Hitachi

***Drive families* : DK23AA, DK23BA, DK23CA, DK23DA, DK23EA, DK23EB, DK23FA (4K80), DK23FB (5K60), C4K40, C4K60**

Contents

1. Introduction

The utility described herein is intended for work with the following HDD manufactured by Hitachi:

- 2.5" HDD manufactured by Hitachi until year 2003. In the end of 2002, Hitachi purchased IBM branch manufacturing hard disk drives and founded HGST – Hitachi Global Storage Technologies Company, which deals with HDD design and manufacture. HGST at that stopped manufacture of 2.5” HDD designed by Hitachi; instead, it continues further development and manufacture of HDD designed by IBM. Therefore, it is necessary to distinguish two lines of 2.5" Hitachi drives:

  1) Hitachi HDD manufactured before 2003 (Native);

  2) Hitachi HDD manufactured after 2003 (IBM).

This PC-3000 suite utility currently supports the following families of 2.5" Hitachi HDD (Native): AA, BA, CA, DA, EA, EB, FA, FB.

- 1.8" HDD manufactured by HGST and belonging to the C4K40 and C4K60 drive families. The latter family is being manufactured at the time of this publication.

2. The structure of drive families

2.1. 2.5" HDD

Drive family	Model	Capacity, GB	RPM	Cache buffer, MB	Heads
DK23AA	DK23AA-60	6	4200	н/д	н/д
DK23BA	DK23BA-20	20	4200	2	4
	DK23BA-10	10		0.5	2
	DK23BA-60	6			
DK23CA	DK23CA-30	30	4200	2	4
	DK23CA-20	20		0.5	3
	DK23CA-15	15			2
	DK23CA-10	10			1
	DK23CA-75	7.5			
DK23DA	DK23DA-40F	40	4200	2	4
	DK23DA-30F	30			3
	DK23DA-20F	20			2
	DK23DA-10F	10			1
DK23EA	DK23EA-60	60	4200	2	4
	DK23EA-40	40			3
	DK23EA-30	30			2
	DK23EA-20	20			
DK23EB	DK23EB-40	40	5400	2	4
	DK23EB-20	20			2
DK23FA (4K80)	HTS428080F9AT00	80	4200	8	4
	HTS428060F9AT00	60		2	3
	HTS428040F9AT00	40			2
	HTS428030F9AT00	30			
DK23FB (5K60)	DK23FB-60	60	4200	8	4
	DK23FB-40	40			3
	DK23FB-20	20			2

2.2. 1.8" HDD

Drive family	Model	Capacity, GB	RPM	Cache buffer, MB	Height, mm	Connector type	Heads
C4K40	HTC424040F9AT00 (DK13FA-40)	40	4200	2	9	2.5"	4
	HTC424020F7AT00 (DK14FA-20)	20			7	2.5"	2
C4K60	HTC426060G9AT00	60	4200	2	9	2.5"	4
	HTC426040G9CE00	40			9	2.5"	4
	HTC426030G7AT00	30			7	2.5"	2
	HTC426020G7CE00	20			7	2.5"	2
	HTC426030G7CE00	30			7	ZIF	2
	HTC426020G7CE00	20			7	ZIF	2
C4K60 Slim	HTC426060G8CE00	60	4200	2	8	ZIF	4
	HTC426040G8CE00	40			8	ZIF	4
	HTC426030G5CE00	30			5	ZIF	2
	HTC426020G5CE00	20			5	ZIF	2

Abbreviations: RPM – Revolutions Per Minute – rotational velocity. N/A – data not available.

3. Utility features

The utility can perform the following functions:

- Reset HDD password.
- Read and write service information.
- Check service tracks and rewrite them completely.
- Read microcode from FLASH memory and write it replacing damaged code.
- Gain access to user data in factory (techno) mode for data recovery purposes, when it cannot be accessed normally.
- Test drive heads.
- Read RAM.
- Read the zone allocation table.
- Reset S.M.A.R.T.
- Clear Error Log.
- After errors, output extensive diagnostic messages about error causes.
- Clear PList and GList.
- Assign defects using PList.
- Indication of extended diagnostic messages informing about errors and HDD status.
- Indication of LBA-CHS conversion results.

