);
- short circuit of coils (which can be checked by a measurement of the resistance on the HDA contacts);
- motor seizure;
- oxidization of the contacts between the controller board and the spindle motor contacts on the HDA.

Troubleshooting the problems with a seized spindle (see section 10.3. Spindle seizure) and s/c motor coils only makes sense when you need to recover data. In the case of a short circuit you can attempt to use a resistor in order to "straighten" the s/c motor coil, or install the disk in a donor HDA.

9.7. The «Application code incompatible with serial flash code» message

The message can be caused by one of the following reasons:

- non-native PCB (or just Flash content);
- App code read from disk surface incorrectly (e.g., because of heads contamination).

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You can attempt to read and analyze App code from disk surface. If readable information is retrieved, in the App body find the «Eng Rev» string and use the text string of firmware version next to it to decide, after analysis of statistical information (please see an additional appendix hereto), which ROM version is native for the drive. The required ROM version is often indicated in new drive families next to the «Eng Rev» string.

9.8. Testing drive heads

Drive heads should be tested using the algorithm described below. If a drive "freezes" during start (remains BUSY and does not respond to terminal commands), perform the operations described in step 1. If the drive does not "freeze" during start, proceed to step 2.

1) ***If a drive hangs at startup:***

- Switch the drive to Safe Mode.
- Load boot adaptive data and SA defects list (you can do that manually or using the commands[1] «F>R1», «F>R2», or with the corresponding command from the loader start dialog).
- Load App code (the easiest way to do that is through the loader startup dialog) and start it in Safe mode (from the loader startup dialog or using the «F>j,,1» command[2]).
- When the drive enters the T> mode, load System Sectors (from the loader startup dialog or using the T>R command).
- Load CERT code and CERT tables (the easiest way to do that is through the loader startup dialog).
- Proceed to actual testing of the firmware and drive heads.

2) ***Heads testing (beginning with this step, the algorithm can be used with drives that do not freeze during start).*** Firstly, you should try switching the heads manually. For a more precise diagnostics you will probably have to run test 4.

- ***Manual head switching test.*** First, you need to find out the number of heads in the drive. To do that, use the «;» command (semicolon). MxHd is the maximum head number. Then perform the series of commands:

```
T>/2
2>s444,0,22
2>U
2>H0
2>H1
...
2>Hx
```

where the digit following «2>H» stands for the number of the head being tested[3]. If a head can "see" the surface, switching will be performed, and the drive will produce the message «Head …», where the head number will be added instead of the ellipsis. If a drive produces other messages («$», «Head Mask» or «HM») or the drive freezes, then the head is damaged.

- ***Test 4.*** This test is intended for more thorough analysis of head condition. To perform it, the «T>T4» command must be sent to drive. Then the HDD will start sequential testing of allowed reading current values (BIAS) for all heads. During the procedure it will output, to terminal, a report similar to the following:

[1] For drives equipped with Serial Flash memory only.

[2] For drives equipped with Serial Flash memory only.

[3] The "2>s444,0,22" command to position over cylinder 444, head 0 is required because, during drive start, the variable used to store the current cylinder number in operations with the terminal can remain uninitialized; then subsequent commands will terminate with code FB, which means an invalid address.

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T>T4
Begin Test 04
ASCII logging on
LBA=1B4F93F1
ASCII logging off

ASCII logging on
Kick Off Test

Testing head 0...
DAC value = FD02
Biasing with current 0025mA
DAC value = FBEA
Biasing with current 0050mA
DAC value = FAD2
Biasing with current 0075mA
DAC value = F9BA
Biasing with current 0100mA
DAC value = F8A2
Biasing with current 0125mA
DAC value = F78A
Biasing with current 0150mA
DAC value = F672
Biasing with current 0175mA
DAC value = F55A
Biasing with current 0200mA
DAC value = FD02
Passed Max OD Bias Current = 0200mA. Limit = 0100mA

Head Mask FFFF - Switch to full int.
Spin Ready
Testing head 1...
DAC value = FCD7
……..

– and so on for all heads. If a head does not pass the test with some BIAS values, the head is damaged. If during BIAS sweep the drive freezes, switches to long (or endless) output of messages «$» or «Head Mask» or «HM», the head is also damaged. Here, the «Head Mask FFFF - Switch to full int.» message at the end of the example is produced after BIAS sweep and represents a part of diagnostic messages generated during recalibration; thus it is not an error message

9.9. Drive hanging at startup

The problem can be caused by corrupted firmware or damaged heads. To identify the source of the problems, you need to check the condition of magnetic heads first. To do that, you can use the procedure described in section 9.8. Testing drive heads. If the test reveals that freezing of the drive is not related to magnetic head damage you should check the firmware for damage. To do that, you can trace firmware loading or perform a test startup of a master sample loader, or directly compare firmware objects of the drive in question to the master samples.

After Self Test the App code can often get damaged (and ATA overlay can be erased altogether). Such drives can hang during startup. To solve the problem, you should perform the first (startup) portion of the procedure described in section 9.8. Testing drive heads, and then write App code and ATA Overlay to the disk surface.

9.10. Infinite or frequent message containing «$» in terminal output

Appearance of the «$» character in terminal means that the positioning subsystem has lost decoding signals from servo labels. The situation can be caused by the following reasons:

- partial damage to the preamplifier, impeding reading;
- damaged or contaminated heads;
- surface damage (scratches, BAD sectors).

Head contamination is the most frequent cause of such messages. If you need to recover data from such HDD, the heads have to be cleaned (see section 10.4. Head contamination) or borrowed from a donor drive (see section 10.1.1. Requirements of donor drives for MHA/ PCB replacement).

9.11. Multiple 43 and 47 errors during drive start

If a drive outputs, to terminal, a lot of 43 and 47 errors during startup, it either has lost the adaptive data required for recording or its heads are contaminated (this is more likely). If you do not need the data (just HDD repair is planned), you can run Self Test (see section 11. Self Test). If you need the data, then most probably you will most probably need to clean the heads or replace them.

9.12. Slow reading caused by the drive being constantly busy with internal surface test

Drive starts, returns ID and data, but functions very slowly. When a HDD is powered on (even if no reading or writing occurs) it constantly outputs, to terminal, messages similar to the examples provided below. The problem is caused by the presence of a large surface area (head) with unstable reading. The problem is accompanied with multiple terminal messages with codes 47 (ECC) and 37 (pending). Reading performance is highly degraded because the slow-down is caused by internal processing of the damaged area performed by the drive itself.

Reset
4096k x 32 DRAM
GALAXY - 1_Disk S-6B 08-30-06_15:36
HM SFI
!
(P)PATA Reset
Master
AT Er 00 Nwt Er 43 RdWr 0001f.01.0526
ATA St 50 Er 01 Op 00 0,0000/0/00,00 01 00
Niwot: 97f29ff7 b6 97f29ff7.3.640 0000 005f 0000 0000
DiskAccess ReadSector EC=43 at 00001f.01.0526

CE Log ErrCode=43 LBA=13b78 Type=5 Add To Pending 13b78
AT Er 00 Nwt Er 43 RdWr 0001f.01.052d
ATA St 50 Er 01 Op 00 0,0000/0/00,00 01 00
Niwot: 9ff79ff7 b6 9ff79ff7.3.640 0000 005f 0000 0000
DiskAccess ReadSector EC=43 at 00001f.01.052d

CE Log ErrCode=43 LBA=13b7f Type=5 Add To Pending 13b7f

CorrectWriteStart
AT Er 00 Nwt Er 13 RdWr 0001f.01.0527
ATA St 50 Er 01 Op 00 0,0000/0/00,00 01 00
Niwot: 00013b79 14 00013b79.2.510 0006 3642 0006 0000
Spare of 00013b79 failed

CorrectWriteStart
AT Er 00 Nwt Er 13 RdWr 0001f.01.052c
ATA St 50 Er 01 Op 00 0,0000/0/00,00 01 00
Niwot: 00013b7a 14 00013b7a.2.510 0005 3643 0005 0000
Spare of 00013b7e failed
AT Er 00 Nwt Er 43 RdWr 0001f.01.0548
ATA St 50 Er 01 Op 00 0,0000/0/00,00 01 00
Niwot: 9ff79ff7 b6 9ff79ff7.3.640 0000 005f 0000 0000
DiskAccess ReadSector EC=47 at 00001f.01.0548

CE Log ErrCode=43 LBA=13b9a Type=5 Add To Pending 13b9a

CorrectWriteStart
...

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To solve this problem in cases where there is no need to recover user data, running the Self Test procedure is recommended. If you need to recover user data, the PC-3000 UDMA + Data Extractor combination should be used. To do that, start the appropriate specialized utility and, during creation of a new task in DE, select the utility operations in the HDD initialization mode for work via ATA with App modifications. In this case the utility automatically selects the HDD initialization template containing firmware hacks that help avoid the problem with significant delay in HDD response to ATA commands. The actual solution for the problem is provided by the options to Fix Pending Bug, Fix Pending Bug' (fix 2). For details please see section 10.6. Additional utility features available in tandem with Data Extractor.

9.13. Problems related to a damaged head or lost reading adaptive data

The problem can be manifested as follows:

- Drive's inability to read service data using its head 0. In this case, start the corresponding loader and check reading using head 0. If reading is impossible and you do not need to recover the data, you can try running Self Test. If the data must be recovered, heads replacement is required.
- LBA-based reading of individual ranges (accompanied with heads knocking and «$» characters in terminal). For testing purposes you can switch to the command mode, then enter level 2 and use the «H»command to switch to different heads (see section 9.9. Drive hanging at startup). If knocking starts and the «$» character appears in drive output, the selected head must be disabled.

Warning! The situation does not apply to data recovery! If you need data, you should first recover it from the drive using the normal heads and then try head replacement from a donor drive to extract information for the skipped heads.

9.13.1. Head disabling using the «Y» command[1]

This command is available in all the drives supported by the suite. It allows disabling of the highest heads changing the drive type. To disable heads, select the type corresponding to a model using fewer heads. For drives preceding the 7200.9 family you can simply use the «;» command to identify the drive type and specify the new type with a number smaller than current by 1 (or more). For 7200.9 and some other drives (please see the information about peculiarities of drive families) the type should be selected on the basis of statistical information. There is a supposition that in those families the type is related to the bit map of the heads allowed for scanning, and the number of heads is the governing factor.

9.13.2. Head disabling using the «k» command[2]

The command allows disabling of drive heads in the middle of a heads stack (it cannot be used to disable head 0). The command functions on 7200.7 Alpine drives with firmware versions containing digit 5 after dot (e.g., 3**.** 54) and newer HDD.

9.13.3. Editing the serial number while disabling drive heads

This operation is necessary because, during subsequent launch, Self Test can discover and enable a previously disabled head causing its emergency termination. For the method for editing the serial number of drives equipped with Serial Flash memory please see section 4.1.1. Disabling heads.

The number of heads is known to be determined by the 3rd character of the serial number; the 2nd character reflects the subgroup of drives. Thus, you should modify the 3rd character whilst considering the second one. Information about possible pairs of characters can be found in App code, where the code includes a table that determines the correspondence between a pair of characters and drive type. Please refer to the sections devoted to family-specific drive peculiarities for details on correspondence between each type and appropriate pair of characters. The actual serial number editing is performed using the «#» command on T level in terminal command mode (see section 13.1.5. T level (0 level), the main test level).

[1] For details on the "T>Y..." command please refer to the Appendix 13. List of commands with descriptions.

[2] For details on the "T>k..." command please refer to the Appendix 13. List of commands with descriptions.

9.14. Problems pertaining to service data damage

Restoring access to data is often only a matter of integrity restoration of the drive firmware and the data it holds.

- Certain service information items have been overwritten. There is a useful aspect: a drive outputs diagnostic messages to terminal while it performs initialization at start-up and during subsequent operations. The messages can be used to identify the service data component pertaining to problem cause and the location.thereof E.g., the «OVERLAY FAILED» message means a problem related to ATA overlay; in that case you may try rewriting the said overlay.
- The problem may pertain to S.M.A.R.T. You will have to reset S.M.A.R.T. using the corresponding item from the user commands menu.
- The problem may also pertain to HDD ID information. The situation can be remedied by rewriting a part of the Vendor track (its sector 4 contains HDD ID template), its restoration from a loader, or by a command to initialize HDD ID and subsequent editing of it in a corresponding dialog.

9.15. Permanent capacity restriction

Some of the drives described herein support physical capacity restriction with a jumper (32G clip) in addition to capacity limitation via HPA. If complete HDD capacity cannot be restored using HPA or HDD ID editor, it may be worthwhile to consider shorting the the jumper. The jumper map can be found in section 12.

9.16. Drive detection as Slave only

The problem can be caused by a short circuit on the PCB or a spindle controller malfunction. One contact of the Master jumper is connected to the ground circuit, the other is linked through a resistor array to pin 59 of the SH6950 spindle controller chip. Thus, if the voltage at the contact is 0V, the drive will act as Master. If it is 5V – Slave. To identify the problem on the PCB, use a multimeter to ensure that:

- One jumper contact is connected to the spindle controller chip and the other is connected to ground.
- There is no short circuit between pin 59 of the spindle controller chip and the ground.
- Check, in the same manner, the Cable Select line (pin 60 of the spindle controller chip).
- Check working voltages on pins 59 and 60 of the spindle controller chip.

9.17. Password protection

The problem with password protection manifests itself in ABR errors returned by the affected drive in response to a command to read any sector by LBA. Bits indicating password protection are enabled in the HDD ID. Whatever the cause of password protection may be, in the end you will have to disable the password to restore access to user data. The utility includes a specialized wizard designed for password removal on Seagate drives (see section 6.2.2. «Security subsystem» wizard).

Please find information below regarding locations of password information in some drive families and the method for manual password removal provided as a reference. U5, Barracuda II-V, Barracuda 7200.7, 8, 9, 10, Momentus, and U Series 7 drives hold password information in one of the sectors occupied by Vendor track (see the table below). To remove the password, it is sufficient to write zeros to two first bytes of the sector. That can be accomplished using the «Service information objects» interactive wizard. To do so, select the PCHS tab (Fig. 6.15), and highlight the Vendor track and necessary sector within (see the table below), and specify the length as 1 sector. Write zeroes to the first two bytes, then write the sector back to the disk. After that you will have to toggle power supply off/on.

Family	Sector number in Vendor track
U5	5
Barracuda II	7
Barracuda III	5
Barracuda IV	5
Barracuda V	5
Barracuda 7200.7, 8, 9, 10	6
U Series 7	5
Momentus	6

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10. Data recovery

10.1. Problems pertaining to PCB damage

HDD malfunctions are frequently caused by damage to the drive controller board. In these cases, to restore access to user data on the drive you have to install a functional board from another drive of the same family using an identical firmware version. With Barracuda drives, the method is applicable to all families except for Barracuda II. In the Barracuda II drive family, replacement of the electronics board borrowed from a donor drive may cause overwriting of some data in Flash memory. After that, the swapped electronics board stops working both with the HDA of the drive being restored and with its native HDA. To minimize problems with Barracuda II, you will have to read the donor ROM firmware using the utility, or unsolder the ROM chip from donor PCB, read its firmware in a programmer device, then solder it back, all of this before replacing the board If you then encounter problems with spontaneous reprogramming of donor Flash ROM, you will be able to restore its original contents. A separate section in this manual describes board replacement in drives of Barracuda families using Serial Flash chips (see section 4).

10.1.1. Requirements of donor drives for MHA/ PCB replacement1

In order to find out whether a drive is suitable to be a donor for PCB or MHA replacement, you should consider several parameters indicated on drive label and the main PCB chip. Please note the «Configuration code» («Config»), «Firmware» and «Site code» lines on the drive's label (Fig. 10.1). Successful replacement is possible only when they match («Site code» influences MHA replacement but you can ignore it during board swap).

Mismatch of the «Configuration code» («Config») and, quite frequently, of the «Firmware» lines results in board incompatibility caused by the components used on the electronics boards (various PCB revisions use different chips, in particular, the read-write channel and VCM controller)., A proper replacement requires resoldering (or reprogramming) of the ROM from the drive being restored to the donor PCB because, while the firmware specified on drive label may match, its extended code portions still may differ. E.g., the label may state version 3.19 while the ROM may contain version 3.19.125. HDDs equipped with Serial Flash (Barracuda V, 7200.7, U Series 7) have a number of peculiarities described in a separate section.

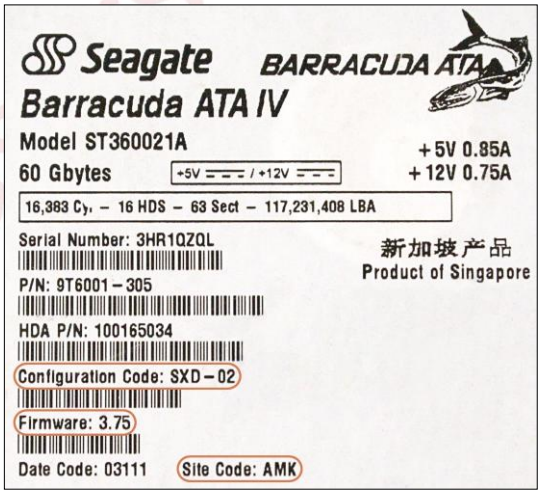

Fig. 10.1.

Attention! In addition to the main ROM (which may be located outside or inside the main chip), there is also built-in ROM containing the start-up firmware portion and the embedded code. The embedded code must be identical for a correct replacement of parts. That is a mandatory condition. Embedded ROM code version is specified in the first line of the marking on the main chip (Fig. 10.2).

Fig. 10.2.

Correct MHA selection does not require compliance with such strict conditions. Sometimes MHAs may even turn out to be compatible between different drive families, provided that they use identical read-write channels and VCM controller chip. Basically, you can use, for replacement,a MHA from a drive manufactured in the same country as the recipient drive («Site Code»). In some drives (Barracuda 4, 5, 7200.7) the following condition is essential: firmware version and country of manufacture (Site Code) must match completely. This is explained by the fact that recent lines of Seagate HDDs manufactured by different factories have some constructional differences. In particular, they are based on different preamplifier chips and MHA (which differ in some minor details

[1] We would like to thank Stanislav Korb who has kindly provided information for this chapter.

that have negative impacts on the opportunities for successful replacement). If a MHA seems to be compatible based on the parameters described above, you can use a MHA with a greater number of heads for replacement. E.g., you can take the MHA from a 4-head Seagate Barracuda ATA IV drive and use it as a donor component for a 2-head drive, if the country of manufacture and firmware versions are identical. In such case, the installation of a new MHA (with a greater number of heads) must be preceded by a strict current type specification in the recipient drive (Yxx on T level). The possibility of such replacement is explained by the fact that the tolerance of adaptive parameters in each zone is calculated while testing as an arithmetic mean of the sum of adaptive parameters – both for zones and for heads. That is why the chances of replacing MHA in a single-head drive with a MHA containing more than one head would be rather low, as the tolerance interval in such drives has an insufficient range of values. In general, the smaller is the difference between a donor and recipient drives with regard to the number of heads, the more stable data reading in the recipient HDD will be. The number of heads must be identical to allow optimal recovery conditions.

10.2. Identification and board interchangeability in Barracuda drives equipped with serial Flash chips

You can refer to section 4.2. Firmware architecture in HDD equipped with Serial Flash for the structure of drive firmware data. It specifies certain requirements for the scheme used to find a donor PCB (the scheme itself is described in the above-mentioned section). Statistical information about correspondences between individual firmware objects will be listed in a special appendix.

10.3. Spindle seizure[1]

Spindle seizure is fairly common in Seagate Barracuda HDDs. The drive's motor is unable to rotate the drive shaft. Quite often it may be very difficult to turn the shaft, even using manual tools. Such malfunction makes a drive unusable. However, user data from it are recoverable and the procedure sometimes does not even require disk replacement. The procedure required to disengage the seizure is described further using a Barracuda IV drive as an example. Let us examine Fig. 10.3 below to understand the target site for our operations.

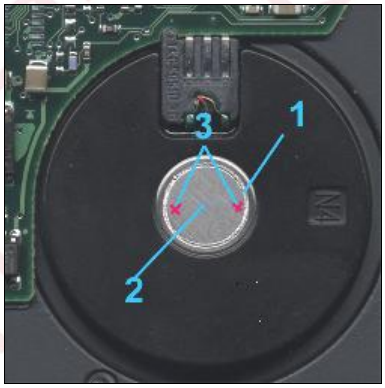

Fig. 10.3.

Here 1 – weld seam, approximately 0,5 mm deep (may be less), 2 – bearing cover, 2 mm thick.,
3 – locations where dia. 1.5 – 2 mm (smaller diameter is allowed) openings must be drilled, drilling depth – no more than 1 mm!

To remove the bearing cover, you will need a grinding wheel with a small motor or several openings drilled along the weld seam circle not deeper than 1 mm. You can use the grinding wheel to grind off the welding layer. You can also select a suitable cutter and use it with a milling machine, where available. Then, insert a modified screwdriver into the drilled openings (3) and turn the bearing cover. If the weld seam has been cut through properly you will not need excessive force to remove the cover.

Attention! It is essential to prevent debris from the cutting procedure from falling into the bearing. Therefore, wash off all the debris with alcohol before you remove the cover.

[1] The chapter is based on the article "Seagate Barracuda IV: how to release a jammed bearing" by Sergey Yatsenko. We would like to thank Ilya Noikin and Dmitry Dedkov for development of the method and Alexander Shashkov for provided tool photographs.

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Sample tools used for the d procedure above are shown in the photographs below.

Tool set for cover cutting

Screwdriver bit

Gripping device

Fig. 10.4.

After cover removal of the cover, you will see the following (or similar) picture:

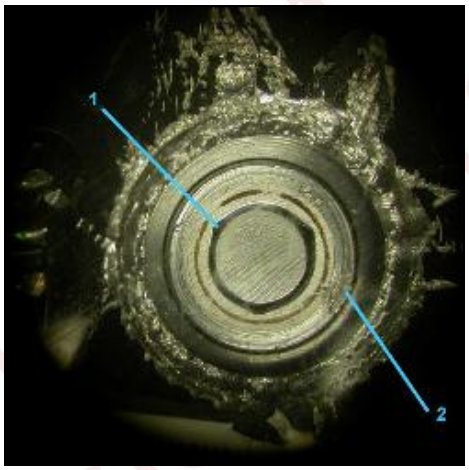

Fig. 10.5.