4. Constructional peculiarities of Hitachi HDD

Hitachi HDDs have the following typical features:

Microprogram is stored in internal ROM (FLASH memory) of an ARM microprocessor manufactured by Samsung. In C4K60 drive family the microprocessor is integrated into a Marvel chip in BGA package. The service area on disk surface has no modules containing portions of the control microprogram (overlays). Head map, HDD model name, drive capacity and other values are recorded in microprocessor Flash ROM.

1) HDD service area on disk surface contains the following recorded data: 4 or 6 service modules (depending upon drive family), S.M.A.R.T. and SelfTest modules. Besides, HDD of AA, BA, CA, and DA drive families use adaptive data recorded on disk surface, too. In the EA, EB, FA, FB, C4K40, and C4K60 drive families adaptive data are stored in microprocessor Flash ROM. Location of adaptive data determines the opportunities for PCB replacement and actual data recovery if drive PCB fails. Thus, in AA, BA, CA, and DA drive families you can replace the HDD electronics board with another one borrowed from an identical drive model; drives belonging to other families require soldering the microprocessor with Flash ROM over to the new PCB.

2) The service information is recorded to the following cylinders:

In AA drive family:

- Cylinder 0 contains service information modules for all heads.
- Cylinders 2, 3 contain just zeros for all heads.
- Cylinder 4 contains SelfTest logs.
- Cylinder 1 cannot be read (remains unformatted).
- User data area begins with cylinder 5

In BA drive family:

- Cylinder 0 contains service information modules for all heads.
- Cylinders 2, 4 contain just zeros for all heads.
- Cylinder 5 – contains SelfTest logs.
- Cylinder 6 is reserved for relocation of defects.
- Cylinders 1 and 3 cannot be read (remain unformatted).
- User data area begins with cylinder 7.

In FB, FA, EB, EA, DA, CA, C4K40, and C4K60 drive families:

- Cylinders 0 and 2 contain service data modules. They contain duplicate copies for heads 0 and 1. Thus, there are 4 copies in all.
- Cylinder 4 contains just zeros for all heads.
- Cylinder 5 contains SelfTest logs.
- Cylinder 7 is reserved for relocation of defects.
- Cylinders 1, 3 and 6 cannot be read (remain unformatted).
- User data area begins with cylinder 8.

3) List of service data modules:

Module ID	Purpose
DR[1]	Serial number
DP[2]	Adaptive data.
PD[3]	Primary Data, PLIST
GD[3]	Grown Data, GLIST и error log
ID[4]	Identification, serial number and Max LBA value in case of its modification.
SD[3]	Secure Data. Password module.
10 00[5]	SMART, current values.
10 00[5]	SMART, threshold values.

Note:

1 – in FB, FA, EB, EA, DA, C4K40, and C4K60 drive families only.

2 – in DA family only.

3 – AA and BA drive families have no identifier.

4 – in AA and BA drive families the module also contains adaptive data.

5 – the hexadecimal value acts as module identifier.

4) The modules are protected with a checksum. A HDD reads first the module on cylinder 0 using head 0. If the checksum does not match, then the drive reads the module using head 1. If checksum mismatch occurs again as well, then in AA and BA families drives read modules using heads 2 and 3 (when present) while in B, FA, EB, EA, DA, CA, C4K40, and C4K60 families drives read the modules from cylinder 2. If at least one copy has been read successfully, the HDD switches to the normal operation mode. If none of the copies containing modules DR, DP, PD, GD, and SD can be read, then such HDD switches to inoperability state and responds to all commands with ERR=04h (ABORT).

5. Terminal mode

The terminal mode allows the operator to read ROM and RAM content at the specified addresses. The utility also allows reading (and recording) of microcode from (to) microprocessor Flash ROM.

6. Preparing for work

1) Plug the IDE cable of your PC-3000 tester board into the IDE connector of the PC-2" adapter.