Here 1 – openings used for grease pumping (the grease is rather liquid and its quantity is sufficient, but it will not leak because it has magnetic properties and bearing cartridge is magnetized); 2 – the burr preventing normal shaft rotation.

Removal of the burr (you can pick it off with a screwdriver) or debris allow the drive to resume free rotation. However, rotation is only possible with the PCB facing up as the shaft is no longer supported by the cover and, therefore, moves freely in vertical direction.

Attention! Before you switch on the drive's power supply, you should close the opening (e.g., using a transparent adhesive tape), otherwise contaminated external air will be sucked into the HDA.

10.4. Head contamination

We have found a peculiarity in new drives (Barracuda 7200.7 and more recent models) where, to prevent scratching, the manufacturer covers disks with special film. As time passes the coating may peel off and contaminate drive heads, making it necessary to wash the heads with a special solution or replace the heads to recover user data. For details regarding cleaning of HDD disks and heads please refer to the web site of the Ontrack company who produce special solutions for that purpose at http://www.ontrack.com.

10.5. Peculiarities of HotSwap procedure

HotSwap is a popular method employed for data recovery in the case of problems with HDD service area. Essentially, it means replacement of a PCB on recipient drive with an initialized PCB from a donor drive. The HotSwap procedure may encounter certain obstacles with Barracuda II and Barracuda 7200.7 drives.

In Barracuda II a HotSwap procedure may cause overwriting of some data in Flash memory, and after such overwriting the borrowed PCB stops working, both with the recipient HDA and its native HDA. To minimize problems with Barracuda II, you will have to use the appropriate utility menu item to read ROM content from the donor board or unsolder the ROM chip from donor PCB, read its firmware in a programmer device, then solder it back, all before replacement of the board. Then, if you encounter problems with spontaneous reprogramming of donor Flash ROM you will be able to restore its original contents.

In Barracuda 7200.7 and newer families, every drive has its own zone allocation which seriously complicates data recovery after HotSwap. This peculiarity results in the appearance of large gaps while reading, or alternatively, blocks containing “garbage”.

Please keep these hotswap drawbacks in mind, such as foreign translator in controller RAM. Therefore, if you decide to use HotSwap, you will have to employ the respective tools for restoration of logical translation, such as DataExtractor.

10.6. Additional utility features available in tandem with Data Extractor

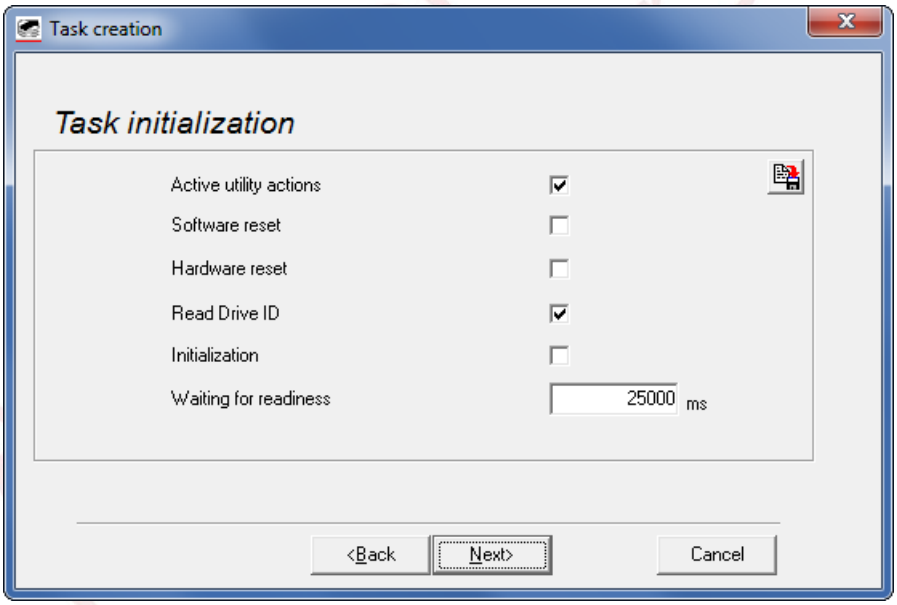

Fig. 10.6.

A regular HDD startup often reveals certain problems with the drive’s inability to enter the ready state and provide access to user data. This may be indicated by considerable delays in response to ATA commands (pending-bug), drive freezing during startup caused by a damaged head, etc. Interaction between the specialized utility and Data Extractor is intended to help obtain access to user data and provide some services, including fast building of the heads map via ATA. Apart from the main purpose (drive startup in a mode that allows working with it), some features speed up manipulation of a HDD in general, by bypassing internal operations causing errors, and protecting the firmware against corruption due to the functionality blocking its internal modification by the drive (e.g., G-List supplementing). There are four features that use integration between the utility and Data Extractor:

- HDD initialization at task launch (configured at task launch);
- special handling of HDD readiness loss (managed in task settings);
- special handling of HDD errors (managed in task settings);
- manual invoking of HDD initialization (available in the services menu).

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Since all integration variations have the same interface (*the settings are stored separately!*), we shall closely examine the method of launching Data Extractor using initialization at task launch/opening.

When you create a task with the Utility special actions option enabled, a brief wizard will start, suggesting the selection of the HDD initialization mode (the scenario selected for task launch will be copied to the scenario for handling of readiness loss), Fig. 10.7.

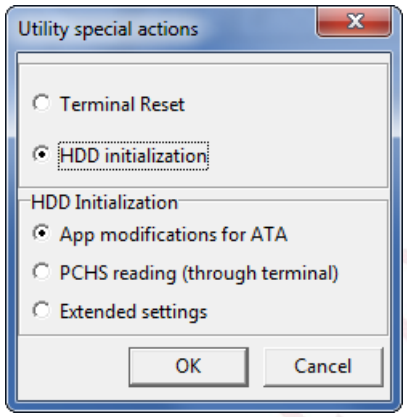

Fig. 10.7.

Selection of the «Terminal Reset» option will send, via terminal, the command to reset the HDD. Selection of the «HDD Initialization» option will instruct the utility to perform a number of steps to start the drive:

- The ***App modifications for ATA*** option enables a number of modifications to the HDD executable code that, in most cases, allows starting of a drive for work via ATA[1].
- The ***PCHS reading (through terminal)*** option enables a number of operations to start a HDD for reading via terminal in cases where its condition does not allow interaction via ATA (e.g., localized areas of surface scratches where HDD can accidentally position its heads when started in ATA mode, while processing the internal firmware algorithms).
- The ***Extended settings*** allows manual selection of the necessary operations.

Please keep in mind that if HDD initialization is selected, you will have to specify a HDD loader. It can be selected from a HDD profile or the suite database. For this purpose you can use a donor loader which is compatible with the drive, or a loader copied directly from the drive in question. At present, full functionality of the firmware fixes require only the presence of App code in the loader. If you additionally plan to load ATA overlay to the drive, the loader must also include the overlay. If HDD firmware contains two ATA overlays, you can just load overlay 0 with a fix which blocks loading of the 1st one[2]. If only the native loader must be used and the drive freezes during start, the following procedure is possible:

- Switch the drive and the utility into Safe Mode.
- Switch the HDD to work via terminal using the maximum stable data exchange rate (to read the loader quickly).
- Start the loader reading procedure and specify, in the creation dialog, reading of App code ONLY.

If a native App code is required, but its automatic reading to loader fails, you can try reading it from several copies[3] on the disk surface and then “assemble” it manually[4]. Please keep in mind that the loader is not a universal solution. If head 0 is seriously damaged, its use can render a drive unable to read critically important adaptive data, or even cause scratches on the disk surface.

[1] The list of available modifications will be examined in further detail.

[2] Two active overlays are not allowed to remain in memory at the same time.

[3] The list of App copies can be obtained in Safe Mode by using the “F>y” terminal command.

[4] Of course, this is only possible if various App copies are damaged in different parts.

Once the startup settings and loader are selected for HDD initialization, the utility reads the ROM image from the drive's RAM. The ROM image will be stored in a file in the LDR subfolder of the task folder. The utility will use the file from that location. Please note the following during the procedure:

- the HDD must be responsive to terminal commands before the task creation. If the drive freezes during startup, the utility should be used to switch it to Safe Mode first.
- If, for some reason, an existing folder is used and Data Extractor fails to clear it during task creation, the utility will assume that the ROM image has already been read and will attempt to adjust its algorithm to the existing file, causing unpredictable consequences during initialization startup.

Once all the necessary steps for initialization preparation have been performed, the utility will proceed to load the drive firmware objects. Please keep in mind the following aspects during the procedure:

- The algorithm implementation is protected Therefore, transferred data are encrypted first (approximately in 30-50 seconds) by the computer on which the suite is installed. After the transfer to the destination HDD, they are decrypted by the drive itself (approximately 40-50 seconds).
- If the HDD controller is damaged, the drive may freeze during start.
- If a donor controller is used and its RAM size differs from the original, the HDD may freeze during startup.

We shall closely examine the dialog of applicable options displayed after selection of «Extended settings» during task creation[1], or after opening of an existing task[2].

10.6.1. Extended settings for HDD startup

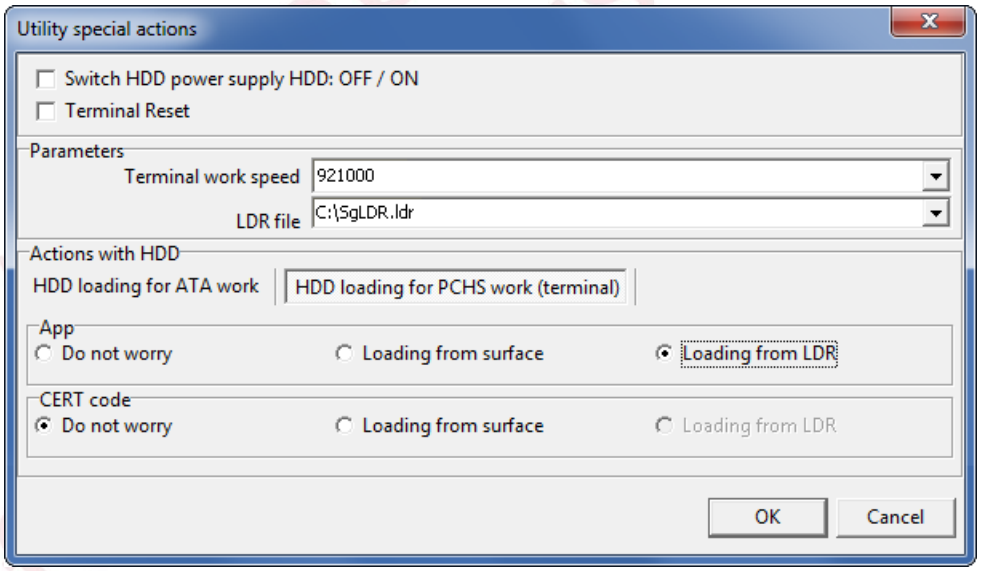

Fig. 10.8.

The extended settings dialog allows you to adjust the automatic HDD initialization template defined during task creation, as well as the parameters defined manually earlier. Let us review, in detail, the settings in this dialog:

- ***Switch HDD PWR supply: OFF / ON*** – selection of this option forces HDD restart using the power switch.
- ***Terminal Reset*** – the utility sends, to the terminal, the FW restart command. The option can be used together with Hard reset / Soft reset while handling HDD errors or readiness loss.

[1] Complete manual configuration is necessary.

[2] Already contains all the necessary parameters selected from a template, or manually.

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- ***The group of initialization parameters:*** Terminal work speed – terminal data exchange rate that will be used to transfer commands and associated data to drive, LDR file – the file containing the FW components necessary to start the HDD.

- ***Actions with HDD*** – select the start for work via ATA or terminal.

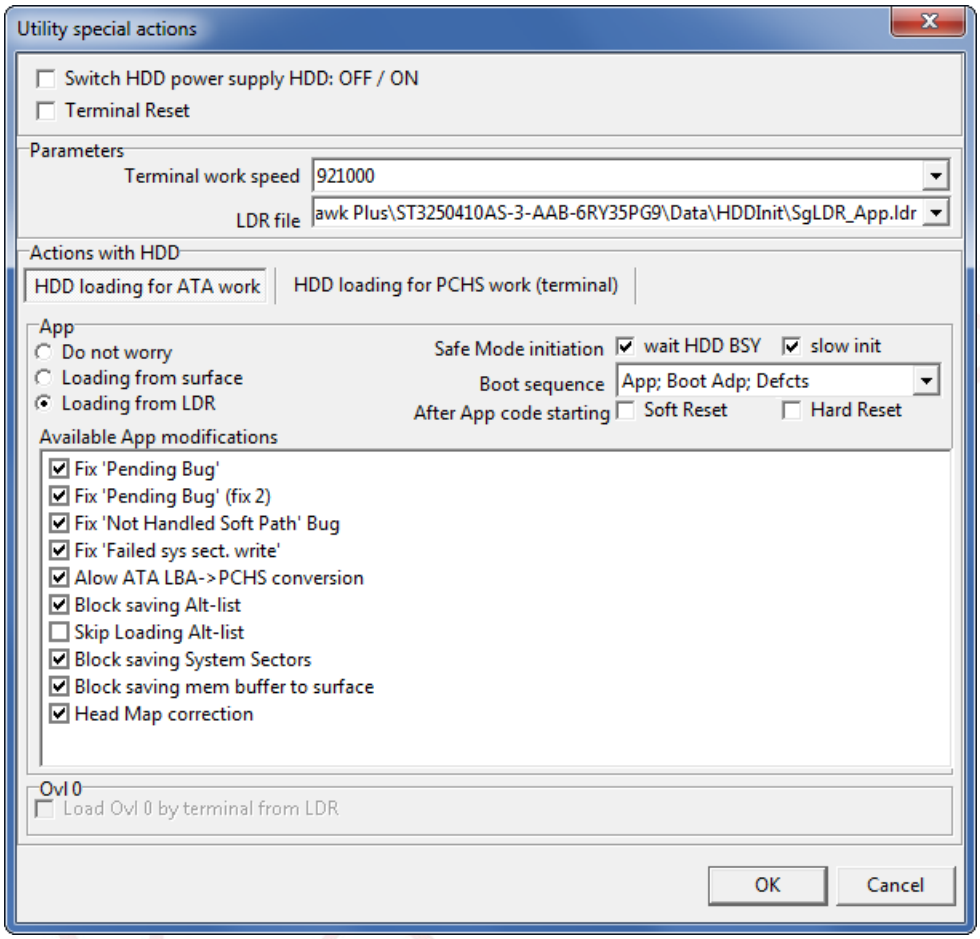

Fig. 10.9.

When work via terminal is selected, you can load App code / Cert code from the HDD service area, or from a loader. Consequently, the task settings should define reading through the utility.

When start for work via ATA is selected, you can use App code from the disk surface «Do not worry» – regular start without control of the loading procedure; «Loading from surface» – utility-controlled loading of App code from disk surface accomplished by sending appropriate commands), or use a loader as its source. When FW components from the disk surface, or loader, are used to start, the options for switching to Safe Mode are available: «wait HDD BSY» and «slow init». They are necessary in cases where the standard procedure for switching to Safe Mode does not initialize the SATA kernel of the drive completely[1]. Additionally, the dialog contains available FW modifications. Please note that at the time of this publication they only apply to App code. Consequently, the loader used in the procedure may contain only the App code. Furthermore, the modifications feature is provided as a part of the suite activation system rather than a part of the utility. This means that the list of modifications will be supplemented during setup and activated independently from the release of feature updates.

Let us examine the modifications available at present:

- ***Fix 'Pending Bug', Fix 'Pending Bug' (fix 2)*** – the fixes allow bypassing of the so-called Pending Bug (a situation when a HDD devotes 99% of its time to internal self-scanning processes), making the processing of ATA commands much slower (see the corresponding section for details). Both fixes disable the so-called

[1] The situation is as follows: terminal messages show that the HDD has been initialized completely and preceded to the cycle of ATA command processing, whilst all the interface indicators (error register, status register) are on or off.

offline scan of disk surface using different methods. They are separated to extend the applicability range of the fix algorithm.

- ***Fix 'Not Handled Soft Path'*** – the fix helps bypass HDD freezing which is encountered when the SMART subsystem is active and causing the terminal message «Not handled software path». When the fix is used, the message still may appear, but the situation does not cause the HDD to freeze.

- ***Fix 'Failed sys sect. Write'*** – the message appears when the SMART subsystem fails to update its logs because of writing problems. The fix disables the writing procedure, thus extending the HDD life in addition to acceleration interactions with it, as it blocks recording to the service area for SMART routines.

- ***Enable LBA→PCHS conversion by ATA*** – modification of the drive that allows quick building of the heads map in ATA mode[1].

- ***Solve the 'Ovl 1 not loaded' problem*** – the modification allows the bypass of the drive's inability to load ATA overlay 1 because of a problem or corruption of the overlay itself. During drive startup the message «Unable To Load Overlay 1» appears, then the HDD switches to command mode *T*>.

- ***Block Alt list saving*** – the modification blocks recording of an updated Alt list to surface, which occurs when the Autoreassign mechanism starts working as the HDD detects unreadable areas. Apart from accelerating work with HDD, the fix extends HDD life because it prevents SA recording by Autoreassign.

- ***Skip Alt list loading.*** If a HDD detects a problem with Alt list reading during startup, it can disable writing to disk surface[2] (in particular, making it impossible to load ATA Overlay 1), or attempt to restore Alt list. In situations where a drive has writing problems, some FW versions can enter an endless cycle of recording attempts (traced FW start looks like an endless sequence of ***cmd 56 …***). At present, the fix does not initialize the area of Alt list storage in RAM, thus causing garbage to collect there[3]. Therefore, the automatic use of it without a real need is not recommended. Furthermore, please keep in mind that when the Alt list content is correct and valid, the substituted areas described in it may contain critical user data.

- ***Block saving of System Sectors*** – the fix disables updating of the System Sectors data. Apart from certain improved functionalities with a HDD, it also extends its life by preventing SA recording in the adaptive data area.

- ***Block memory buffer saving to surface*** – disables the procedure which saves the service data used by some of the SMART routines (in particular, reset) and procedures which change the FW settings. Apart from improving certain functionalities with a HDD, it also extends its life by preventing SA recording in the unique service data area.

- ***Edit heads map*** – the option allows editing the physical heads map of a HDD to avoid a freeze or long MHA knocking whenever a damaged head is accessed. The method is based on substitution of a functional head instead of a damaged one through the drive heads translation table. Please keep in mind that the translation table of physical heads will be modified. Thus, if a HDD has disabled heads in the middle of the stack, their numbering will have to be adjusted accordingly. The procedure for identification of damaged heads is described in detail in the corresponding section. Here we shall only note that after the logical numbers of damaged heads are defined, they should be converted to physical head numbers before using them in this fix, based on the response to the «T>k» command. A ead number corresponds to its index in table, where the number in cell is the head selection code.

Fig. 10.10 demonstrates the original map of physical heads 00 01 02 03 04 05, which has been modified so that whenever head 4 is accessed, the drive will actually select head 3. This method allows you to prevent attempts to access the damaged physical head 04 which causes the HDD to freeze.

In addition to the opportunities mentioned above, the mode allows you to load the ATA overlay to drive's RAM, thus enabling a drive with a damaged overlay to start without the risk of corrupting essential service data by overwriting SA, and also in cases where service data recording is impossible in principle.

[1] Please see details further.

[2] Results in error 33 – Adaptives not loaded.

[3] Revision of the fix in order to enhance it is in progress.

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10.6.2. Creation of a heads map

Interaction of Data Extractor with the utility allows you to build the map of HDD heads. It will allow data recovery from the functional heads before you proceed to work with the damaged ones (in particular, to replace with donor heads). When creation of a heads map is selected, the utility displays a dialog requesting the selection of the map creation mode, Fig. 10.11.

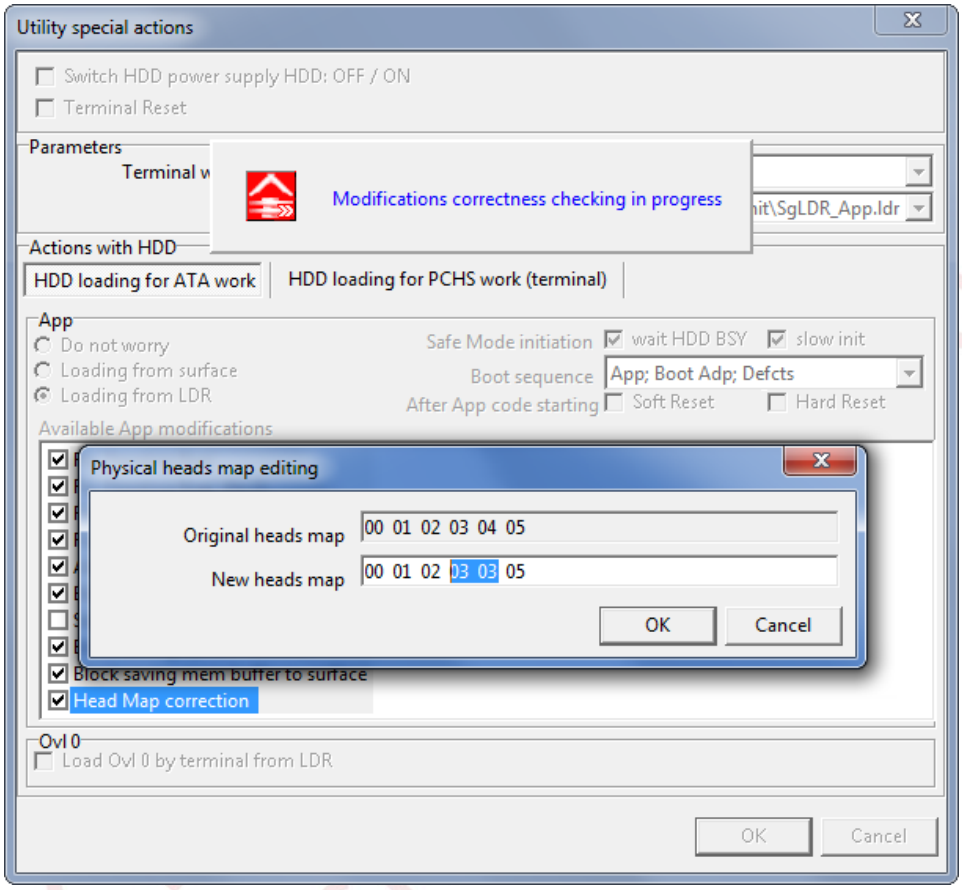

Fig. 10.10.