2) Connect the power cable to the corresponding connector of the PC-2" adapter. If a PC-3K PWR power supply adapter is present, then it should be used as power source. Otherwise, you have to use a standard external PC power supply unit and switch power off/on manually after a respective request displayed on-screen.

3) Connect the drive being tested to the PC-2" adapter; please pay attention to the separate group of contacts on drive and adapter connectors. Set the jumpers in accordance with the on-board scheme for Hitachi HDD.

4) Connect the PC-2" adapter to COM port using the PC-KALOK adapter or to USB port using the PC-USB-TERMINAL adapter.

5) Switch on the power supply to the drive being tested. If the PC-3K PWR adapter is available, you can control drive power using the Power icon on the utility toolbar.

7. Launching the utility

After utility start, it displays a dialog for selection of drive family and model.

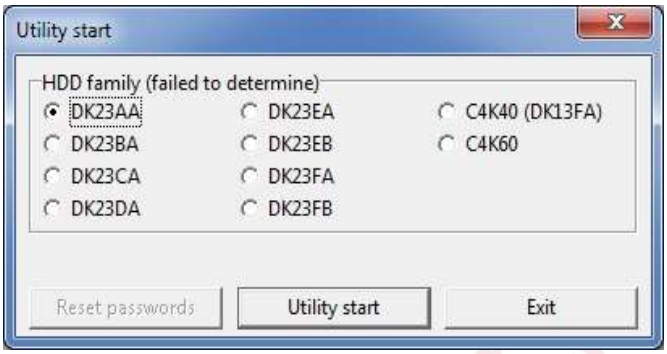

Fig. 7.1. Utility start.

The utility at the start uses the COM port to read such HDD ID parameters as HDD family, microcode version, microcode checksum; then it sends techno commands and reads the zone allocation table.

Below is a sample report output to utility log after running those checks without errors:

> *Com identification.....: Ok*
> *Code ver.....: K4B62400*
> *Code CS..... : 1287h*
> *Techno On.....: Ok*
> *Techno+ ON.....: Ok*
> *Zone table.....: Ok*

Attention! If the first three checks end in an error (indicating either malfunction of the PCB or COM port of the HDD or its improper connection), then microcode reading and loading, work with passwords, reading of RAM or ROM will be impossible.

After utility start, the following features become available:

1) ***Utility status***
2) ***Work with ROM***
   - Read RAM
   - Read ROM
3) ***Work with service area***
   - Heads test
   - Zone allocation table
   - SA structure test
   - Read modules
   - Write modules
   - Reading service tracks
   - Writing service tracks
   - Read HDD microcode
   - Write HDD microcode
   - Microcode compilation
   - Security subsystem

4) ***Logical test***

5) ***Defect list:***

Defect list editing
Clearing P-List
Clearing G-List
LBA to CHS conversion

6) ***Clear S.M.A.R.T.***

7) ***Clear S.M.A.R.T. Error Log***

All messages output by the utility are displayed in the «Log» tab.

The «Terminal» tab allows the operator to work with HDD in terminal mode.

If a HDD is password-protected, the utility will display a warning about the set password in the family selection dialog; besides, the «Remove password» button will become available. Pressing the button will initiate an automatic procedure disabling the password.

7.1. Terminal

The following commands can be entered in terminal:

- ***ESC*** – switch HDD to terminal mode
- ***Q ENTER*** – force HDD to exit the terminal mode
- ***D <number> ENTER*** – ROM dump, where the number stands for an address in ROM
- ***R <number> ENTER*** – RAM dump, where the number stands for an address in RAM
- ***W ENTER*** – write byte to RAM.
- ***E ENTER*** – write to ROM, recording is possible beginning with 20000h address. The drive accepts the command without errors, but no actual recording to ROM occurs. Perhaps, additional actions are required during the procedure (switching on techno power supply or enabling techno mode jumpers). The issue is not thoroughly studied yet.

D and R commands produce dumps in 256-bytes blocks.

ROM capacity is 262144 bytes (0-3FFFFh).