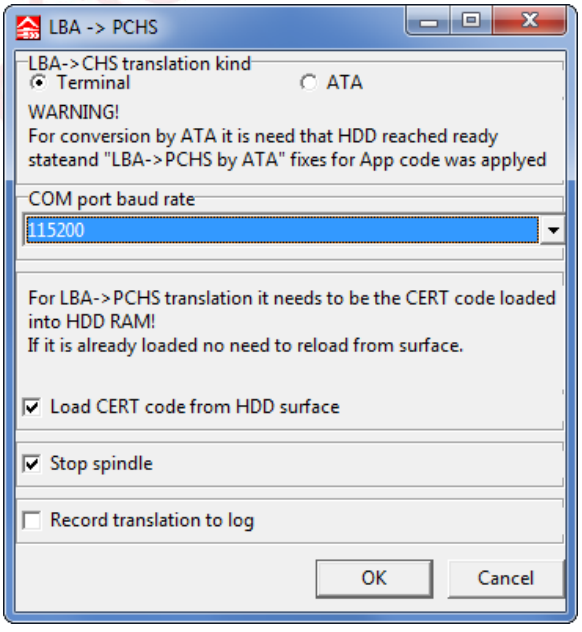

Fig. 10.11.

When working with a HDD in its original condition with its native firmware, you can build the heads map via terminal only. The procedure requires loading of Cert code[1] and a few hours of work performed by the suite (work via terminal is slow compared to ATA). However, using the appropriate App code fix during HDD initialization (while creating / opening the task or invoking it manually) allows you to build the heads map quickly (within a few minutes) via ATA[2]. Whether you are building the heads map via terminal or ATA, you can stop the HDD spindle for the duration of the procedure. This may be useful when dealing with damaged heads/surface because the HDD will waste no time processing requests caused by the surface errors / heads positioning. Please keep in mind that if a HDD has a physically damaged surface in the SA or parking area, each spindle stop and spin-up cycle increases the risk of developing a scratch.

11. Self Test

Self Test in Seagate drives performs adjustments of adaptive drive settings and scans the disk surfaces, detecting and reassigning revealed defects. It works as a fairly sophisticated tool because a large part of the factory diagnostics and HDD fine-tuning is accomplished using Self Test. Until now, there was a really serious obstacle preventing Self Test use in Seagate drives belonging to Barracuda family. During the process the Self Test routine erases some service data blocks essential for HDD functioning in user mode: ATA overlay (the actual program processing ATA commands and S.M.A.R.T.), HDD ID module, App code (in some drive families). This version of our suite provides opportunities for using the terminal to write the service data areas and initialize or edit the HDD ID.

In this manual we have provided the locations of some of the service area objects (including ATA overlay) in drive families supported by the utility. In addition to cylinder numbers, the tables contain offsets of object tracks relative to the beginning of the service area. That, in particular, allows for the identification of object locations in drives of the 7200.7 and newer families, where the SA may “drift” and occupy various cylinders. If you have encountered a situation where a drive's SA is located in a different place, you can employ the method described in section 4.3. Identification of parameters for SA objects to identify the coordinates of SA objects.

Prior to running Self Test you have to copy, from the drive, the data which may become corrupted during the procedure (ATA overlay, Stuff sector, etc.[3]), or create a loader from the drive (see section 4.6. Loader (definition)). The Self Test procedure can be started manually, or from the «User commands» menu. Prior to selection of the «Self Test» or «Extended Self Test» command, you should connect the drive to a seperate power supply unit. A complete Self Test cycle usually takes a few days. In the case of serious surface damage the process may take considerably more time, or even cause emergency Self Test termination. You will be able to monitor Self Test progress via terminal by connecting the drive to COM port.

Warning! If you are using the “PC-USB TERMINAL” adapter, do not disconnect it from USB cable because it will disable the virtual COM port, resulting in the need to restart the utility after reconnection! Rather just unplug the cable connecting the adapter to the drive, or disconnect the PC Seagate (PC SEAG.SATA) adapter from the HDD.

After Self Test is completed the drive will enter level 50 or, e.g., 4F (if an error occurs). In the case of an error you will have to analyze the Self Test logs to identify its cause. You can view the logs, beginning with level T, one by one (using the «E» command), or in a chain beginning with a selected log (the «T>D» command). For more details please refer to the section 13.1.5. T level (0 level), the main test level. During analysis you should check the test logs:

- 4 – shows heads status;
- 4D – log containing summarized information pertaining to the processing of drive defectoscopy tests;
- 4E – log containing summarized information about the health status of the drive during Self Test procedure.

If the error is not fatal you can switch the drive to Age 50 using the ATA interface (e.g., from the user command menu) and perform final flaw detection within the utility by using logical scanning with recording enabled. When Self

[1] The “tail” portion of Cert code is often located under a damaged head 1. This peculiarity causes certain problems while building the heads map. In that case the Cert code has to be loaded from an external source, for example, from a loader.

[2] If a HDD does not enter the ready state on its own, you will have to perform the operations necessary to make it reach readiness.

[3] See the description of specific drive family features.

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Test completes you will have to write the drive' ATA overlay, Stuff HDD ID template, and some other SA objects to the drive, if necessary (please see family-specific information).

Sometimes, after Self Test is complete, you may see that an error has caused the erasing of some other areas, in addition to the ATA overlay and HDD ID tracks. In this case the drive will report the missing objects in terminal after the drive is powered on.

Caution! Once you have launched Self Test, do not disconnect HDD power supply until the second test completes (for some drive families its number is 99, please see family-specific details). During that test the Self Test routine reformats the service area. If you interrupt Self Test before completion of the second test, you will have to rewrite the service data. You can identify completion of the second test by entering the «.» command which outputs the current Age.

Attention! If you are planning to launch Self Test, make sure that your HDD is connected to a seperate power supply unit. Doing so will help you avoid many problems.

11.1. The procedure for using Self Test in Seagate Barracuda drives

Selection of tests from Self Test groups (Age) can be performed using the «N» command on «T» level (for details on the «N» command refer to section 13.1.5. T level (0 level), the main test level). Self Test can be started using various Age values, but Age = 2 is the most efficient one. The service area will also be processed by this routine. Let us examine the procedure of initiating Self Test:

1) First you have to read and store the data that Self Test is likely to corrupt. You can perform the operation using the «Reading SA surface» and «Reading tracks group» dialogs, or create a loader (see section 4.6. Loader (definition)).

2) Connect the HDD to a seperate power supply unit which will power it throughout the whole Self Test procedure (approximately 24 hours).

3) If Self Test is started in Safe Mode, or if some heads have been disabled, you should use the «T>#,,22» command to define the HDD serial number. In that instance you may also have to modify the drive type – MDV or HDV. The current type can be found at the end of the string produced in response to the [Ctrl]+[L] command. Type switching is required if test 2 terminates abnormally with the «GC seek code error» message or a similar one (the text differs in various drive families). Switching commands: «4>c2» – for MDW, «4>c3» – for HDW.

4) Start Self Test in regular or extended mode.

5) Regularly monitor the Self Test status in the terminal (current Age can be checked using the «.» command). During this stage, you may detach the drive from the utility terminal (disconnecting the PC-SEAGATE adapter from the HDD) and connect it, from time to time, to monitor its status. This is the longest part, taking about 24 hours. However, it is largely dependent upon the condition of the disk surfaces and preamplifier/heads.

6) Identify the completion of Self Test, or its slow-down. Successful Self Test completion is manifested by the drive switching to Age = 50. An error is indicated by Age = 4F. In the case of a slow-down, the drive does not respond to the «.» command for a long time (the Self Test procedure includes some intervals, even when processing of resident commands is blocked for a certain time, which could be several minutes). You can also identify completion of the Self Test procedure as follows: use the Ctrl+D, Ctrl+O commands to enable the maximum level of detail to be displayed while reporting HDD microprogram operations (all values set to 1). The drive must respond to the commands accordingly. If it does not, it means that a slow-down has occurred. Self Test stop is manifested by a lengthy absence of new information about microprogram actions in the above-mentioned mode of maximum tracing details. We have noticed that that during Self Test a drive passes several very long tests (Age = 8, 33, 38, 6x), but extended tracing details show that it is frequently busy executing test subroutines (appending relevant data to the log). Therefore, it is simple to distinguish a long test (with rare standard output of results) from termination of testing when a drive is switched to a certain Age value. You can estimate the test status using the «.» command which outputs the current PCHS and LBA coordinates from drive variables.

7) If an error occurs (Age is not equal to 50 after completion of the tests), analyze the Self Test logs and decide what should be done with the drive. E.g., you can choose to disable one of the heads, perform additional manipulations with adaptive data on level 7 (commands «I», «d» – please refer to section

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13.1.8. Level 7, work with adaptive data), etc. After these operations you will have to restart Self Test. In the case of non-critical errors, you can switch the drive to Age = 50 and finish its restoration by scanning it on the logical level via ATA in the universal utility. Problems with heads or preamplifier, large corrupted surface portions, etc. are to critical errors.

8) Rewrite ATA overlay, restore HDD ID and other SA objects which were corrupted by Self Test, if necessary (see family-specific peculiarities), by rewriting their content from tracks saved earlier or from a loader. In this case you should choose, not just the loading of firmware objects to drive RAM, but its recording to disk surface as well! When a loader is used you do not have to enter the locations of the objects being recorded as everything is performed automatically. You will have to reset S.M.A.R.T. attributes. S.M.A.R.T. data should be reset after the HDD ID information is loaded to the drive's RAM. If you are recording HDD ID using congen, you can reset S.M.A.R.T. immediately. If HDD ID has been saved to the disk surface first, you will need to restart the drive, switching its power supply on/off or using the FW restart command (for Barracuda and similar drives it will be – [Ctrl]+[C]).

Attention! Recording to the disk surface in 7200.7 and newer drives (MDW type) has a peculiarity. After Self Test the service area may be shifted to other cylinders. Therefore, recording has to be performed to the cylinder determined by the new SA configuration instead of the original cylinder from which the data have been copied. To write the data you should use the dialog for writing to surface. The following procedure should be observed:

- B In the «Writing SA surface» dialog, select the track file containing the object being recorded from the HDD profile or database.
- Correct the cylinder number. To do that, select the target object (e. g., ATA overlay) in the objects list. The utility will automatically substitute the necessary value into the editing line with the required cylinder number.
- Proceed with actual recording by pressing the «OK» button.

9) If necessary (in the case of heads being disabled before Self Test), modify the drive type information in Stuff (see section 4.5. The structure of HDD ID template, Stuff (main parts))

10) When necessary, modify the HDD ID information in the HDD ID editing dialog.

11) Perform drive testing in the logical scanning mode. We recommend first recording to the whole disk surface, with subsequent reading or verification.

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12. Peculiar features of drive families

12.1. U Series X (C1), 5400.2(C2) drive family

Sample zone allocation table returned by the drive:

```
    1          2                3        4    4    4    4

VBPIConfig:    08     FF
RamHeadMap:    00     F1
Total Capacity=02692E8B
               SCyl          ECyl          H0    H1   H2   H3
               ----          ----          --    --   --   --
Zone 0:        00000064  -   00000095      576   NIL
Zone 1:        0000009C  -   00000FA0      981   NIL
Zone 2:        00000FA1  -   00001F40      900   NIL
Zone 3:        00001F41  -   000038A4      864   NIL
Zone 4:        000038A5  -   00004844      816   NIL
Zone 5:        00004845  -   000057E4      792   NIL
Zone 6:        000057E5  -   00006978      748   NIL
Zone 7:        00006979  -   00007B0C      720   NIL
Zone 8:        00007B0D  -   00008980      672   NIL
Zone 9:        00008981  -   00009A4C      648   NIL
Zone A:        00009A4D  -   0000A7F8      617   NIL
Zone B:        0000A7F9  -   0000BF68      576   NIL
Zone C:        0000BF69  -   0000CD14      528   NIL
Zone D:        0000CD15  -   0000DB87      518   NIL
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec) for the Hi head.

Service area: under study. It seems to be Zone 0

ATA terminal is present

Command «V» (output of defect list) is not supported.

BootCode (SafeMode): standard scheme of levels.

The «T>#» command for serial number change does not work because the extended commands handler intercepts it. Serial number correction method is unknown as yet.

12.1.1. Typical malfunctions

This drive family is very close to Barracuda 5400.1 both in terms of functionality and layout appearance. The PCB components in these families are totally identical. The following malfunctions occur most often:

- Failure of protective diodes in +5 V and +12 V circuits. The problem is frequently accompanied by a burnout of the contact pad oriented towards the connector. A part of the conductive line, the contact pad may get damaged. In order to restore the HDD operation you will have to repair the line. The diode is not critical for HDD functioning.
- Failure of the microchip controlling the spindle motor and VCM. PCBs fall into two types according to the type of spindle and VCM control chip: electronics boards using Smooth 100222354 and Smooth 100256186. The latter is equipped with a heatspreader pad in the base and therefore burns much less frequently than the former.

Sometimes a HDD does not function with power supply units that have +5 V supply voltage higher than the rated values (5,05 – 5,10 V or higher). Such drives produce scratching sounds with the head. A sufficient repair method would be to lower the 5 V supply voltage to 4,80 – 4,90 V.

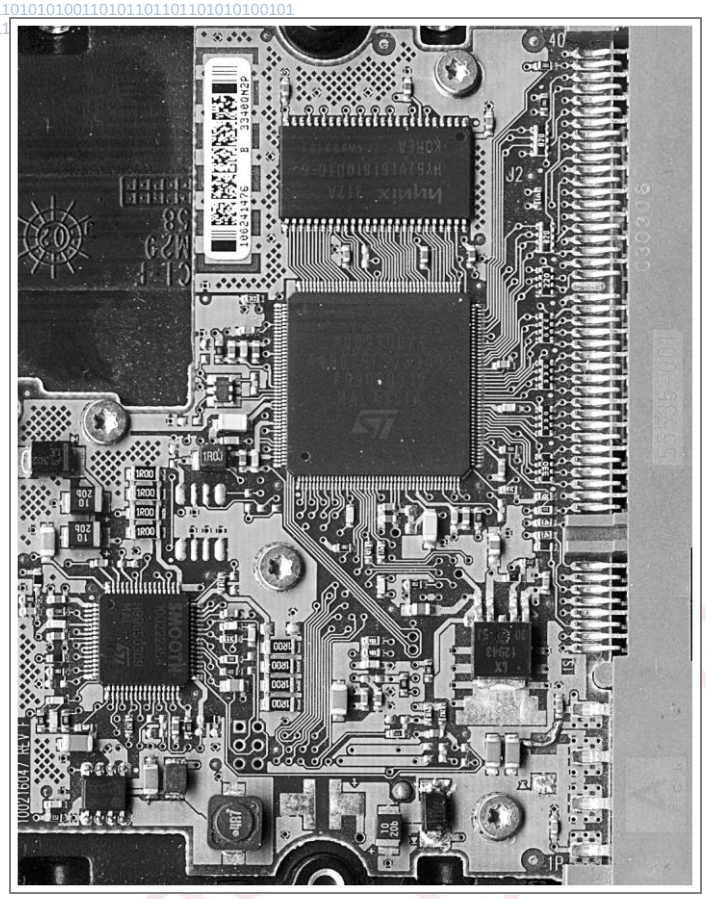

Fig. 12.1.

12.1.2. PCB layout

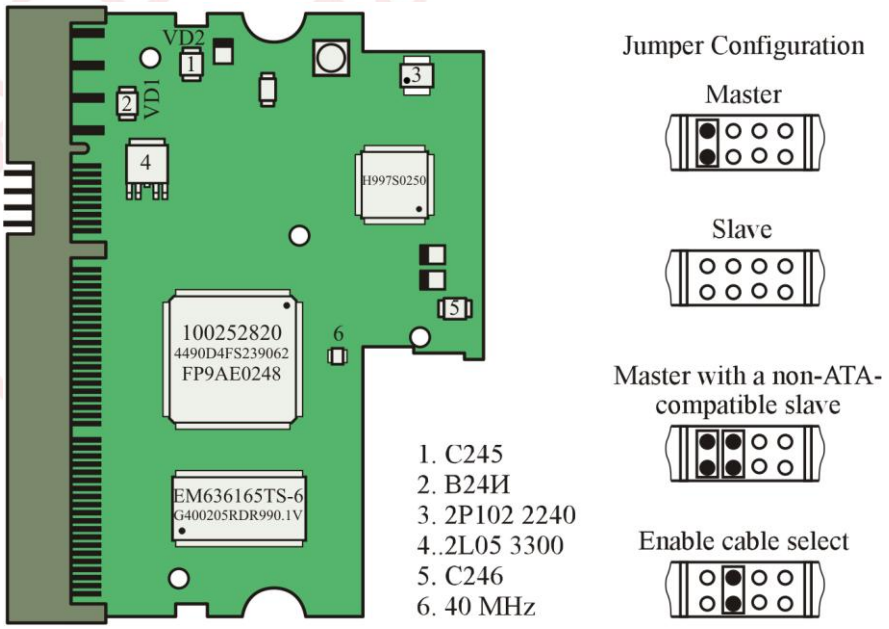

Fig. 12.2.

Here VD1 is a protective 5 V diode, VD2 is a protective 12 V diode.

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12.2. U5 drive family

Sample zone allocation table returned by the drive:

```
    1         2              3        4
Zone 0:     0006     -     0C7E     800    389.020
Zone 1:     0C7F     -     1750     785    382.415
Zone 2:     1751     -     26DD     768    367.059
Zone 3:     26DE     -     3268     729    355.294
Zone 4:     3269     -     3C10     704    342.588
Zone 5:     3C11     -     4718     672    325.378
Zone 6:     4719     -     4FFB     640    311.634
Zone 7:     4FFC     -     56C7     614    301.176
Zone 8:     56C8     -     5BAB     595    292.318
Zone 9:     5BAC     -     6335     576    276.706
Zone A:     6336     -     6A1D     537    265.412
Zone B:     6A1E     -     7068     512    251.641
Zone C:     7069     -     72C8     493    244.706
Sys= 42FD-4323
Total LBAs = 013143AB
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec); «Sys=» – stands for service area coordinates, Here it means the initial and final cylinders (hex).

Service area:

Service area SPT – 0x26C
CERT track – 0x4304 (offset[1] 0x07), 0x96 sectors must be read
ATA overlay track – 0x4305 (offset 0x08), 0x50 sectors must be read
VENDOR data track – 0x4307 (offset 0x0A), 0x100 sectors must be read

ATA terminal is present.

Command «V» (output of defect list) is supported.

BootCode (SafeMode): standard scheme of levels.

12.2.1. Typical malfunctions

The following malfunctions occur most often:

- Failures of +12 V pass-through diodes of the microchip controlling the spindle motor and VCM, and some components supporting its operation (the HDA does not usually suffer in such cases).
- Failure of the reading-writing channel on the drive's PCB (this malfunction is not common in HDDs of this family).

These drives are typically based on a BGA microcontroller chip. Its pad may be completely, or partially, filled with compound. In our experience, drives where the pads are completely filled with compound are more robust.

The surface of the microcontroller chip is completely covered with compound and heats and cools. A microchip which is only covered with compound in the center heats up in the center. It does not heat up much along the edges. Therefore, as time passes, such conditions cause thermal micro deformations of the controller which may degrade some contacts between the controller and the electronics board, causing a problem with BGA mounting.

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. E.g.: Sys= 42FD-4323, ATA overlay offset is 0x08, then ATA overlay cylinder is 0x42FD+0x08 = 0x4305.

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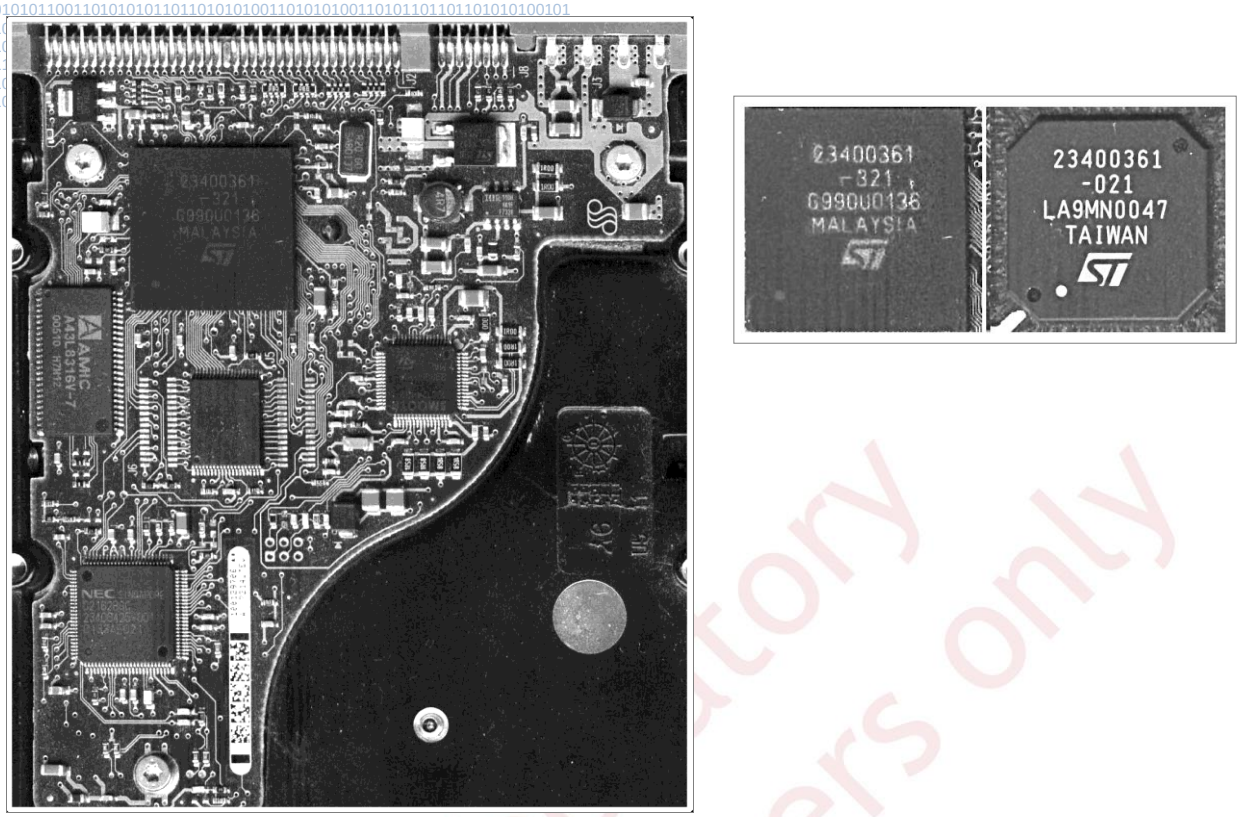

Fig. 12.3.

12.2.2. PCB layout

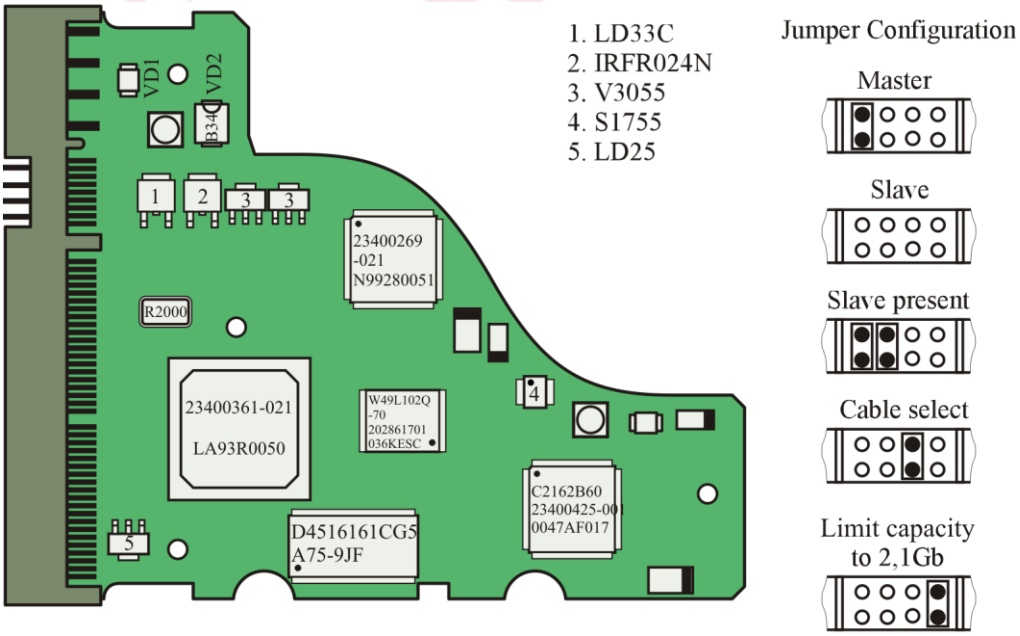

Fig. 12.4.

Here VD1 and VD2 are pass-through diodes.

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12.3. Barracuda I (Durango) drive family

Sample zone allocation table returned by the drive:

```
   1          2        3     4
Zone 0:      0006  -  0A29  527    323.765
Zone 1:      0A2A  -  1151  503    310.588
Zone 2:      1152  -  157D  503    310.588
Zone 3:      157E  -  1E46  479    292.489
Zone 4:      1E47  -  25EE  447    276.706
Zone 5:      25EF  -  2A6C  431    265.882
Zone 6:      2A6D  -  2EF4  407    252.773
Zone 7:      2EF5  -  34DB  383    234.740
Zone 8:      34DC  -  39D0  351    218.353
Zone 9:      39D1  -  3C27  328    205.348
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec).

Service area: under study

Service area SPT – 0x200
Next zone beginning – 0x06 (offset[1] 0x00)
Next zone end – 0x0F (offset 0x09)
CERT track – 0x0D (offset 0x07) , 0x100 sectors must be read
ATA overlay track – 0x0A? (offset 0x04)
VENDOR data track – 0x0F (offset 0x09)

ATA terminal is present.

Command «V» (output of defect list) is not supported.

BootCode (SafeMode): standard scheme of levels.

12.3.1. PCB layout

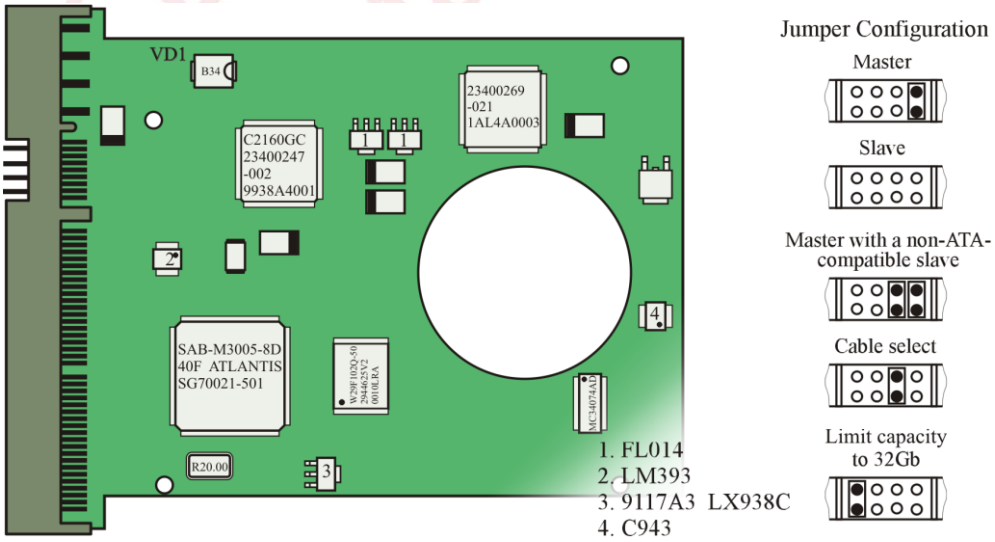

Fig. 12.5.

Here VD1 is a pass-through diode.

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. E.g.: the service area here starts with cylinder 6, ATA overlay offset is 0x04, then ATA overlay cylinder is 0x6+0x04 = 0x0A.

12.4. Barracuda II (Vail) drive family

Sample zone allocation table returned by the drive:

```
  1          2        3      4
Zone 0:      0020  -  087F    585    363.922
Zone 1:      0880  -  1610    570    353.882
Zone 2:      1611  -  1C1A    552    343.253
Zone 3:      1C1B  -  23F7    528    328.916
Zone 4:      23F8  -  2B87    504    314.353
Zone 5:      2B88  -  3563    480    294.533
Zone 6:      3564  -  3BA1    450    281.246
Zone 7:      3BA2  -  41F0    426    267.492
Zone 8:      41F1  -  4966    400    250.242
Zone 9:      4967  -  4E28    380    239.059
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec).

Service area:

Service area SPT – 0x226
CERT track – 0x0D (offset[1] 0x0D), 0x6B sectors must be read
ATA overlay track – 0x0E (offset 0x0E), 0x47 sectors must be read
VENDOR data track – 0x0F (offset 0x0F), 0x100 sectors must be read

ATA terminal is present.

Command «V» (output of defect list) is supported.

BootCode (SafeMode): standard scheme of levels.

Caution! In the case of PCB replacement, the electronics board may fail, this because the drive records something to Flash. Therefore, you are advised to read and backup ROM contents before replacing the PCB.

Hard disk drives belonging to this family were manufactured in two versions: with ATA-66 support and ATA-100 support.

Standard	Models
ATA-66	ST310210A, ST315320A, ST320420A, ST330630A
ATA-100	ST310216A, ST315324A, ST320424A, ST330631A

12.4.1. Typical malfunctions

Typical PCB malfunctions of hard disk drives in this family include burn-outs and failures of the stabilizers in the spindle motor control circuit (Fig. 12.6, see the right part).

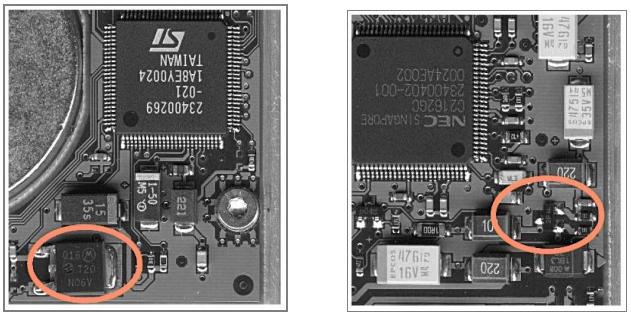

Fig. 12.6.

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. E.g.: the service area here starts with cylinder 0, ATA overlay offset is 0x0E, then ATA overlay cylinder is 0+0xE = 0x0E.

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Fig. 12.7.

This usually cause failures of the flat elements in the circuit, but never really make the controlling driver fail. Another common issue is failure of one of the latching transistors (Fig. 12.6, see the left part) in the reading-writing channel circuit. These malfunctions are always manifested in the same manner. When the drive starts up, faint knocking at the frequency of approximately 3 – 5 Hz can be heard. Failures of pass-through diodes in the 12 V circuit are also typical in these drives.

12.4.2. PCB layout

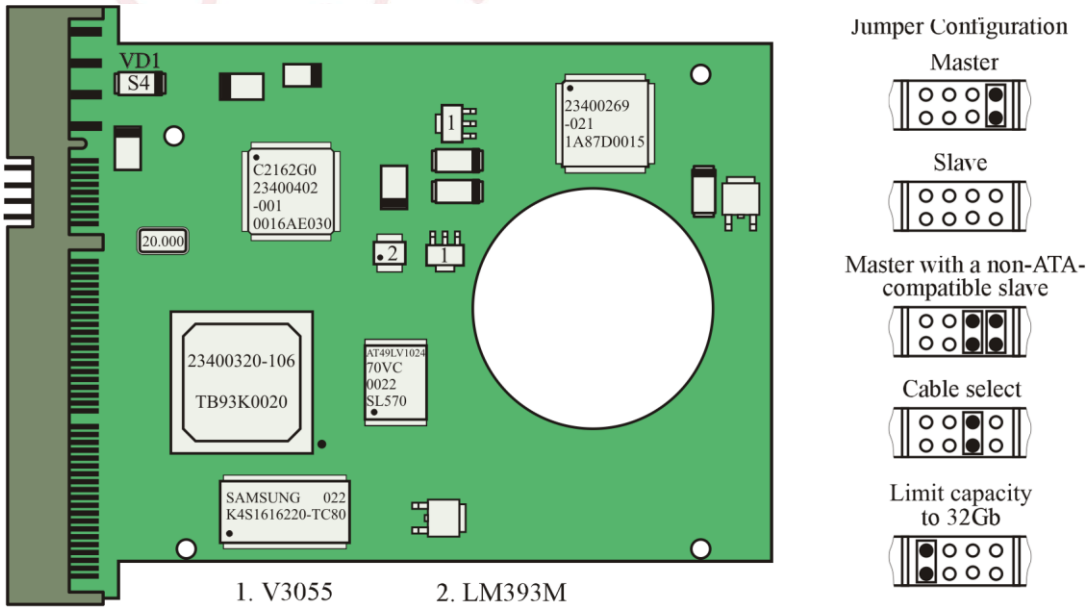

Fig. 12.8.

Here VD1 is a pass-through diode.

12.5. Barracuda III (Aspen) drive family

Sample zone allocation table returned by the drive:

```
    1       2          3      4
Zone 0:   0008  -    11BC   806    501.961
Zone 1:   11BD  -    1CA5   777    484.392
Zone 2:   1CA6  -    24E8   756    470.588
Zone 3:   24E9  -    2AB4   738    460.623
Zone 4:   2AB5  -    346B   720    443.399
Zone 5:   346C  -    41A8   672    418.824
Zone 6:   41A9  -    49CC   648    403.045
Zone 7:   49CD  -    5082   624    389.647
Zone 8:   49CD  -    5800   596    374.256
Zone 9:   5801  -    60D0   576    355.556
Zone A:   60D1  -    695D   534    336.732
Zone B:   695E  -    6EEB   514    324.183
Zone C:   6EEC  -    7433   489    308.706
Sys= 6784-67AC
Total LBAs = 0393A711
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec); «Sys=» – stands for service area coordinates, here it means the initial and final cylinders (hex).

Service area:

Service area SPT – 0x202
CERT track – 0x678D (offset[1] 0x09)
ATA overlay track – 0x678E (offset 0x0A)
VENDOR data track – 0x6790 (offset 0x0C)

ATA terminal is present.

Command «V» (output of defect list) is supported.

BootCode (SafeMode): standard scheme of levels.

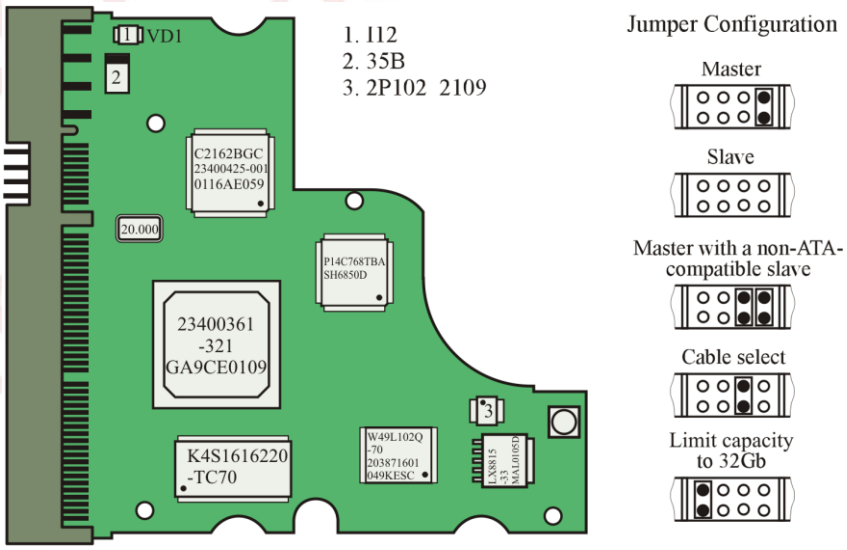

Fig. 12.9.

Here VD1 is a protective 12 V diode.

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. E.g.: Sys= 6784-67AC, ATA overlay offset is 0x0A, then ATA overlay cylinder is 0x6784+0x0A = 0x678E.

12.5.1. Typical malfunctions

As a rule of thumb, drives of this family encounter buffer RAM failures, or enable password protection because of an error while accessing the buffer RAM. ROM chip failures are also possible. Failures of the protective diodes in the +12 V circuit are also common in these drives. In order to restore normal drive functionality it is usually sufficient to just remove the diode. However, to avoid future failures you are advised to replace it with an identical replacement one.

12.5.2. PCB layout

See Fig. 12.9.

12.6. Barracuda IV (Snowmass) drive family

Sample zone allocation table returned by the drive:

```
   1        2          3     4
Zone 0:    0015   -    17AF  833   552.156
Zone 1:    17B0   -    2FE0  833   552.156
Zone 2:    2FE1   -    40F0  833   552.156
Zone 3:    40F1   -    5700  784   510.588
Zone 4:    5701   -    696B  784   510.588
Zone 5:    696C   -    7D00  718   477.647
Zone 6:    7D01   -    8B8B  686   454.117
Zone 7:    8B8C   -    9B24  653   435.294
Zone 8:    9B25   -    A9D6  616   414.117
Zone 9:    A9D7   -    BA00  588   385.882
Zone A:    BA01   -    C4BA  548   371.092
Zone B:    C4BB   -    D105  522   352.941
Zone C:    D106   -    DC91  490   330.756
Sys= 7000-7028   02B9 SPTK on sys trks
Total LBAs = 04C66911
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec); «Sys=» – stands for service area coordinates, here it means the initial and final cylinders (hex), and SA SPT.

Service area: the drives of this family have 2 groups of microprogram versions using various cylinder ranges as service area locations.

Service area SPT – 0x02B9

Ver 3.xx

CERT track	0x7009 (offset[1] 0x09), 0x100 sectors must be read
ATA overlay track	0x700A (offset 0x0A) , 0x110 sectors must be read
VENDOR data track	0x700C (offset 0x0C) , 0x100 sectors must be read

Ver 7.xx

CERT track	0x5809 (offset 0x09) , 0x100 sectors must be read
ATA overlay track	0x580A (offset 0x0A) , 0x110 sectors must be read
VENDOR data track	0x580C (offset 0x0C) , 0x100 sectors must be read

ATA terminal is present

Command «V» (output of defect list) is supported

BootCode (SafeMode): standard scheme of levels

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. E.g.: Sys= 7000-7028, ATA overlay offset is 0x0A, then ATA overlay cylinder is 0x7000+0x0A = 0x700A.

In order to actually start Self Test, you have to send the [Ctrl]+[T] command from the terminal, or select «Restart testing at current Age» from the user commands menu.

Hard disk drives with capacities of 15 (ST315313A) and 30 (ST330011A) Gb were manufactured, respectively, on the basis of 20 (ST320011A) and 40 (ST340016A) Gb models of that family, and did not pass all factory tests.

12.6.1. Typical malfunctions

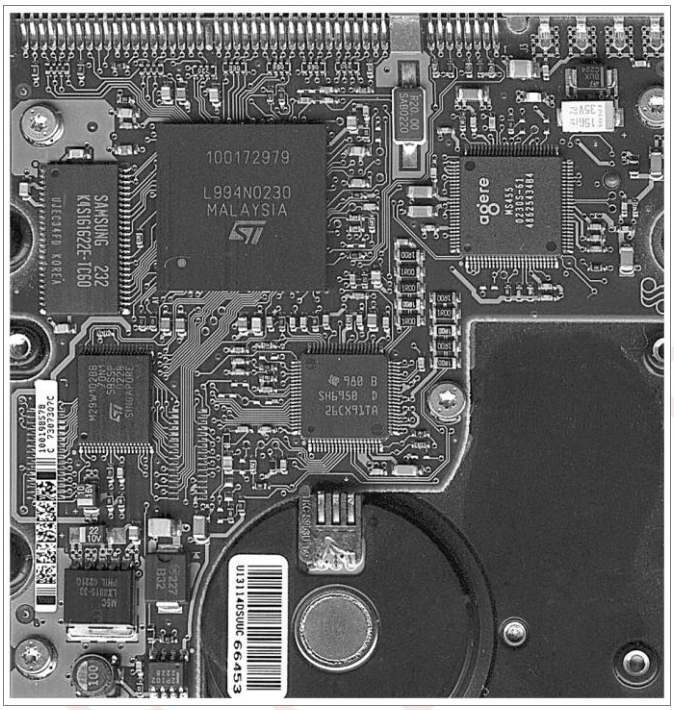

Fig. 12.10.

The common malfunctions in this drive family are: failures of the 12 V diodes, failure of the microchip controlling the spindle motor and VCM, and partial failures of the reading-writing channel which are manifested as impossibility to record anything to a drive, or as inability when reading the service area, giving NIWOT positioning errors.

HDDs of this family exhibit the following two malfunctions more frequently than other drive families of Barracuda series:

- Spindle seizure (see section 10.3. Spindle seizure).
- Failure of the preamplifier commutator chip. As a rule of thumb, no visible malfunctions can be seen on the PCB, but the affected drive will produce regular knocking sounds by hitting its heads against the limiter. In terminal it will appear to accesses one head after another, from 0000h to 000Fh, but does not find any of them. Fig. 12.11 illustrates a photograph of a burnt-out preamplifier from a drive of this family.

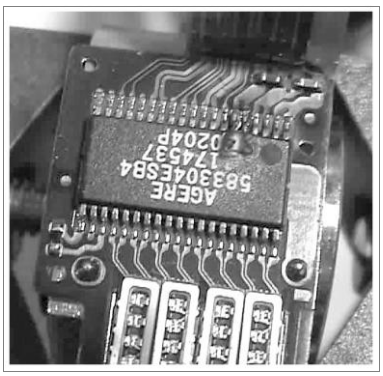

Fig. 12.11.

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12.6.2. PCB layout

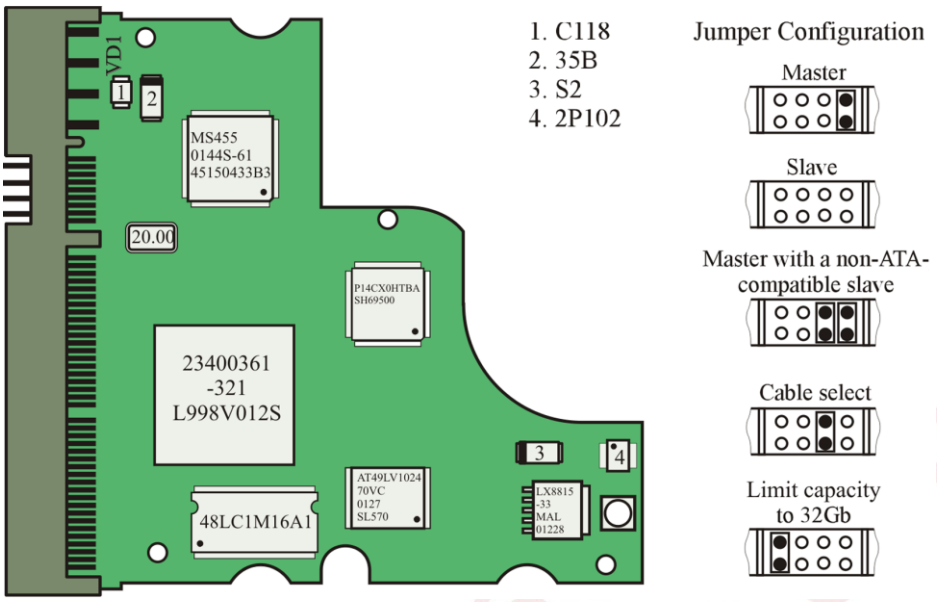

Fig. 12.12.