If a HDD is in terminal mode, then access to it via the ATA interface is blocked; the drive responds to any command with BUSY status until it leaves the terminal mode. Therefore, after completion of work in terminal it is essential to explicitly leave the mode by pressing [Q+ENTER].

8. «Tests» menu

8.1. Utility status

This menu item displays the parameters read during utility start:

- HDD family
- microcode version
- microcode checksum
- number of heads
- number of cylinders

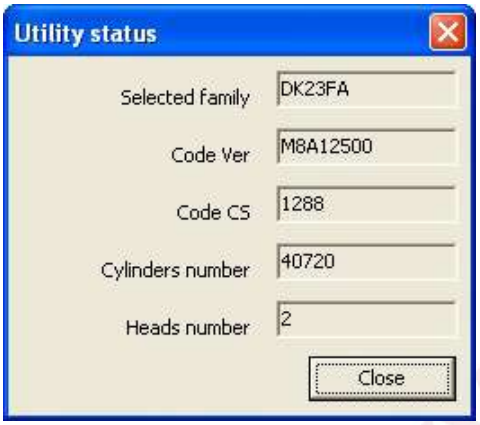

Fig. 8.1. Utility status.

8.2. Work with ROM

8.2.1. Read RAM

Attention! Correct functioning of that feature requires connection via COM port.

Selection of the «Read RAM» option brings up the following dialog:

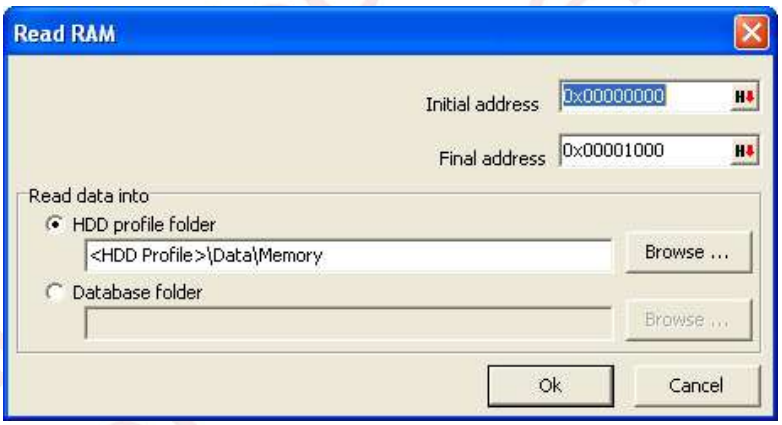

Fig. 8.2. Read RAM

Here you can select the initial and final RAM address in hex notation and the destination for the resulting file: HDD profile folder or database. RAM size in Hitachi HDD ranges from 0.5 to 8 MB (see the «Drive families» section).

8.2.2. Read ROM

Attention! Correct functioning of that feature requires connection via COM port.

Selection of the «Read ROM» menu item opens a dialog identical to that for the «Read RAM» feature. Here you can select the initial and final RAM address in hex notation and the destination for the resulting file: HDD profile folder or database. ROM size in Hitachi HDD is 256 Kb (or, more precisely, 262143 bytes).

Drive ROM contains the microprogram, heads table, HDD model name and capacity. In EA, EB, FA, FB, and C4K40 drive families ROM also contains serial number and adaptive data recorded beginning with address 34000h. ROM structure in C4K60 drive family is not thoroughly studied yet at the time of publication of this manual.

8.3. Work with service area

The «Work with service area» menu contains a group of commands intended for manipulating the data in ROM and in modules within the service area on disk surface.

8.3.1. Heads test

The test performs reading of all zones using all physical heads. You can specify the number of reading commands to use per zone in the dialog displayed before the test begins. If the test reveals errors, they are displayed in Cylinder-Head-Sector format, i.e. the utility shows error location.

If you check the «Cancel current head test if an error occurs» option, then error occurrence will exclude the head that has produced it from further testing while the remaining heads will go on. The test will be terminated, if errors occur on all heads.

8.3.2. Reading

The «Reading» test has been implemented in the utility for the following reason: after occurrence of any error the program will output an extensive diagnostic message about error cause. The feature is not available in the universal utility. After the test you can estimate the chances for data recovery and HDD repair.