Here VD1 is a protective 12 V diode.

12.7. Barracuda V (Avalanche) drive family

Sample zone allocation table returned by the drive:

```
     1          2          3          4
Zone 00:      0000E   -    01AC1      921     576.4071
Zone 01:      01AC2   -    0342B      901     564.7006
Zone 02:      0342C   -    04C5B      901     564.7006
Zone 03:      04C5C   -    06360      873     548.5071
Zone 04:      06361   -    07949      832     512.4018
Zone 05:      0794A   -    08E24      832     512.9041
Zone 06:      08E25   -    0A1FD      790     495.2004
Zone 07:      0A1FE   -    0B4E1      754     474.7071
Zone 08:      0B4E2   -    0C6DB      721     461.6072
Zone 09:      0C6DC   -    0D7F8      702     443.8039
Zone 0A:      0D7F9   -    0E841      665     420.7061
Zone 0B:      0E842   -    0F7C1      624     387.7065
Zone 0C:      0F7C2   -    10681      568     367.5007
Zone 0D:      10682   -    1148C      540     344.4171
Zone 0E:      1148D   -    121E9      508     326.9135
Zone 0F:      121EA   -    12EA7      485     311.0184
Sys= 0C958-0C9D0   027E SPTK on sys trks
Total LBAs = 06FEE9198
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec); «Sys=» – stands for service area coordinates, here it means the initial and final cylinders (hex), and SA SPT.

Service area:

Service area SPT – 0x027E
App code track – offset[1] for SAFE MODE !!! 0x015

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. (E.g.: Sys= 0C958-0C9D0, ATA overlay offset 0x23, then ATA overlay cylinder is 0x0C958+0x23 = 0xC97B).

CERT track – 0xC97A (offset 0x22)
ATA overlay track – 0xC97B (offset 0x23)
VENDOR data track – 0xC97D (offset 0x25)

ATA terminal is not present

Command «V» (output of defect list) is supported

BootCode (SafeMode): Level F

In order to actually start Self Test, you have to send the [Ctrl]+[T] command from the terminal, or select «Restart testing at current Age» from the user commands menu.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

Type	Characters in SN
40	KE
41	KC
42	KB
43	KA
51	KD
50	KF

12.7.1. Typical malfunctions

Drives of this family are characterized by a PCB malfunction which frequently results in commutator and preamplifier chip failure inside the HDA due to a disruption of the 5 V power supply lines. As a rule of thumb this situation causes failure of the microchip controlling the spindle motor and voice coil (with a burn-out), as well as failure of the components supporting its operation. A typical malfunction occurring in thist group of drives is burning-out of the protective 5 and 12 V diodes.

12.7.2. PCB layout

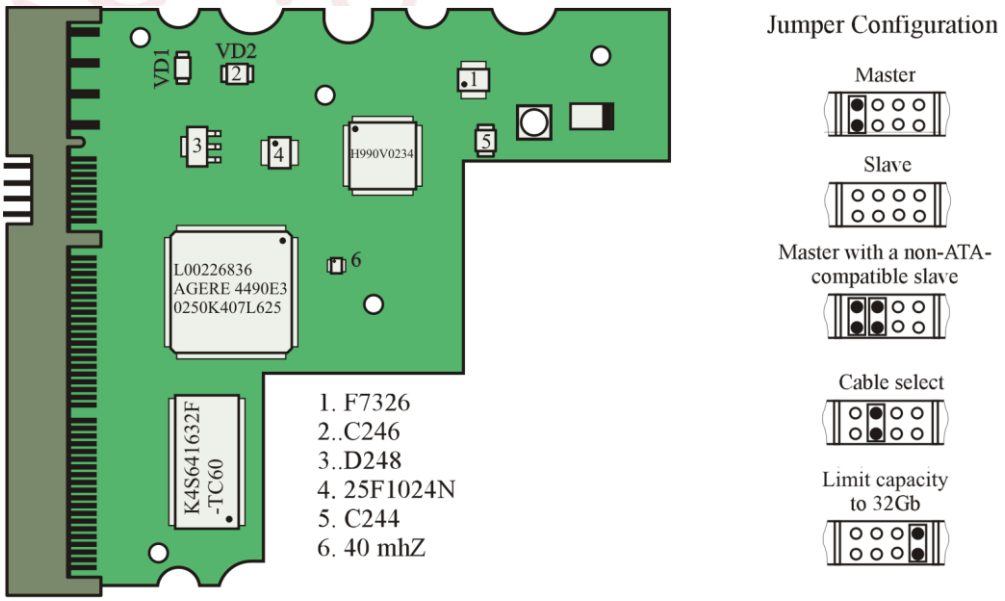

Fig. 12.13.

Here VD1 is a protective 5 V diode, VD2 is a protective 12 V diode.

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12.8. U Series 7 (Avalanche) drive family

Sample zone allocation table returned by the drive:

```
    1          2              3        4
Zone 00:       0000E    -     01AC1    921      576.4071
Zone 01:       01AC2    -     0342B    901      564.7006
Zone 02:       0342C    -     04C5B    901      564.7006
Zone 03:       04C5C    -     06360    873      548.5071
Zone 04:       06361    -     07949    832      512.4018
Zone 05:       0794A    -     08E24    832      512.9041
Zone 06:       08E25    -     0A1FD    790      495.2004
Zone 07:       0A1FE    -     0B4E1    754      474.7071
Zone 08:       0B4E2    -     0C6DB    721      461.6072
Zone 09:       0C6DC    -     0D7F8    702      443.8039
Zone 0A:       0D7F9    -     0E841    665      420.7061
Zone 0B:       0E842    -     0F7C1    624      387.7065
Zone 0C:       0F7C2    -     10681    568      367.5007
Zone 0D:       10682    -     1148C    540      344.4171
Zone 0E:       1148D    -     121E9    508      326.9135
Zone 0F:       121EA    -     12EA7    485      311.0184
Sys= 0C958-0C9D0   027E SPTK on sys trks
Total LBAs = 06FEE9198
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec); «Sys=» – stands for service area coordinates, here it means the initial and final cylinders (hex), and SA SPT.

Service area:

Service area SPT – 0x027E
App code track – offset[1] for SAFE MODE !!! 0x015
CERT track – 0xC97A (offset 0x22)
ATA overlay track – 0xC97B (offset 0x23)
VENDOR data track – 0xC97D (offset 0x25)

ATA terminal is not present

Command «V» (output of defect list) is supported

BootCode (SafeMode): Level F

In order to actually start Self Test, you have to send the [Ctrl]+[T] command from the terminal, or select «Restart testing at current Age» from the user commands menu.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

Type	Characters in SN
40	KE
41	KC
42	KB
43	KA
51	KD
50	KF

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. E.g.: Sys= 0C958-0C9D0, ATA overlay offset 0x23, then ATA overlay cylinder is 0x0C958+0x23 = 0xC97B.

12.8.1. Typical malfunctions

The list of malfunctions is similar to that for the Barracuda V drive family.

12.8.2. PCB layout

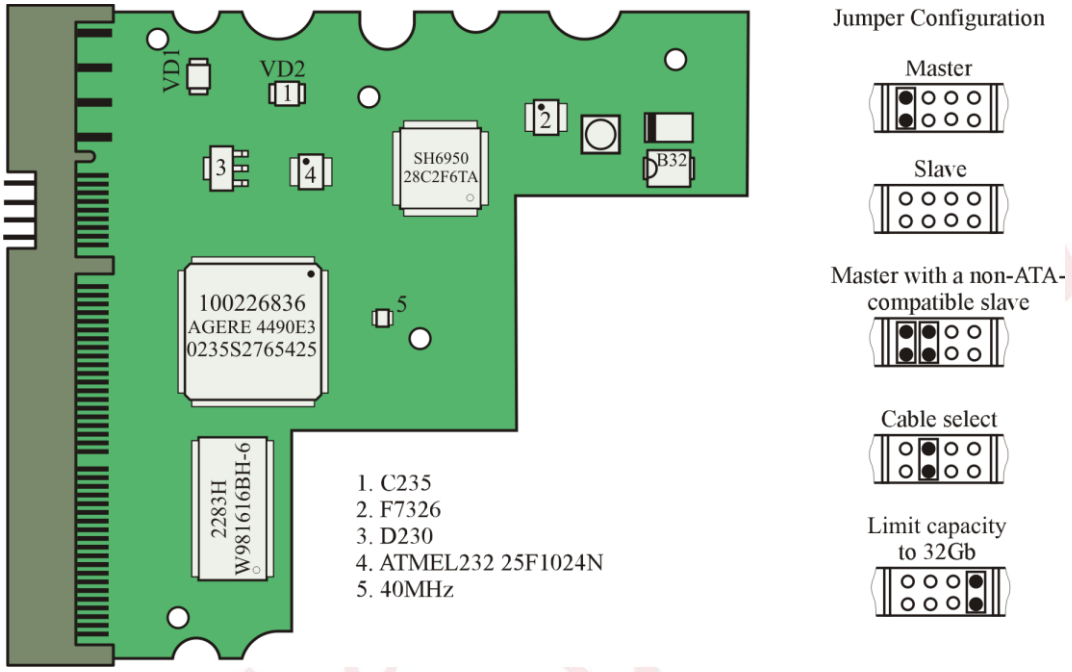

Fig. 12.14.

Here VD1 is a protective 5 V diode, VD2 is a protective 12 V diode.

12.9. Barracuda 7200.7 (ALPINE, APLUS) drive family

Barracuda 7200.7 drive family consists of several subfamilies: Alpine, APLUS (Alpine Plus, 7200.7 Plus) and Puma. Here we shall discuss first two subfamilies. They can be identified by the following (or similar) lines that each drive outputs to the terminal during startup. Use the line to select offsets for service area location.

In the ALPINE drive subfamily:

```
ALPINE - 1_Disk    S.15  01-16-03 11:51
.....
```

The APLUS drive subfamily:

```
APLUS - 1_Disk    S.07  02-09-04 16:00
.....
```

Sample zone allocation table returned by the drive:

```
     1          2          3          4          5
Zone 00:       00018   -  00BE8       1100     (044C)   683.439
Zone 01:       00BE9   -  027FE       1056     (0420)   666.63
Zone 02:       027FF   -  04707       1026     (0402)   646.275
Zone 03:       04708   -  06CA3        990     (03DE)   622.431
Zone 04:       06CA4   -  08B66        953     (03B9)   602.353
```


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```
Zone 05:      08B67   -   0A479       916     (0394)   580.392
Zone 06:      0A47A   -   0C405       880     (0370)   545.882
Zone 07:      0C406   -   0D99A       836     (0344)   527.59
Zone 08:      0D99B   -   0ECD9       806     (0326)   506.144
Zone 09:      0ECDA   -   10337       770     (0302)   480.724
Zone 0A:      10338   -   11397       733     (02DD)   461.672
Zone 0B:      11398   -   12854       691     (02B3)   437.423
Zone 0C:      12855   -   13F38       660     (0294)   410.353
Zone 0D:      13F39   -   14AE7       623     (026F)   396.401
Zone 0E:      14AE8   -   155D6       605     (025D)   383.316
Zone 0F:      155D7   -   16358       572     (023C)   363.922
Sys= 0E5B0-0E62F   0280 SPTK on sys trks
Total LBAs = 04A96402
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec); 5 – SPT in zone (hex); «Sys=» – stands for service area coordinates, here it means the initial and final cylinders (hex), and SA SPT.

Service area. This drive family is characterized by a peculiar feature: the starting cylinder number is stored in the App code zone at an address within the Flash ROM of the drive. Therefore, the service area location is unique and uses various cylinders in different drives, even if they use the same firmware versions. The offsets of the service area elements relative to SA beginning and SA SPT remain constant. After a Self Test procedure the whole service area may become shifted. This means that after Self Test you will have to compare the resulting zone allocation and record tracks with a corresponding offset relative to their source cylinders.

	For the group preceding APLUS ROM	For APLUS
Service area SPT	0x0280	0x035C
App code track	offset FOR SAFE MODE !!! 0x015	offset FOR SAFE MODE !!! 0x015
CERT track	offset 0x029	offset 0x047
ATA overlay track	offset[1] 0x02A	offset 0x049
VENDOR data track	offset 0x02C	offset 0x04B
SeaDex script track	offset 0x04A	offset 0x050

ATA terminal is not present

Command «V» (output of defect list) is supported

BootCode (SafeMode): Level F

In order to actually start Self Test, you have to send the [Ctrl]+[T] command from the terminal, or select «Restart testing at current Age» from the user commands menu.

The drive family includes models equipped with 2 and 8 Mb RAM.

RAM capacity, Mb	Models
2	ST340014AS,ST380011AS, ST3120022AS, ST3160021AS, ST340014A, ST380011A, ST3120022A, ST3160021A
8	ST380013AS, ST3120026AS, ST3160023AS, ST380013A, ST3120026A, ST3160023A

Hard disk drives of this family are characterized by a broad variety of electronics boards. This variety is caused by the fact that the drives use magnetoresistive heads from different manufacturers, and these heads require various components to ensure their functionality. These include the chip controlling the spindle motor and VCM, their framework, and the read-write channel in the microcontroller chip. The drives are based on microcontroller chips of two different types: microcircuits made by ST Lab and Agere Corp. They have very different designs and are incompatible. The chips controlling the spindle motor and VCM can belong to any two incompatible types: Smooth made by ST Lab and SH6950 from TMS.

[1] "Offset" here means addition to the number of the base cylinder of a drive's service area. E.g.: Sys= 0E5B0-0E62F, ATA overlay offset 0x2A, then ATA overlay cylinder is 0x0E5B0+0x2A = 0xE5DA.

The drive family consists of two subfamilies: Alpine proper with service area SPT equal to 280h, and Aplus with SA SPT equal to 35Ch. Both subfamilies have different (the difference can be seen on the level of embedded microcontroller firmware) offsets of tracks containing CERT, ATA overlay and Vendor data relative to the SA start, and with the service area location on the disks (along the external or internal disk edge). There are no differences between these subfamilies with regard to PCB components.

Drives of the APLUS subfamily support the command for output of the SA map («y» on level «T») to terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu). Sample report generated by the command (the first column contains name of the track in service area, the second – cylinder number):

```
                                PhysCyl   GrayCyl
First System Cylinder           0000F7C7  000107D0
First Zero Offset Cylinder      0000F7D1  000107DA
First App Code Cylinder         0000F7DC  000107E5
Second App Code Cylinder        0000F7DD  000107E6
Second Zero Offset Cylinder     0000F7E8  000107F1
Third App Code Cylinder         0000F7F3  000107FC
Fourth App Code Cylinder        0000F7F4  000107FD
First Adaptives Cylinder        0000F7F5  000107FE
First User Defect List Cylinder 0000F7F6  000107FF
First Alternate Pool Cylinder   0000F7FA  00010803
First Cert Code Cylinder        0000F80E  00010817
First Intf Code Cylinder        0000F810  00010819
First Intf System Cylinder      0000F812  0001081B
First SEADEX Cylinder           0000F817  00010820
First Cert Log Cylinder         0000F829  00010832
First Decay Cylinder            0000F839  00010842
First SPLASH Cylinder           0000F846  0001084F
Last System Cylinder            0000F846  0001084F
```

Please find below the table of correspondences between the names in the table and the names used in the utility.

Name in utility	Name in report produced by the «y» command
CERT track	First Cert Code Cylinder
ATA overlay track	First Intf Code Cylinder
VENDOR data track	First Intf System Cylinder

Alpine drives with firmware versions containing the «5» digit after dot (e.g, 3.54) support the «T>k» command for disabling of drive heads in the middle of the head stack..

While editing the serial number in a drive with disabled heads, please take into account the relationship between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

APLUS		ALPINE	
Type	Characters in SN	Type	Characters in SN
E0	JX	20	JX
E1	JV	21	JV
E1	LH	21	LH
E2	JT	22	JT
E3	LJ	23	LJ
E3	JS	23	JS
F0	JR		
F1	JQ		
F2	JP		
F3	JN		

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12.9.1. Typical malfunctions

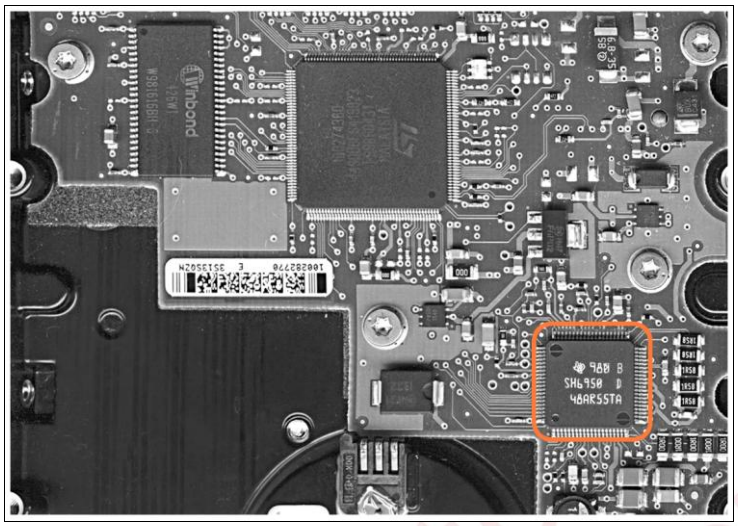

Fig. 12.15.

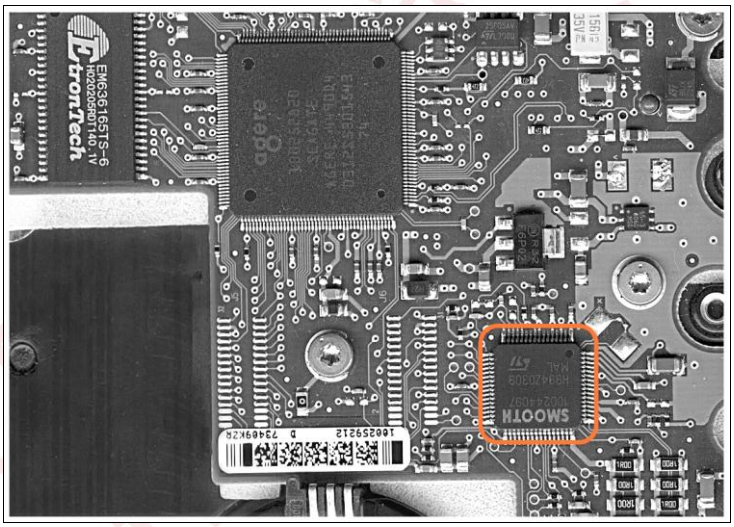

Fig. 12.16.

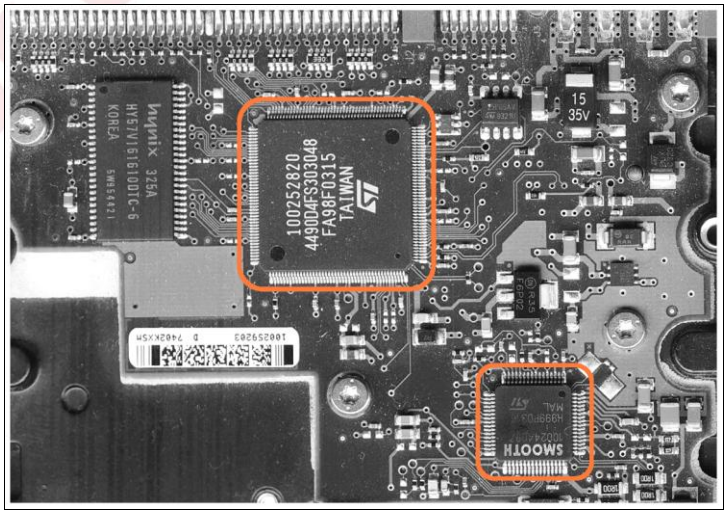

Fig. 12.17.

The photographs above illustrates drive types which are based on completely incompatible components. One of them uses the SH6950 chip (Fig. 12.15) as spindle motor and VCM controller, whilst the two other boards use a Smooth spindle motor and VCM controller (Fig. 12.16, Fig. 12.17).

In this drive family the following malfunction is most common: failure of the microcontroller portion which is responsible for reading and writing operations (read-write channel). Repair, in this case, is only possible by replacing the microcontroller chip with a compatible one. To ensure compatibility, the second and the third lines of digits on the chip casings must be identical (for example, 100252820/449004FS303048, Fig. 12.17). Burn-outs of the spindle motor and VCM controller chip are also common. If the assembly of two field-effect transistors and Schottky diode in the circuit fails, the preamplifier chip usually fails too. Another typical malfunction is failure of the +5 and +12 V protective diodes, which can usually be successfully replaced.

12.9.2. PCB layout

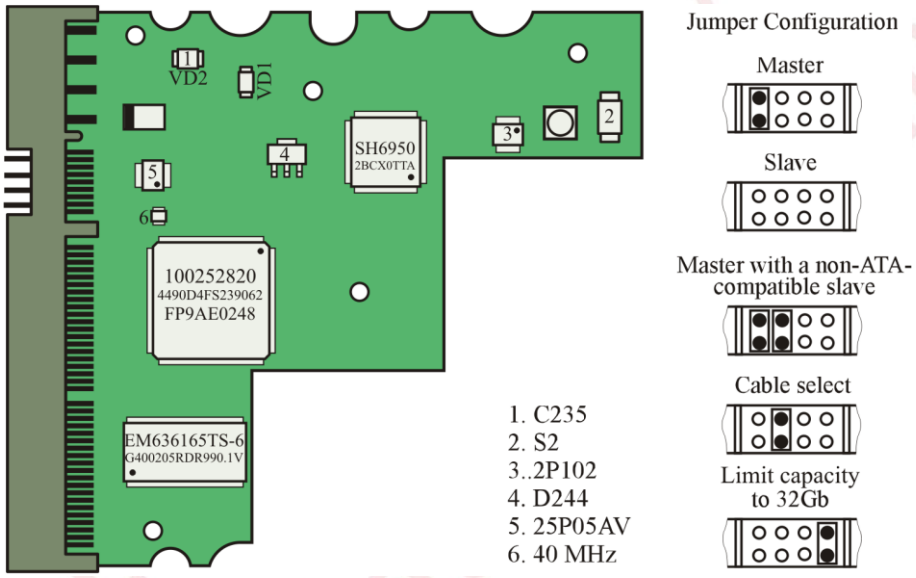

Fig. 12.18.

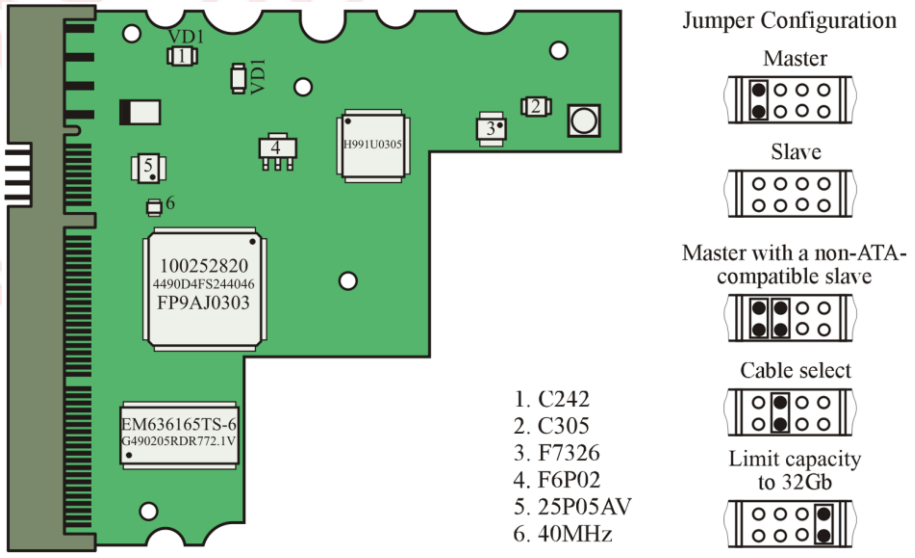

Fig. 12.19.

Here VD1 is a protective 5 V diode, VD2 is a protective 12 V diode.

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12.10. Barracuda 7200.7 (PUMA) drive family

Sample zone allocation table returned by the drive:

```
Head 00
Zone 00:  00018 - 0132D  1100 (044C) 687.097
Zone 01:  0132E - 03BFE  1045 (0415) 663.594
Zone 02:  03BFF - 05D87  1012 (03F4) 644.516
Zone 03:  05D88 - 07831   990 (03DE) 627.097
Zone 04:  07832 - 09073   953 (03B9) 606.774
Zone 05:  09074 - 0A797   916 (0394) 585.484
Zone 06:  0A798 - 0C72C   880 (0370) 551.613
Zone 07:  0C72D - 0D653   836 (0344) 535.777
Zone 08:  0D654 - 0E8AC   806 (0326) 515.881
Zone 09:  0E8AD - 0FD7A   770 (0302) 491.129
Zone 0A:  0FD7B - 10DD3   733 (02DD) 471.216
Zone 0B:  10DD4 - 1204F   691 (02B3) 448.680
Zone 0C:  12050 - 137F9   660 (0294) 417.339
Zone 0D:  137FA - 145B5   616 (0268) 401.985
Zone 0E:  145B6 - 155F4   586 (024A) 381.567
Zone 0F:  155F5 - 164F8   550 (0226) 357.097

Head 01
Zone 00:  00018 - 0132D  1100 (044C) 687.097
Zone 01:  0132E - 03BFE  1045 (0415) 663.594
Zone 02:  03BFF - 05D87  1012 (03F4) 644.516
Zone 03:  05D88 - 07831   990 (03DE) 627.097
Zone 04:  07832 - 09073   953 (03B9) 606.774
Zone 05:  09074 - 0A797   916 (0394) 585.484
Zone 06:  0A798 - 0C72C   880 (0370) 551.613
Zone 07:  0C72D - 0D653   836 (0344) 535.777
Zone 08:  0D654 - 0E8AC   806 (0326) 515.881
Zone 09:  0E8AD - 0FD7A   770 (0302) 491.129
Zone 0A:  0FD7B - 10DD3   733 (02DD) 471.216
Zone 0B:  10DD4 - 1204F   691 (02B3) 448.680
Zone 0C:  12050 - 137F9   660 (0294) 417.339
Zone 0D:  137FA - 145B5   616 (0268) 401.985
Zone 0E:  145B6 - 155F4   586 (024A) 381.567
Zone 0F:  155F5 - 164F8   550 (0226) 357.097

Head 02
Zone 00:  00018 - 0132D  1100 (044C) 687.097
Zone 01:  0132E - 03BFE  1045 (0415) 663.594
Zone 02:  03BFF - 05D87  1012 (03F4) 644.516
Zone 03:  05D88 - 07831   990 (03DE) 627.097
Zone 04:  07832 - 09073   953 (03B9) 606.774
Zone 05:  09074 - 0A797   916 (0394) 585.484
Zone 06:  0A798 - 0C72C   880 (0370) 551.613
Zone 07:  0C72D - 0D653   836 (0344) 535.777
Zone 08:  0D654 - 0E8AC   806 (0326) 515.881
Zone 09:  0E8AD - 0FD7A   770 (0302) 491.129
Zone 0A:  0FD7B - 10DD3   733 (02DD) 471.216
Zone 0B:  10DD4 - 1204F   691 (02B3) 448.680
Zone 0C:  12050 - 137F9   660 (0294) 417.339
Zone 0D:  137FA - 145B5   616 (0268) 401.985
Zone 0E:  145B6 - 155F4   586 (024A) 381.567
Zone 0F:  155F5 - 164F8   550 (0226) 357.097
Reserve:  0EE39 - 0EEBF   640 (0280) 454.147
Total KBAs = 0E02CAFA
```


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The zone allocation parameters are output here individually for each head. The first column contains zone number, the second – initial zone cylinder (hex), the third – final zone cylinder (hex), the fourth – SPT (dec), the fifth column shows SPT as hex. «Reserve:» – service area descriptor (therefore, it includes the initial cylinder (hex), final cylinder (hex), SPT (dec) , SPT (hex).

The S-ATA models of this family share most of the peculiarities of the P-ATA branch of Barracuda 7200.7.

Service area

Service area SPT – 0x0280
App code track – offset FOR SAFE MODE !!! 0x015
CERT track – offset 0x047 (for the zero and the first heads)
ATA overlay track – offset 0x049
VENDOR data track – offset 0x04B

Attention! Hard drives of this family have a peculiarity pertaining to drive startup. After power-up, the drives do not enter the "ready" state until receipt of the RESET signal. To enter the utility correctly after starting you will have to respond to the «Drive is not ready» message with the «Utility start» command, and then use the utility start-up dialog to perform the «Generate Hard Reset signal» and «Read HDD ID again» operations.

Drives of this family support the command for output of the SA map («y» on level «T») to terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu). Sample report generated by the command (the first column contains name of the track in service area, the second – cylinder number):

```
                                PhysCyl   GrayCyl
First System Cylinder           0000EE39  0000F68E
First Zero Offset Cylinder      0000EE43  0000F698
First App Code Cylinder         0000EE4E  0000F6A3
Second App Code Cylinder        0000EE4F  0000F6A4
Second Zero Offset Cylinder     0000EE5A  0000F6AF
Third App Code Cylinder         0000EE65  0000F6BA
Fourth App Code Cylinder        0000EE66  0000F6BB
First Adaptives Cylinder        0000EE67  0000F6BC
First User Defect List Cylinder 0000EE68  0000F6BD
First Alternate Pool Cylinder   0000EE6C  0000F6C1
Second User Defect List Cylinder 0000EE7C  0000F6D1
First Cert Code Cylinder        0000EE80  0000F6D5
First Intf Code Cylinder        0000EE82  0000F6D7
First Intf System Cylinder      0000EE84  0000F6D9
First SEADEX Cylinder           0000EE89  0000F6DE
First Cert Log Cylinder         0000EE9B  0000F6F0
First Decay Cylinder            0000EEB2  0000F707
First SPLASH Cylinder           0000EEBF  0000F714
Last System Cylinder            0000EEBF  0000F714
```

Please find below the table of correspondences between the names in the table and the names used in the utility. The CERT code occupies 2 tracks in drives of that family.

Name in utility	Name in report produced by the «y» command
CERT track	First Cert Code Cylinder
ATA overlay track	First Intf Code Cylinder
VENDOR data track	First Intf System Cylinder

The drives support the «T>k» command for disabling of drive heads in the head stack middle.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

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Type	Characters in SN
A8	JX
A8	MQ
A9	JV
A9	MR
AA	JT
AA	MS
AB	MT
AB	JS

12.10.1. PCB layout

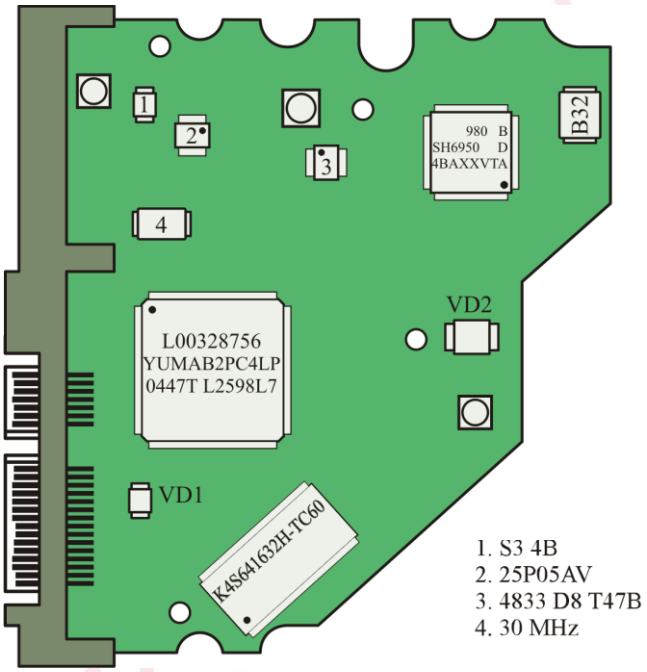

Fig. 12.20.

Here VD1 is a protective 5 V diode, VD2 is a protective 12 V diode.

12.11. 7200.8 (Tonka) drive family

Service area

Service area SPT – 0x02C9
App code track – offset FOR SAFE MODE !!! 0x016
CERT track – offsets 0x064 (beginning)
ATA overlay track – offset 0x068
VENDOR data track – offset 0x06C

Drives of this family support the command for output of the SA map («y» on level «T») to terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu). Sample report generated by the command (the first column contains name of the track in service area, the second – cylinder number):

```
                                PhysCyl   GrayCyl
First System Cylinder           000161E8  00016FBD
First Zero Offset Cylinder      000161F2  00016FC7
First App Code Cylinder         000161FE  00016FD3
```

```
Second App Code Cylinder          00016200  00016FD5
Second Zero Offset Cylinder       0001620C  00016FE1
Third App Code Cylinder           00016218  00016FED
Fourth App Code Cylinder          0001621A  00016FEF
First Adaptives Cylinder          0001621C  00016FF1
First User Defect List Cylinder   0001621E  00016FF3
First Alternate Pool Cylinder     00016226  00016FFB
Second User Defect List Cylinder  00016244  00017019
First Cert Code Cylinder          0001624C  00017021
First Intf Code Cylinder          00016250  00017025
First Intf System Cylinder        00016254  00017029
First SEADEX Cylinder             00016260  00017035
First Cert Log Cylinder           00016284  00017059
First Decay Cylinder              000162FA  000170CF
First SPLASH Cylinder             00016314  000170E9
Last System Cylinder              00016315  000170EA
```

Please find below the table of correspondences between the names in the table and the names used in the utility. The CERT code occupies 2 tracks in drives of this family.

Name in utility	Name in report produced by the «y» command
CERT track	First Cert Code Cylinder
ATA overlay track	First Intf Code Cylinder
VENDOR data track	First Intf System Cylinder

While tracing the SA objects reading commands, (see section 4.3. Identification of parameters for SA objects) the track index received in the tracing report should be multiplied by two to obtain the SA offset.

The drives support the «T>k» command for disabling of drive heads in the middle of the head stack.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

Heads	Characters in SN
1	LR
1	NA
2	LS
2	NB
3	LT
3	NC
4	LV
4	ND
5	NE
6	NF
6	LW

As the table above implies, the relationship is established not on the drive type level (which seems to be reduced to the bit map of allowed heads), but on the level of number of heads.

Self Test procedure corrupts App code. Self Test is performed in two stages. The first stage consists of tests 2 - 99, at which point the drive stops and waits for the operator to respond to the passed tests. If you switch the power off at that point, configuration results may be discarded. To continue, the [Ctrl]+[T] command must be sent to terminal.

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Attention! During Self Test a repetitive «SATA interrupt not processed!» message output may occur. The easiest method to bypass it is to connect a live SATA adapter to the drive and press the Reset button on it. The drive and adapter will reconnect, and the unprocessed interrupt status will be reset. The Self Test procedure will then resume.

12.12. 7200.9 (Tonka2, Tonka4D, Tonka15, TLite, TLite1HD, TLite2HD) drive family

Service area

Service area SPT – 0x02C9
App code track – offset FOR SAFE MODE !!! 0x016
CERT track – offsets 0x064 (beginning)
CERT tables track – offsets 0x066
ATA overlay track – offset 0x068
VENDOR data track – offset 0x06C

Drives of this family support the command for output of the SA map («y» on level «T») to terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu). Sample report generated by the command (the first column contains name of the track in service area, the second – cylinder number.):

```
                    PhysCyl   GrayCyl
1st Sys Cyl       00015F48  00016FBD
1st 0 Offset Cyl  00015F52  00016FC7
1st App Code Cyl  00015F5E  00016FD3
2nd App Code Cyl  00015F60  00016FD5
2nd 0 Offset Cyl  00015F6C  00016FE1
3rd App Code Cyl  00015F78  00016FED
4th App Code Cyl  00015F7A  00016FEF
1st Adaptive Cyl  00015F7C  00016FF1
1st UsrDfect Cyl  00015F7E  00016FF3
1st Alt Pool Cyl  00015F86  00016FFB
2nd UsrDfect Cyl  00015FA4  00017019
1st CertCode Cyl  00015FAC  00017021
1st IntfCode Cyl  00015FB0  00017025
1st Intf Sys Cyl  00015FB4  00017029
1st Cert Log Cyl  00015FE4  00017059
1st Decay     Cyl 0001605A  000170CF
1st SPLASH    Cyl 00016074  000170E9
Last System   Cyl 00016075  000170EA
```

Please find below the table of correspondences between the names in the table and the names used in the utility. The CERT code occupies 2 tracks in drives of that family.

Name in utility	Name in report produced by the «y» command
CERT track	1st CertCode Cyl
ATA overlay track	1st IntfCode Cyl
VENDOR data track	1st Intf Sys Cyl

While tracing the SA objects reading commands (see section 4.3. Identification of parameters for SA objects), the track index received in the tracing report should be multiplied by two to obtain the SA offset.

The drives support the «T>k» command for disabling of drive heads in the head stack middle.

Command format is «T>Y»; the command belongs to the second type.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

Heads	Characters in SN	Heads	Characters in SN
1	LR	4	LV
1	PF	4	ND
1	NA	5	NE
2	LS	6	NF
2	NB	6	LW
3	LT	7	MV
3	NC	7	PG

As the table above implies, the relationship is established not on the drive type level (which seems to be reduced to the bit map of allowed heads) but on the level of number of heads.

The «T>F» (SetStuff) command of the second type (operating words); initialization is presumably not implemented in code.

Self Test procedure corrupts App code.

Warning! Self Test is performed in two stages. The first stage consists of tests 2 - 99, at which point the drive stops and waits for the operator to respond to the passed tests. If you switch the power off at that point, configuration results may be discarded. To continue, the [Ctrl]+[T] command must be sent.

12.13. 7200.10 (Galaxy2D) drive family

Service area

Service area SPT – 0x0280
App code track – offset FOR SAFE MODE !!! 0x016
CERT track – offsets 0x064 (beginning)
CERT tables track – offsets 0x072
ATA overlay track – offset 0x074
VENDOR data track – offset 0x078

Drives of this family support the command for output of the SA map («y» on level «T») in terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu). Sample report generated by the command (the first column contains name of the track in service area, the second – cylinder number):

```
T>y
                    PhysCyl   GrayCyl
1st Sys Cyl       0001603F  00016FBD
1st 0 Offset Cyl  00016049  00016FC7
1st App Code Cyl  00016055  00016FD3
2nd App Code Cyl  00016057  00016FD5
2nd 0 Offset Cyl  00016063  00016FE1
3rd App Code Cyl  0001606F  00016FED
4th App Code Cyl  00016071  00016FEF
1st Adaptive Cyl  00016073  00016FF1
1st UsrDfect Cyl  00016079  00016FF7
1st Alt Pool Cyl  00016091  0001700F
1st CertCode Cyl  000160AF  0001702D
1st IntfCode Cyl  000160B3  00017031
1st Intf Sys Cyl  000160B7  00017035
1st Cert Log Cyl  000160F1  0001706F
1st Decay     Cyl 000161A3  00017121
1st SPLASH    Cyl 000161BD  0001713B
Last System   Cyl 000161BE  0001713C

Copy     PhysCyl  StartSec length    Name
0000     0016049    0000     0001     BootAdaptives
0001     0016049    00D5     0001     BootAdaptives
0002     0016049    01AA     0001     BootAdaptives
```

```
0003    0016063    0000    0001    BootAdaptives
0004    0016063    00D5    0001    BootAdaptives
0005    0016063    01AA    0001    BootAdaptives
0000    0016049    0001    0003    RsvTrackDefLst
0001    0016049    00D6    0003    RsvTrackDefLst
0002    0016049    01AB    0003    RsvTrackDefLst
0003    0016063    0001    0003    RsvTrackDefLst
0004    0016063    00D6    0003    RsvTrackDefLst
0005    0016063    01AB    0003    RsvTrackDefLst
0000    0016055    0000    0238    AppCode
0001    0016057    001E    0238    AppCode
0002    001606F    0000    0238    AppCode
0003    0016071    001E    0238    AppCode
0000    0016073    0000    001C    DriveAdaps
0001    0016075    0028    001C    DriveAdaps
0002    0016077    0050    001C    DriveAdaps
0000    0016073    001C    0010    MediaZonTbl
0001    0016075    0044    0010    MediaZonTbl
0002    0016077    006C    0010    MediaZonTbl
0000    0016073    002C    0007    ACFCTbl
0001    0016075    0054    0007    ACFCTbl
0002    0016077    007C    0007    ACFCTbl
0000    0016073    0033    0007    BackUpACFCTbl
0001    0016075    005B    0007    BackUpACFCTbl
0002    0016077    0083    0007    BackUpACFCTbl
0000    0016073    003A    0018    AltLst
0001    0016075    0062    0018    AltLst
0002    0016077    008A    0018    AltLst
0000    0016073    0052    00A4    DosTbl
0001    0016075    007A    00A4    DosTbl
0002    0016077    00A2    00A4    DosTbl
0000    0016079    0000    027F    UsrSlipKBALst
0001    001607D    0000    027F    UsrSlipKBALst
0002    0016081    0000    027F    UsrSlipKBALst
0000    001607B    0000    006A    UsrSlipKBALst2
0001    001607F    0000    006A    UsrSlipKBALst2
0002    0016083    0000    006A    UsrSlipKBALst2
0000    0016085    0000    027F    UsrSlipDftLst
0001    0016089    0000    027F    UsrSlipDftLst
0002    001608D    0000    027F    UsrSlipDftLst
0000    0016087    0000    006A    UsrSlipDftLst2
0001    001608B    0000    006A    UsrSlipDftLst2
0002    001608F    0000    006A    UsrSlipDftLst2
```

Please find below the table of correspondences between the names in the table and the names used in the utility. The CERT code occupies 2 tracks in drives of this family.

Name in utility	Name in report produced by the «y» command
CERT track	1st CertCode Cyl
ATA overlay track	1st IntfCode Cyl
VENDOR data track	1st Intf Sys Cyl

The report produced by the «T>y» command in this drive family is much more detailed when compared with earlier drive families. It can be used to find information about the locations of various SA objects.

While tracing the SA objects reading commands (see section 4.3. Identification of parameters for SA objects), the track index received in the tracing report should be multiplied by two to obtain the SA offset.

The drives support the «T>k» command for disabling of drive heads in the middle of the head stack.

Command format is «T>Y»; the command belongs to the second type.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

Heads	Characters in SN	Heads	Characters in SN
1	LR	6	NF
1	PF	6	LW
1	NA	7	MV
2	LS	7	QD
2	NB	3	QE
3	LT	4	QF
3	NC	6	QG
4	LV	5	QH
4	ND	8	PM
5	NE	8	PG

As the table above implies, the relationship is established not on the drive type level (which seems to be reduced to the bit map of allowed heads) but on the level of the number of heads.

Command format is «T>Y»; the command belongs to the second type. The «T>F» (SetStuff) command of the second type (operating words); initialization is presumably not implemented in code.

Self Test procedure corrupts App code.

Warning! Self Test is performed in two stages. The first stage consists of tests 2 - 99, then the drive stops and waits for operator to respond to the passed tests. If you switch the power off at that point, configuration results may be discarded. To continue, the [Ctrl]+[T] command must be sent to terminal.