The «Reading» test allows the user to check surface readability in two modes: normal and techno. The data read during the procedure are not transferred anywhere, the test checks reading only.

Selection of that mode opens the following dialog:

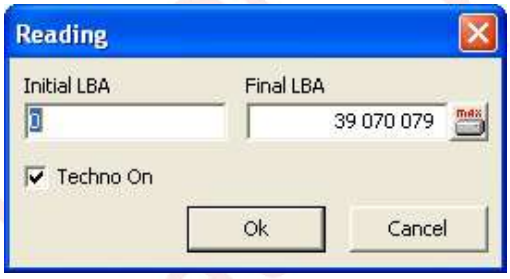

Fig. 8.3. Reading.

You can specify the initial and final LBA or enable/disable the «Techno On» checkbox.

If you enable the «Techno On» checkbox, then reading will be performed in factory mode. That might be useful in some cases, when a drive contains corrupted modules preventing data access in normal mode. However, sending the «Techno On» key to such drive may allow reading of user data. After you have discovered the opportunity, you may use Data Extractor PCI for data recovery.

If you disable the «Techno On» checkbox, the utility will perform reading in normal (user) mode.

8.3.3. Zone allocation table

Selection of the «Zone allocation table» menu item makes the utility log the table of zone allocation with indication of the initial (Beg Cyl) and final (End Cyl) cylinders of each zone and the number of sectors per zone (SPT – Sector Per Track).

8.3.4. SA Structure test

This test reads the table of modules in the service area checking module headers and their checksums. The utility scans modules using all heads that allow module reading and checks cylinders 0 and 2 (where the modules are located). In drive models where modules are located within the 0 cylinder only, the reading routine uses heads as the only criterion.

Test progress is reflected in log; after completion the utility generates a report. Fragment of the report:

```
Modules checking
-------------------------------------------------------------------------------------------
Module      :: Cyl  : Head : Read : Hdr  : CS   :: Cyl  : Head : Read : Hdr  : CS   ::
-------------------------------------------------------------------------------------------
DR          :: 0    : 0    : Ok   : Ok   : Ok   :: 2    : 0    : Ok   : Ok   : Ok   ::
PD          :: 0    : 0    : Ok   : Ok   : Ok   :: 2    : 0    : Ok   : Ok   : Ok   ::
GD          :: 0    : 0    : Ok   : Ok   : Ok   :: 2    : 0    : Ok   : Ok   : Ok   ::
ID          :: 0    : 0    : Ok   : Ok   : Ok   :: 2    : 0    : Ok   : Ok   : Ok   ::
SD          :: 0    : 0    : Ok   : Ok   : Ok   :: 2    : 0    : Ok   : Ok   : Ok   ::
~SAT        :: 0    : 0    : Ok   : None : Ok   :: 2    : 0    : Ok   : None : Ok   ::
~STH        :: 0    : 0    : Ok   : None : Ok   :: 2    : 0    : Ok   : None : Ok   ::
-------------------------------------------------------------------------------------------
```

Where: Cyl – number of the checked cylinder; Head – number of the checked head; Hdr header check result; CS – Check Sum, the result of checksum verification.

8.3.5. Reading modules

You can use this command to save all or some of the modules to a HDD profile folder or database for future use. Selection of that menu item opens the following dialog:

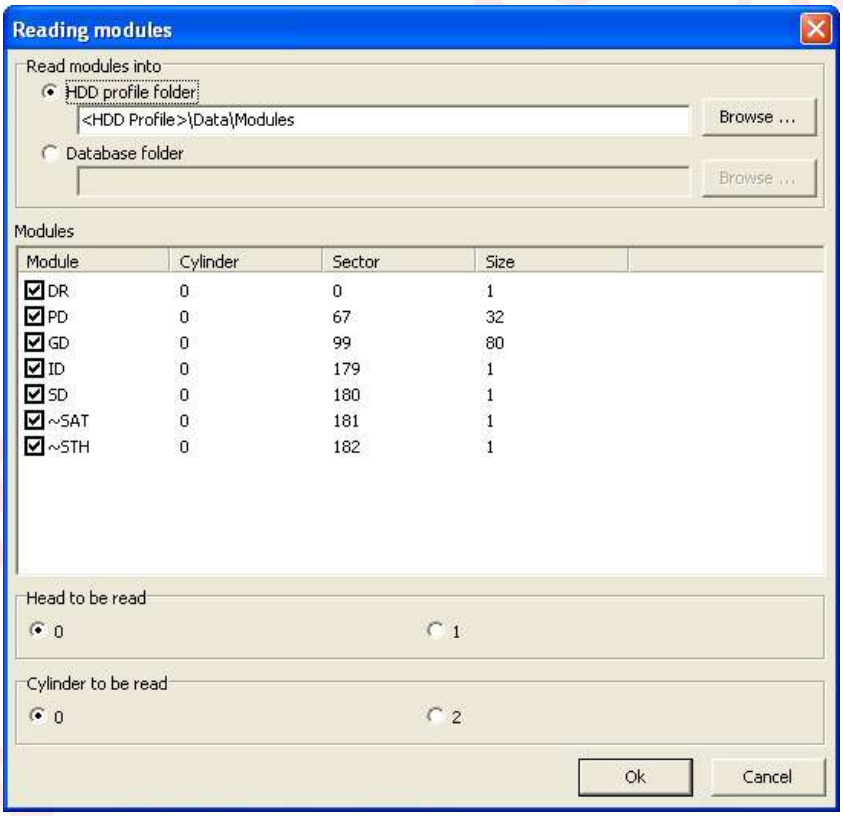

Fig. 8.4. Reading modules.

The «Reading modules» dialog allows you to choose the modules and the source from which they will be read – head and cylinder. Here you can also select the destination where the data will be saved – HDD profile folder or database. You can select modules manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination.

8.3.6. Writing modules

Recording allows the operator to overwrite all or some modules using the HDD profile folder or database as source.

Having launched the test, you will see a sequence of dialogs understandable from the context. First, you will be offered to select the data source: a HDD profile folder or your database.

If you select the «Writing modules from HDD profile files» option, the following dialog will be displayed:

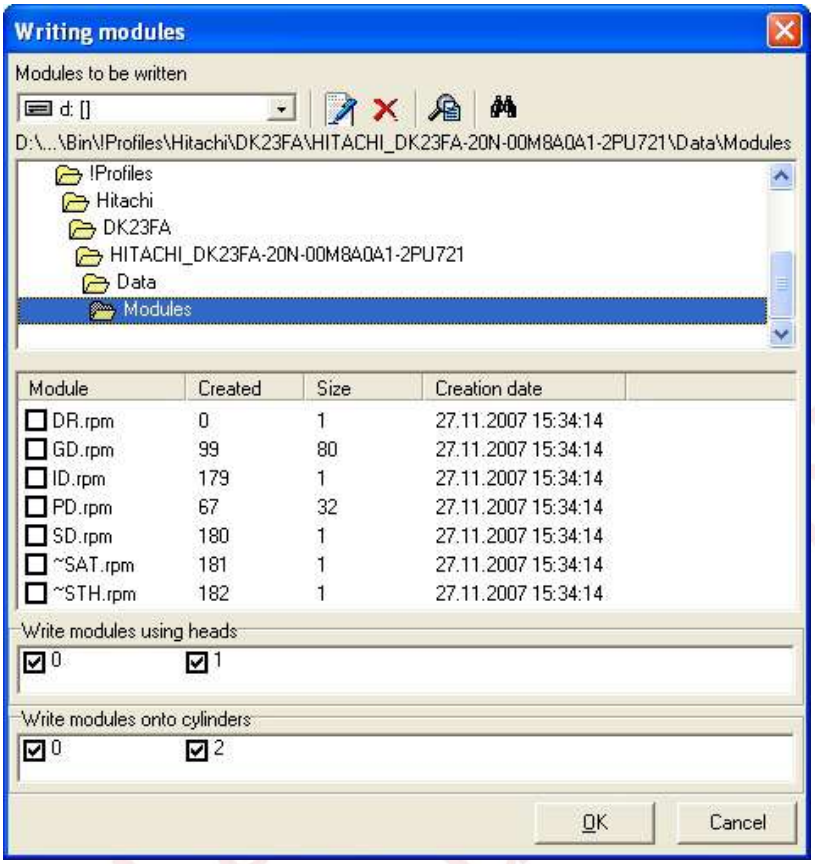

Fig. 8.5. Writing modules.