12.14. Momentus, 2.5” (NEPTUNE) drive family

Sample zone allocation table returned by the drive:

```
   1        2              3        4        5
Zone 00:  00001     -     00941     853      (0355)    386.738
Zone 01:  00942     -     01AB6     832      (0340)    376.471
Zone 02:  01AB7     -     027C6     810      (032A)    368.105
Zone 03:  027C7     -     0361A     789      (0315)    358.902
Zone 04:  0361B     -     04A8C     768      (0300)    345.467
Zone 05:  04A8D     -     059B0     736      (02E0)    334.118
Zone 06:  059B1     -     06CEC     704      (02C0)    318.893
Zone 07:  06CED     -     07B62     672      (02A0)    306.196
Zone 08:  07B63     -     08EA3     640      (0280)    288.627
Zone 09:  08EA4     -     09A9B     608      (0260)    277.399
Zone 0A:  09A9C     -     0A94F     576      (0240)    263.529
Zone 0B:  0A950     -     0B349     554      (022A)    254.118
Zone 0C:  0B34A     -     0BD44     533      (0215)    244.706
Zone 0D:  0BD45     -     0CAED     512      (0200)    231.827
Zone 0E:  0CAEE     -     0D7E4     475      (01DB)    219.608
Zone 0F:  0D7E5     -     0E5F4     448      (01C0)    205.611
Sys= 0968F-09709   0201 SPTK on sys trks
Total LBAs = 04A9220A
```

Here: 1 – zone number; 2 – initial zone cylinder (hex); 3 – final zone cylinder (hex); 4 – SPT in zone (dec); 5 – SPT in zone (hex); «Sys=» stands for service area coordinates, here it means the initial and final cylinders (hex), and SA SPT.

This drive family is based on Barracuda 7200.7 technology, so the drive has the peculiarities typical of the 7200.7 family with a few features determined by the 2.5” form factor.

Service area

Service area SPT – 0x0201
App code track – offset FOR SAFE MODE !!! 0x015
CERT track – offset 0x044, 0x045 (for the zero head)
ATA overlay track – offset 0x046
VENDOR data track – offset 0x048

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Attention! Hard drives of this family have a peculiarity pertaining to drive startup. Some drives block the terminal after initialization when connected as «Master». You will have to connect the drive as «Slave» to allow work via the terminal. Fig. 12.21 shows the scheme of jumper settings on the PC-2" adapter for Seagate Momentus drives.

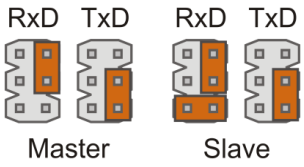

Fig. 12.21.

The start-up sequence in this case looks as follows:

- Connect the HDD as «Master», switch on the power supply, start the utility in the normal manner.
- Use the «Utility start» dialog to disable drive's power supply. Enable the «Slave» jumper and switch the drive's power supply on.
- Wait until the «(P)PATA Reset», «Slave» message appears, then launch the utility using the «Utility start» button.

Unfortunately, this method prevents the operator from using ATA commands as the utility can only function in Master mode. Therefore, a method for forcing the terminal to become enabled has been developed. It has been noted that the terminal responds to commands while a drive is processing a command. Therefore, the utility sends, at startup, a command requesting HDD ID (0xEC), but does not accept the results. In the case of PATA drives, the approach allows the operator to achieve the necessary result without further complications. In SATA drives, the sector transferred by the drive remains "stuck" in the adapter, blocking the passage of further commands. The Seagate utility takes that into account while switching modes. If other utilities are used the operator should first send the Hard Reset signal, or press the Reset button on the adapter.

Drives of this family support the command for output of the SA map («y» on level «T») to terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu). Sample report generated by the command (the first column contains name of the track in service area, the second – cylinder number):

```
                                PhysCyl    GrayCyl
First System Cylinder           0000968F   00009A70
First Zero Offset Cylinder      00009699   00009A7A
First App Code Cylinder         000096A4   00009A85
Second App Code Cylinder        000096A5   00009A86
Second Zero Offset Cylinder     000096B0   00009A91
Third App Code Cylinder         000096BB   00009A9C
Fourth App Code Cylinder        000096BC   00009A9D
First Cert Log Cylinder         000096BF   00009AA0
First Cert Code Cylinder        000096D3   00009AB4
First Intf Code Cylinder        000096D5   00009AB6
First Intf System Cylinder      000096D7   00009AB8
First Adaptives Cylinder        000096DC   00009ABD
First User Defect List Cylinder 000096DD   00009ABE
First Alternate Cylinder        000096E1   00009AC2
First Thermal Cylinder          000096EB   00009ACC
First SEADEX Cylinder           000096EB   00009ACC
First Decay Cylinder            000096FD   00009ADE
Last System Cylinder            00009709   00009AEA
```

Please find below the table of correspondences between the names in the table and the names used in the utility.

Name in utility	Name in report produced by the «y» command
CERT track	First Cert Code Cylinder
ATA overlay track	First Intf Code Cylinder
VENDOR data track	First Intf System Cylinder

Attention! The CERT code occupies 2 tracks in drives of this family. Its beginning is located on the cylinder specified above (head 0), while the remaining part can be found on the next cylinder (head 0). Thus, you will have to copy one more additional track before Self Test.

The drives support the «T>k» command for disabling of drive heads in the middle of the head stack.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

Type	Characters in SN
60	KV
61	KW
70	KX
71	KY

12.14.1. PCB layout

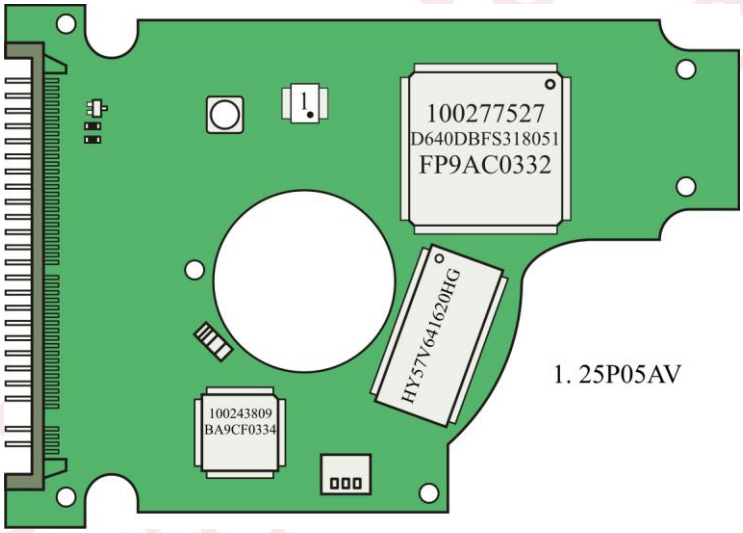

Fig. 12.22.

12.15. Momentus, 2.5” (MERCURY) drive family

Sample zone allocation table returned by the drive:

```
Head 00
Zone 00:  00005 - 016C8   962 (03C2) 445.490
Zone 01:  016C9 - 0271F   937 (03A9) 435.033
Zone 02:  02720 - 03542   912 (0390) 424.874
Zone 03:  03543 - 04B1B   888 (0378) 409.098
Zone 04:  04B1C - 05C5D   851 (0353) 396.401
Zone 05:  05C5E - 0737F   814 (032E) 378.263
Zone 06:  07380 - 0822F   789 (0315) 366.563
Zone 07:  08230 - 08EDA   764 (02FC) 356.392
Zone 08:  08EDB - 0A1F2   740 (02E4) 340.915
Zone 09:  0A1F3 - 0B15E   703 (02BF) 328.067
Zone 0A:  0B15F - 0C447   666 (029A) 310.035
Zone 0B:  0C448 - 0D440   629 (0275) 294.533
Zone 0C:  0D441 - 0E8A1   592 (0250) 274.286
Zone 0D:  0E8A2 - 0F666   555 (022B) 261.176
Zone 0E:  0F667 - 107D7   518 (0206) 243.258
```


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```
Zone 0F:  107D8 - 10F8D   493 (01ED) 232.941

Head 01
Zone 00:  00005 - 01310  1006 (03EE) 467.266
Zone 01:  01311 - 021CC   986 (03DA) 457.557
Zone 02:  021CD - 0319C   962 (03C2) 445.490
Zone 03:  0319D - 03EBA   937 (03A9) 435.294
Zone 04:  03EBB - 04BD8   912 (0390) 425.190
Zone 05:  04BD9 - 05FF8   888 (0378) 409.412
Zone 06:  05FF9 - 06F3E   851 (0353) 396.549
Zone 07:  06F3F - 08444   814 (032E) 378.562
Zone 08:  08445 - 097DA   777 (0309) 361.830
Zone 09:  097DB - 0AF08   740 (02E4) 341.176
Zone 0A:  0AF09 - 0BB6E   703 (02BF) 328.366
Zone 0B:  0BB6F - 0CD38   666 (029A) 310.140
Zone 0C:  0CD39 - 0DBF4   629 (0275) 294.902
Zone 0D:  0DBF5 - 0EED2   592 (0250) 274.286
Zone 0E:  0EED3 - 0FBC2   555 (022B) 261.315
Zone 0F:  0FBC3 - 109C6   518 (0206) 243.258

Head 02
Zone 00:  00005 - 01984   917 (0395) 426.667
Zone 01:  01985 - 03514   888 (0378) 409.098
Zone 02:  03515 - 041D4   858 (035A) 400.248
Zone 03:  041D5 - 05164   838 (0346) 389.647
Zone 04:  05165 - 061E4   814 (032E) 378.263
Zone 05:  061E5 - 071D4   789 (0315) 366.431
Zone 06:  071D5 - 07F84   764 (02FC) 356.199
Zone 07:  07F85 - 09424   740 (02E4) 340.706
Zone 08:  09425 - 0A4A4   703 (02BF) 328.067
Zone 09:  0A4A5 - 0BA64   666 (029A) 309.864
Zone 0A:  0BA65 - 0CC34   629 (0275) 294.533
Zone 0B:  0CC35 - 0E1C4   592 (0250) 273.987
Zone 0C:  0E1C5 - 0F094   555 (022B) 261.176
Zone 0D:  0F095 - 10354   518 (0206) 242.995
Zone 0E:  10355 - 10EF4   493 (01ED) 232.727
Zone 0F:  10EF5 - 11554   473 (01D9) 224.000
Reserve:  0CCC4 - 0CDEF   498 (01F2) 241.384
Total KBAs = 095CC951
```

Here the zone allocation parameters are output individually for each head. The first column contains zone number, the second – initial zone cylinder (hex), the third – final zone cylinder (hex), the fourth – SPT (dec), the fifth column shows SPT as hex. «Reserve:» – service area descriptor (therefore, it includes the initial cylinder (hex), final cylinder (hex), SPT (dec) , SPT (hex).

The drive family is based on Barracuda 7200.7 technology, so the drive has peculiarities typical of the 7200.7 family with a few features determined by the 2.5” form factor.

Service area

Service area SPT – 0x01F2
App code track – offset FOR SAFE MODE !!! 0x016
CERT track – offset (beginning) 0x064
ATA overlay track – offset 0x068
VENDOR data track – offset 0x06C

While tracing the SA objects reading commands (see section 4.3. Identification of parameters for SA objects), the track index received in the tracing report should be multiplied by two to obtain the SA offset.

Warning! Hard drives of this family have a peculiarity pertaining to drive startup. Some drives block the terminal after initialization when connected as «Master». You will have to connect the drive as «Slave» to allow work via the terminal. Fig. 12.23 shows the scheme of jumper settings on the PC-2" adapter for Seagate Momentus drives.

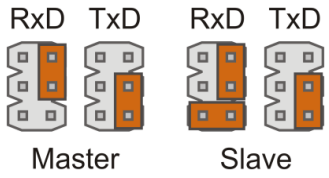

Fig. 12.23.

The start-up sequence in this case looks as follows:

- Connect the HDD as «Master», switch on the power supply, start the utility in the normal manner.
- Use the «Utility start» dialog to disable drive's power supply. Enable the «Slave» jumper and switch the drive's power supply on.
- Wait until the «(P)PATA Reset», «Slave» message appears, then launch the utility using the «Utility start» button.

Unfortunately, this method prevents the operator from using ATA commands as the utility can only function in Master mode. Therefore, a method for forcing the terminal to become enabled has been developed. It has been noted that the terminal responds to commands while a drive is processing a command. Therefore, the utility sends, at startup, a command requesting HDD ID (0xEC), but does not accept the results. In the case of PATA drives, the approach allows the operator to achieve the necessary result without further complications. In SATA drives, the sector transferred by the drive remains "stuck" in the adapter, blocking the passage of further commands. The Seagate utility takes that into account while switching modes. If other utilities are used the operator should first send the Hard Reset signal, or press the Reset button on the adapter.

Drives of this family support the command for output of the SA map («y» on level «T») to terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu). Sample report generated by the command (the first column contains name of the track in service area, the second – cylinder number):

```
T>y
                                    PhysCyl   GrayCyl
First System Cylinder              0000CCC4  0000E51D
First Zero Offset Cylinder         0000CCCE  0000E527
First App Code Cylinder            0000CCDA  0000E533
Second App Code Cylinder           0000CCDC  0000E535
Second Zero Offset Cylinder        0000CCE8  0000E541
Third App Code Cylinder            0000CCF4  0000E54D
Fourth App Code Cylinder           0000CCF6  0000E54F
First Adaptives Cylinder           0000CCF8  0000E551
First User Defect List Cylinder    0000CCFA  0000E553
First Alternate Pool Cylinder      0000CD02  0000E55B
Second User Defect List Cylinder   0000CD20  0000E579
First Cert Code Cylinder           0000CD28  0000E581
First Intf Code Cylinder           0000CD2C  0000E585
First Intf System Cylinder         0000CD30  0000E589
First SEADEX Cylinder              0000CD3C  0000E595
First Cert Log Cylinder            0000CD60  0000E5B9
First Decay Cylinder               0000CDD4  0000E62D
First SPLASH Cylinder              0000CDEE  0000E647
Last System Cylinder               0000CDEF  0000E648
```

Please find below the table of correspondences between the names in the table and the names used in the utility.

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Name in utility	Name in report produced by the «y» command
CERT track	First Cert Code Cylinder
ATA overlay track	First Intf Code Cylinder
VENDOR data track	First Intf System Cylinder

Attention! The CERT code occupies 2 tracks in drives of this family. Its beginning is located on the cylinder specified above (head 0) while the remaining part can be found on the next cylinder (head 1). Thus, you will have to copy one more additional track before Self Test.

The drives support the «T>k» command for disabling of drive heads in the middle of the head stack.

Command format is «T>Y»; the command belongs to the second type.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3). The relationship between pairs of characters in serial numbers and the number of drive heads is provided below.

Heads	Characters in SN
1	LD
2	LE
3	LF
4	LG

Warning! Self Test is performed in two stages. The first stage consists of tests 2 - 99, then the drive stops and waits for the operator to respond to the passed tests. If you switch the power off at that point, configuration results may be discarded. To continue, the [Ctrl]+[T] command must be sent.

12.16. Momentus, 2.5” (VENUS) drive family

The zone allocation report for the family is identical to the report for the Mercury family.

Service area

Service area SPT – 0x01F2
App code track – offset 0x016
CERT track – offset (beginning) 0x064
ATA overlay track – offset 0x06C
VENDOR data track – offset 0x070

While tracing the SA objects reading commands (see section 4.3. Identification of parameters for SA objects), the track index received in the tracing report should be multiplied by two to obtain the SA offset.

Drives of this family support the command for output of the SA map («y» on level «T») to terminal. To run the command, CERT must be loaded (that is arranged automatically in the user commands menu).

Warning! The CERT code occupies 2 tracks in drives of this family. Its beginning is located on the cylinder specified above (head 0), while the remaining part can be found on the next cylinder (head 1).

The drives support the «T>k» command for disabling of drive heads in the middle of the head stack.

Command format is «T>Y»; the command belongs to the second type.

While editing the serial number in a drive with disabled heads, please take into account the relation between character 3 of the serial number and the number of heads (see section 9.13.3. Editing the serial number while disabling drive heads). The relationship between pairs of characters in serial numbers and drive type is provided below.

Heads	Characters in SN	Heads	Characters in SN
1	LX	2	RL
2	LY	3	RM
3	LZ	4	RN
1	RK	4	MA

Caution! Self Test is performed in two stages. The first stage consists of tests 2 - 99, then the drive stops and waits for the operator to respond to the passed tests. If you switch the power off at that point, configuration results may be discarded. To continue, the [Ctrl]+[T] command must be sent.

13. List of commands with descriptions

13.1. Basic mode

13.1.1. On-Line commands

Command	Action
[Ctrl]+[E]	Shows interface status: error codes, Max CHS, data transfer settings
~	Command interface status
[Ctrl]+[C]	Firmware Reset
[Ctrl]+[D] or [Ctrl]+[N]	Switches the amount of details output in the report on firmware activity.
[Ctrl]+[L]	Displays an information string including firmware version.
[Ctrl]+[O] or [Ctrl]+[]]	Advance Servo Tracing – outputs detailed information about PCHS IO.
[Ctrl]+[R]	Loads CERT.
[Ctrl]+[T]	Restarts tests on the current level.
[Ctrl]+[U]	Outputs AT Stuff dump.
[Ctrl]+[Z]	Switches to command mode.
‘	Displays data transfer status.
.	Displays drive operation status.
;	Displays firmware status.
?	Shows buffers’ map.
Esc	Interrupts execution.

13.1.2. Response formats

13.1.2.1. Command « ’ »

Format of data returned by the command:

```
Cmd  Cyl  Hd Sct  Cnt  Stbuf Segl Csct Cbuf Actv Ercd    Rtry    Flags
xx  xxxx  xx xxxx xxxx  xxxx  xx   xxxx xxxx  x    xx  wwxx.yy.zz   xx
```

Message	Explanation
Cmd xx	The program executed most recently or running at the moment
Cyl xxx	Cylinder (or offset related to base cylinder) for the current command
Hd xx	Head
Sct xxxx	Initial sector

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Cnt xxxx	Data block size in sectors
Stbuf xxxx	Initial buffer for a data block
Segl xx	Size of intermediate input/output buffer
Csct xxxx	Current sector
Cbuf xxxx	Current buffer
Actv x	Command being executed
Ercd xx	Error code for the current command
Rtry wwxx.yy.zz	Retrying settings
Flags xx	Flags

13.1.2.2. Command « . »

Format of data returned by the command:

Pgm=xx Trk=xxxx(yyyy).a(b).zzz(www) Zn=x Err=xx ErCt=xxxx Hlth=xxxx CHlth=xxxx sssss LBA=xxxxxxxx

Message	Explanation
Pgm=xx	Active program. 00 – diagnostic monitor. 50 – program processing ATA interface commands.
Trk=xxxx(yyyy),a(b),zzz(www)	Current active logical cylinder (physical cylinder), log. head (phys. head), log. sector (phys. sector).
Err=xx	Error code for the current operation
ErCt=xxxx	Number of errors after the last drive Reset or the last command to reset the error log
Hlth=xxxx	Accumulated status of health bits (4 figures)
CHlth=xxxx	Current status of health bits (4 figures)
sssss	Drive status. It can be either Ready or Ntrdy
LBA=xxxxxxxx	Current LBA

E.g.: Pgm=50 Trk=0300(0301).2(0).034(068) Err=00 ErCt=0000 Hlth=0000 CHlth=0000 Ready LBA=00123492

13.1.2.3. Command « ; »

Format of data returned by the command:

Age=xx Type=xx MxCyl=xxxx MxHd=x MxSct=xxx Bsz=xx TCode=xxxx

Message	Explanation
Age=xx	Current level
Type=xx	Current drive type
MxCyl=xxxx	Maximum number of cylinders for the current drive, hex
MxHd=x	Maximum number of heads for the current drive, hex
MxSct=xxx	Maximum number of sectors for the current drive, hex
BSz=xx	Single buffer size, hex

E.g.: Age=50 Type=A4 MxCyl=1387 MxHd=3 MxSct=10D Bsz=80 Tcode=0000

13.1.2.4. Command « ? »

Format of data returned by the command:

```
RD:xxxx:yy
WR:xxxx:yy
AC:xxxx:yy
AS:xxxx:yy
SC:xxxx:yy
DP:xxxx:yy
BA:xxxx:yy
ST:xxxx:yy
logbps:xxxx
codebps:xxxx
uP:xxxx:yy
FM:xxxx:yy
AD:xxxx:yy
RL:xxxx:yy
SC: xxxx:yy
AL:xxxx:yy
```

Message	Explanation
RDxxxx:yy	xxxx – initial block of read buffer, yy – buffer length in sectors, hex
WRxxxx:yy	xxxx – initial block of write buffer, yy – buffer length in sectors, hex
AC:xxxx:yy	xxxx – initial block of active log buffer, yy – buffer length in sectors, hex
AS:xxxx:yy	xxxx – initial block of ASCII log buffer, yy – buffer length in sectors, hex
DP:xxxx:yy	xxxx – initial log of display log buffer, yy – buffer length in sectors, hex
SC:xxxx:yy	xxxx – initial block of scratch buffer, yy – buffer length in sectors, hex
BA:xxxx:yy	xxxx – initial block of packet task buffer, yy – buffer length in sectors, hex
ST:xxxx:yy	xxxx – initial block of statistics log buffer, yy – buffer length in sectors, hex
logpbs:xxxx	Bytes per sector in the cert log area
codebps:xxxx	Bytes per sector in code area
uP:xxxx:yy	xxxx – initial block of microprocessor RAM buffer, yy – buffer length in sectors, hex
FM:xxxx:yy	xxxx – initial block of the formatting operation buffer (reassignment of Alt defects), yy – buffer length in sectors, hex
AD:xxxx:yy	xxxx – initial block of adaptive data read/write buffer, yy – buffer length in sectors, hex
RL:xxxx:yy	Reserve slip test
SL:xxxx:yy	User slip list
AL:xxxx:yy	User Alt list

13.1.3. Explanation of health bits

A health long word has the following format (two words in hex notation): X X X X . Y Y Y Y. The first 4 tetrads reflect the current health status, whilst the following 4 tetrads reflect the accumulated health status, i.e. X X X X is the current health status, Y Y Y Y – accumulated health status (you can force the reset of these values with the H command on T level).

Bit number	Meaning of the bit set to 1
15	Excessive number of skipped sectors or Alt substitutions
14	Hardware error
13	Serious R/W error
12	Error Rate Health
11	Offtrack error

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10	Actuator error
9	Servo error
8	Rotational error
7	Reserved for internal use
6	Reserved for internal use
5	Reserved for internal use
4	Servo notification
3	R/W notification
2	Failed assign procedure for a skipped sector or Alt substitution.
1	Motor current warning
0	Rotational error during positioning

13.1.4. Common commands (available on all levels except for 8)

Command	Action
/x	Switch to level x

13.1.5. T level (0 level), the main test level

Command	Action
Bxx	Establishes HDD COM port data transfer rate: **xx** **Baud rate** 1228 1228000 921 921000 625 625000 460 460000 230 230000 115 115000 576 57600 192 19200 96 9600 48 4800
Dx,y,z	Displays CERT logs beginning with «x». If «y» is specified, it means than only records with «y» error code must be displayed. If «z» = 40, quick output is enabled.
Ex,y,z	Display / edit CERT log (see level 2).
F	HDD ID management. Editing is performed in the command line. SetStuff →. Two formats for the entered data are supported. ***Type 1*** Type 1 – means integral data of the HDD ID elements (element number is the word number according to the ATA specification for the HDD ID; data – sequence of words in hex notation): **ASCI**xxyy…yy. Here xx – word number in HDD ID corresponding to the selected parameter; yy…yy – data transferred to the parameter. The values must be entered in hex format, word by word (a word consists of two bytes in high/low byte format), without spaces in the orderin which they appear in HDD ID. Parameter management is performed individually. Each parameter requires one F command. ***Examples:*** «**ASCI01**3FFF» – sets the number of logical cylinders to 0x3FFF. «**ASCI03**0010» – sets the number of logical heads to 0x10 (= 16). «**ASCI06**003F» – sets the number of logical sectors to 0x3F (= 63). «**ASCI1B**xxxxxxxx» – sets the model name. xxxxxxxx stands for ASCII codes of model name in hex notation entered character by character without spaces; the model

	name will be supplemented to 40 characters with spaces (code 20). «**ASCI3C**45670123» – sets (Current) MaxLBA to 0x01234567 «**ASCI83**45670123» – sets the (Native) MaxLBA limit to MaxLBA в 0x01234567 «**ASCIAE**0000», «**ASCIEA**0000» – AE and EA keys are responsible for drive's AAM. In case of "singing" drives (producing a single or several high-tone sounds at the start) the parameters must be disabled (0000). «**ASCIFE**» – initialize HDD ID with default values. ***Type 2*** Type 2 – each HDD ID word is entered separately: **ASCInnWWWW.** Here nn – word number in HDD ID; WWWW – data word in hex notation You will have to restart the drive to make the modifications enter into force (e.g., using [Ctrl]+[C] command). ***Attention!*** There is information that the "ASCIFE" initialization command is not implemented in some drive families (e.g., 7200.9).
Gx	Reads a sector from VENDOR data track. «x» stands for sector number.
Hx,y,z	Display/reset health bits «x» = any character – displays current health. «y» = <skipped> – displays accumulated health values. «z» = 22 – resets health.
I,,22	Initializes service area. Performs all required calibration procedures, formatting, service area mapping and preparing it for recording of service data. It is equivalent to test 2 of the Self Test procedure.
Nx,y,z	Sets drive level (Age) to «x». Command execution requires «z» = 22. (E.g.: N50,,22 – switches HDD to level 50, i.e. the mode of operation via ATA). «y» – RdWrFeatures word flags. The following values are possible: A0 – Sets reading parameters by default. 0A – Sets writing parameters by default. 00 – Ignore the parameter. AA – Sets all parameters by default. Self Test can be launched in extended mode using the «N2,AA,22» command. In this case the drive will require additional actions to recalculate the adaptive data necessary for reading/writing.
R	Reads System Sector in RAM from the service area on disk (System Sector includes adaptive data among other components).
S	Checks Slip list for emptiness or incorrect sorting.
Tx	Runs factory test «x».
Vx,y	Displays defect lists. «x» – bit map, which specifies defect lists, it may be represented by a combination of flags. «y» – when present, enables output of defects for head y only. Bit number in «x» – Purpose: 0 – Show user track list 1 – Show reserved track slip list 2 – Show alt list
Wx,y,z	Saves System Sector from RAM to service area on disk surface (System Sector includes adaptive data among other components). «x», «y» – not used, «z» must be equal to 22 to allow the operation.

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Yx,y,z	The command modifies the drive type, thus managing the number of enabled heads. It supports two formats. The second format type is supported beginning with the 7200.9 drive family. ***Type 1:*** «x» – drive type. Type examples are provided in the descriptions of each individual drive family. «y» – if entered, the instruction enforces the packwriter version of the command (without attempts to write to disk or read from disk surface). «z» – unused. ***Type 2:*** «x» – new maximum head number «y» – if entered, the instruction enforces the packwriter version of the command (without attempts to write to disk or read from disk surface). «z» – if entered, the instruction tells the drive to change drive type to the specified value. Type examples are provided in the descriptions of each individual drive family.
f	Writes Flash memory. In HDD equipped with parallel Flash memory (Barracuda I, II, II, IV), recording is performed in a style identical to U type drives, i.e. via SDLD. HDD equipped with serial Flash memory are assumed to contain ROM code already loaded to buffer 0x400.
ix,y,z	Clears defect lists. «x» – bit map, which specifies defect lists, it may be represented by a combination of flags. «y» – when present, forces saving of defect list to disk surface after the clearing procedure. «z» – must be equal to 22 to allow the operation. Bit number in «x» – Purpose 0 – Clear user track list 1 – Clear reserved track slip list 2 – Clear alt list
kx,y,z	Management of heads disabling. «x» – head to disable (the highest one). The head being disabled cannot have zero number. If «x» = FF, it enables all heads. «y» – new drive type «z» – head to disable (the lowest, if necessary). If entered without parameters (i.e. «T>k»), displays the current heads map.
r	Displays CERT version
#,,z	Enters HDA serial number, «z» must be equal to 22 to allow the operation. The command is not available for the U Series X drive family because of some firmware peculiarities. The first requested parameter is the actual serial number, the second – Pack Writer SN – PN from the HDD label (you can just press [Enter]).
$	Enters PCBA serial number

13.1.6. Level 1, memory management

Command	Action
Bx,y	Displays buffer «x» and the degree of its match with buffer «y» (see level 2).
Dx,y,z	Displays memory dump. «x» stands for higher address part, «y» – lower address word, «z» – if entered, forces highlighting of bytes with that value.
F	Forces enabling of the writing bit. It may be necessary in cases where the adaptive data are not loaded (error during firmware start: Code - 33).
M	Displays information about ROM. Displays Flash ROM code, vendor code, user code of the write algorithm, emergency code of the write algorithm. Restarts firmware after execution.
Nx	Controls SMART and (partially) defect lists. x = 0 – toggles SMART On/Off 1, 4 – resets SMART 5 – displays SMART attributes 6 – displays SMART Thresholds 7 – displays G-List (makes a HDD freeze if CERT is loaded) 8 – displays the log of critical events 9 – displays the Pending List (makes a HDD freeze if CERT is loaded)
P	Displays PCBA information.
Sx,y,z	Edits specified RAM byte.
Ux,y,z	Edits specified buffer byte.
cx,y,z	Compares buffer blocks beginning with «x» and «y», block length = z.
r	Reads CERT code from disk.
t	Reads cert table from disk.
u	Reads SeaDex script from disk (for new drive models).

13.1.7. Level 2, work with drive using physical parameters

Command	Action
Bx,y	Displays the specified buffer. «x» – number of a 512 bytes buffer «y» – number of the second buffer for comparison If «x» is a read buffer and «y» is not specified, the comparison will be performed using a corresponding write buffer.
Cx,y,z	Copies buffers. «x» – source «y» – target «z» – the number of buffers to be copied.
Ex,y	Displays / edits CERT logs. «x» – number of the log to be displayed, if the option is not specified the command outputs the current log, if x = 0, it clears the current log. «y» – if present, enables output of components with error «y» only.
Hx	Selects physical head «x»
Sx,y	Forces positioning to cylinder «x», head «y»
U	Spins up the spindle.
Z	Stops the spindle.
cx,y,z	Compares buffer blocks. «x» – beginning of the first block «y» – beginning of the second block

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	«z» – block length.
r,y,z	Reads sectors from the current service area track. «y» – initial sector number, «z» – number of sectors
sx,y	Positioning to cylinder «x», head «y»
x	Displays zone allocation.

13.1.8. Level 7, work with adaptive data

Command	Action
Bx,y	Displays the specified buffer (see level 2).
Cx,y,z	Copies buffers (see level 2).
Dx	Displays the thermal diode values. The value is displayed in YYZZ format, where YY stands for the thermal diode values during Self Test, ZZ is the current temperature. If «x» is entered, then the target temperature for Self Test will be set to the current value. The drive then will assume that it has already reached the Self Test temperature (before the start of Self Test, the firmware warms up the drive to YY temperature). ***E.g.:*** 7>D TempDiode 3456 7> D1 TempDiode 5656
Ex,y	Displays logs (see level 2).
Hx	Positioning to head «x»
Ix,y,z,a	Displays / modifies adaptive settings for the current head. When entered without parameters, the command displays adaptive values for the current head. «x» – zone number. If «x» = the number of zones, the command will modify all zones. «y» – number of the parameter to be modified «a» = 1 – displays adaptive data and FIR taps «a» = 2 – displays FIR taps.
U	Spins up the spindle.
Z	Stops the spindle.
dx,y,f	Resets adaptive data to default values. «x» – zone number (by default the command uses the current zone). If «x» = the number of zones, then the command will modify all zones. «y» – head number (by default the command uses the current head). If «y» = the number of heads, the command will modify adaptive settings for all heads. «f» – a flag. When entered, it forces a reset of head offset values instead of the channel adaptive settings (reset by default).
r	Reads adaptive data from system sectors in service area.
x	Displays zone allocation

13.2. BootCode (level F – SafeMode)

In some models of the Barracuda drive family, switching to SafeMode preserves the same hierarchy of operational levels as in normal mode. The selection of available commands is somewhat limited. More recent firmware modifications enter a special F level in Safe mode. The level includes features, which in regular mode, are distributed among several levels. Among the models listed in this edition of the manual, these peculiarities are typical for Barracuda V, Barracuda 7200.7, and U Series 7.

13.2.1. On-Line commands

Command	Action
[Ctrl]+[C]	Firmware Reset
[Ctrl]+[D] or [Ctrl]+[N]	Switches the amount of detail output in the report on firmware activity.
[Ctrl]+[L]	Displays an information string including firmware version.
[Ctrl]+[O] or [Ctrl]+[]]	Advance Servo Tracing – outputs detailed information about PCHS IO.
[Ctrl]+[Z]	Switches to command mode.
.	Displays drive operation status.
;	Displays firmware status.
Esc	Interrupts execution.

13.2.2. Level F

Command	Action
Bx,y	Displays the specified buffer (see level 2).
Cx,y,z	Copies buffers (see level 2).
Dx,y,z	Displays memory dump (see level 1).
Rx	Reads system information «x» = 1 – reads track defect list «x» = 2 – reads start-up adaptive data «x» = 4 – reads Application code. If the parameters are not specified, the program will read all system information. After command execution the drive keeps functioning on level «F».
U	Spins up the spindle.
Z	Stops the spindle.
bxx	Sets HDD COM port data transfer rate (see level «T»).
j	Starts the Application code read using the «R» command.
r,y,z	Reads sectors from the current service area track (see level 2).
sx,y	Performs positioning to cylinder «x», head «y» (similarly to s on level 2).

14. HDD error codes

If an error is detected, a drive outputs ,to terminal, its code along with additional information. ***E.g.:*** «Code - FE Track 19A1.3.06E Sns E00 Rty F7FF.FF.80FF Rtf 1C00» – «FE» error.

The error codes are explained as follows:

Code	Error
00	No error
03	Calculated CRC doesn't match the expected value
11	Spin error
12	Ramp load error
13	Offtrack
14	Write fault
15	Rd/wr seek timeout code

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16	Seek timeout
17	“False” AMDET (mis-timed)
18	Bad burst error code
19	Bad Grey code
1A	Early sync code
1B	Missed AM
1C	Failed the servo defect screen threshold
1E	Target generator sector error
1F	Physical sector error
20	Skip write detected using servo burst
22	NRZ freeze occurred (A=A')&(B=B')&(C=C')&(D=D')
29	Thermal Asperity errors padded in test 36
30	Data miscompares
32	Slipped write error (a defective sector, which could not be recorded)
33	Adaptives are not loaded
34	Unexpected ECC verify read failure
35	Unexpected ECC verify read success
36	Pending block encountered during a write
37	Pending block encountered and read successfully
41	Long ECC error correction code
42	Non zero byte detected
43	Data ECC error
44	FIFO over/underrun
45	Track ID miscompare error
46	Track ID read TO code
47	Missed data sync byte
48	Missed data sync after a split
49	Thermal asperity code
4A	Error didn't repeat during dynamic sparing mini cert (usually refers to cases of log overflow)
4B	Error log full
4C	Controller stopped without a reason
4D	Error reassigned during dynamic sparing
4E	Block release timeout error
4F	Buffer ready error
50	Slipped sector (P-List)
51	Alternated sector (G-List)
52	Pad and fill defects
53	Hard error w/AT retries, no error with full retries (instability)
54	Error during scratchfill
55	Bad alt dest ID info (all messages refer to Niwot addressing whenever alternative destination is mentioned) Unable to find valid alt dest
56	Unable to find valid alt dest
57	Unable to delete alt dest
58	Too many defects per head

59	Too many defects per track
5A	Too many dynamic slips
5C	Unknown full slip failure
5E	Pad and fill defects
5F	Entire defect span was not found in User Defect List
60	No spares available (for reassignment of defective sectors, tracks, servo labels and any resources required for the current operation in general)
61	Write blocked w/o a reason
62	Write gate came on early
63	Write gate went off late
64	GC thermal sensor fault detected
65	Shock sensor fault detected
66	Attempt made to write at the wrong target location
68	FW initiated disk sequencer reset
69	FW sequencer abort; split sector runaway RG
70	Bad disk resident cert/diag code
71	Unable to read system sectors code
72	Unable to read packwriter auto-stamp
73	Invalid defect info loaded
74	Invalid alt info table (usually refers to reserved defect lists)
88	Unable to learn good zap on track
89	Cylinder to be skipped out in loopback test
8A	Wedge slipped (track portion from sector xxx to sector yyy)
8B	Write ID failed
8C	Cylinder padded (physical coordinates apply to two cylinders at once – translator problems)
8D	Cylinder filled in
8E	Cylinder skipped out
8F	Max cylinder skips has been reached
90	Zapped burst
91	2 consecutive zapped bursts
92	Too many zapped bursts on a track
93	Unable to zap - 2 consecutive bad bursts
94	Sumsquare of PES (one of adaptive parameters) on this track exceeds limit
95	Unable to zap bad burst
96	Too many position plus velocity threshold breaks
97	Zapped splice code
98	Encroachment code (any corruption of servo packets)
99	Max number of slipped tracks has been reached
9A	The slipped cyl requested does not exist
9B	Head switch timeout error code
A0	Preamp miscommunication
A1	Reserve track defect list bad
A2	Boot adaptives bad

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A3	Bad application code
A4	Not enough sectors saved to the disc for adaptives
A5	Application code checksum error
A6	Application code not compatible
CE	Cert test passed
CF	Cert test failed
ED	Attempt to write the user slip list but no valid list
FB	Missing critical parameter
FC	Command aborted (internal only)
FD	R/w command rejected
FE	Invalid address passed to Niwot
FA	FA: Un-initialized preamp code for new preamp interface
FF	Unsupported code in the new preamp interface

15. Key values for HDD ID editing in terminal

Keys 1, 3, and 6 use standard values: 3FFF, 0010 and 003F respectively.

Values for keys 1B, 3C, 83 can be found in the table below.

Model	Key: 1B	Keys: 3C, 83
Seagate U5 Family		
ST310211A	5354333130323131412020202020202020202020202020202020202020202020202020202020202020	2C61012A
ST315311A	5354333135333131412020202020202020202020202020202020202020202020202020202020202020	A50101BF
ST320413A	5354333230343133412020202020202020202020202020202020202020202020202020202020202020	A7810254
ST330621A	5354333330363231412020202020202020202020202020202020202020202020202020202020202020	AC81037E
ST340823A	5354333430383233412020202020202020202020202020202020202020202020202020202020202020	B57104A8
Seagate U7 Family		
ST330012A	5354333330303132412020202020202020202020202020202020202020202020202020202020202020	AC81037E
ST340012A	5354333430303132412020202020202020202020202020202020202020202020202020202020202020	B57104A8
ST360012A	5354333630303132412020202020202020202020202020202020202020202020202020202020202020	CF3106FC
ST380022A	5354333830303232412020202020202020202020202020202020202020202020202020202020202020	F8890950
ST3120020A	5354333132303032304120202020202020202020202020202020202020202020202020202020202020	4BB10DF9
Seagate Barracuda 5400.1 Family (Vendor Name: Grand 2C)		
ST320015A	5354333230303135412020202020202020202020202020	A7810254

	20202020202020202020202020202020	
ST340015A	53543334303031354120202020202020202020202020 20202020202020202020202020202020	B57104A8
Seagate Ux Family		
ST310014ACE	53543331303031344143452020202020202020202020 20202020202020202020202020202020	43130131
ST320014A	53543332303031344120202020202020202020202020 20202020202020202020202020202020	A7810254
Seagate Barracuda ATA Family (Vendor Name: Rango)		
ST36810A[1]	53543336383130412020202020202020202020202020 20202020202020202020202020202020	A5BC00CB
ST310220A	53543331303232304120202020202020202020202020 20202020202020202020202020202020	43130131
ST313620A	53543331333632304120202020202020202020202020 20202020202020202020202020202020	4CA90197
ST320430A	53543332303433304120202020202020202020202020 20202020202020202020202020202020	8EF10263
ST327270A	53543332373237304120202020202020202020202020 20202020202020202020202020202020	9951032E
ST328040A	53543332383034304120202020202020202020202020 20202020202020202020202020202020	FA210351
Seagate Barracuda ATA II (Vendor Name: Vail)		
ST310210A	53543331303231304120202020202020202020202020 20202020202020202020202020202020	0B790130
ST315320A	53543331353332304120202020202020202020202020 20202020202020202020202020202020	113501C8
ST320420A	53543332303432304120202020202020202020202020 20202020202020202020202020202020	16F10260
ST330630A	53543333330363304120202020202020202020202020 20202020202020202020202020202020	22690390
Seagate Barracuda ATA III (Vendor Name: Aspen)		
ST310215A	53543331303231354120202020202020202020202020 20202020202020202020202020202020	0B790130
ST315310A	53543331353331304120202020202020202020202020 20202020202020202020202020202020	113501C8
ST320414A	53543332303431344120202020202020202020202020 20202020202020202020202020202020	A7810254
ST330620A	53543333330363230412020202020202020202020202020 20202020202020202020202020202020	AC81037E
ST340824A	53543334303832344120202020202020202020202020 20202020202020202020202020202020	B57104A8
Seagate Barracuda ATA IV (Vendor Name: Snowmass)		
ST320011A	53543332303031314120202020202020202020202020 20202020202020202020202020202020	A7810254

[1] For this model is the key 1=372B, key 3=000F

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ST340016A	5354333430303136412020202020202020202020202020202020202020202020202020202020202020	B57104A8
ST360021A	5354333630303231412020202020202020202020202020202020202020202020202020202020202020	CF3106FC
ST380021A	5354333830303231412020202020202020202020202020202020202020202020202020202020202020	F8B10950
Seagate Barracuda ATA V (Vendor Name: Avalanche)		
ST330013A	5354333330303133412020202020202020202020202020202020202020202020202020202020202020	AC81037E
ST340017A	5354333430303137412020202020202020202020202020202020202020202020202020202020202020	B57104A8
ST360015A	5354333630303135412020202020202020202020202020202020202020202020202020202020202020	CF3106FC
ST380023A	5354333830303233412020202020202020202020202020202020202020202020202020202020202020	F8B10950
ST3120023A	5354333132303032334120202020202020202020202020202020202020202020202020202020202020	4BB10DF9
Seagate Barracuda 7200.7 (Vendor Name: Alpine)		
ST340014A	5354333430303134412020202020202020202020202020202020202020202020202020202020202020	B57104A8
ST380011A	5354333830303131412020202020202020202020202020202020202020202020202020202020202020	F8B10950
ST380013A	5354333830303131412020202020202020202020202020202020202020202020202020202020202020	F8B10950
ST3120022A	5354333830303133412020202020202020202020202020202020202020202020202020202020202020	4BB10DF9
ST3120026A	5354333132303032324120202020202020202020202020202020202020202020202020202020202020	4BB10DF9
ST3160021A	5354333132303032364120202020202020202020202020202020202020202020202020202020202020	9EB112A1
ST3160023A	5354333136303032314120202020202020202020202020202020202020202020202020202020202020	9EB112A1
ST340014AS	5354333136303032334120202020202020202020202020202020202020202020202020202020202020	B57104A8
ST380011AS	5354333430303134415320202020202020202020202020202020202020202020202020202020202020	F8B10950
ST380013AS	5354333830303131415320202020202020202020202020202020202020202020202020202020202020	F8B10950
ST3120022AS	5354333132303032324153202020202020202020202020202020202020202020202020202020202020	4BB10DF9
ST3120026AS	5354333132303032324153202020202020202020202020202020202020202020202020202020202020	4BB10DF9
ST3160021AS	5354333136303032314153202020202020202020202020202020202020202020202020202020202020	9EB112A1
ST3160023AS	5354333136303032334153202020202020202020202020202020202020202020202020202020202020	9EB112A1