If you select the «Writing modules from HDD profile files» option, the following dialog will be displayed:

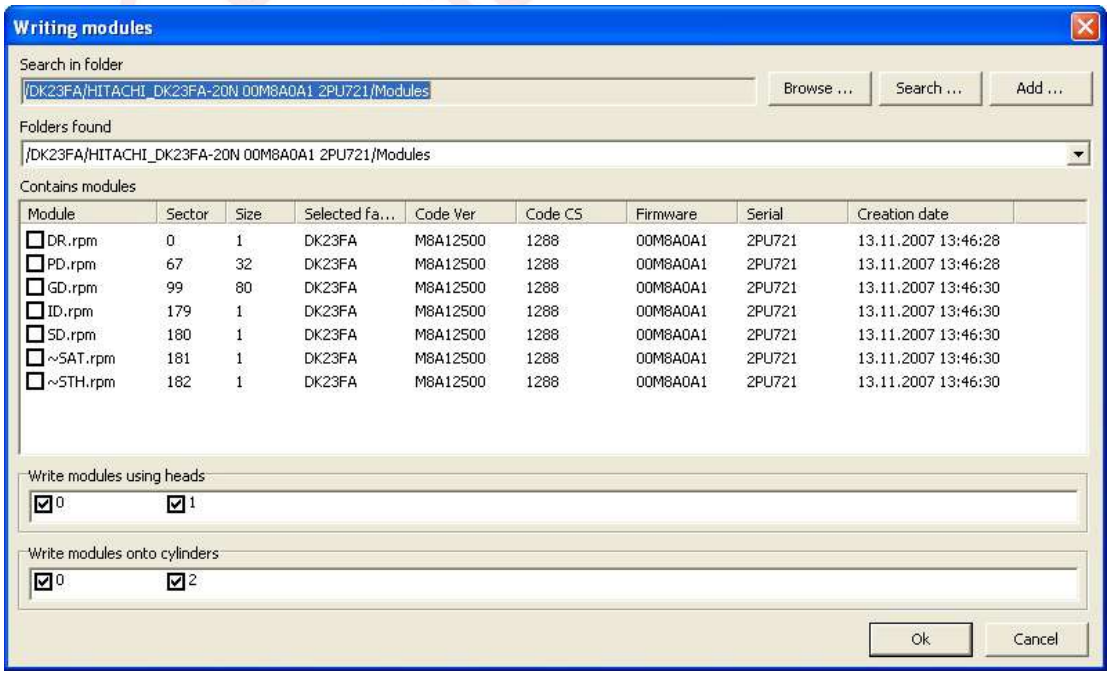

Fig. 8.6. Writing modules

In the window, you should select the required modules and specify the cylinders and heads to be used for recording of the selected modules.

You can select them manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination.

8.3.7. Reading service tracks

You can use this command to save all or some of the service tracks to a HDD profile folder or database for future use. While reading, the utility creates 2 files for each track, one of them has the *.trk extension, the other – *.map. The first file contains the copied track; the second one is a bit map telling, which sectors have been read with or without errors. The size of that file (bits) is equal to the size of the *.trk file divided by 512. Each bit in the file points to a corresponding sector. If a bit is equal to 1, then the corresponding sector has been read without errors; if it is 0, then an error has occurred. The utility uses the file while recording tracks. The generated files are named using the: «0005_00.trk» format where the first number (here «0005») indicates the track number and the second digit after the underscore represents the head number.

Selection of that item brings up the following dialog window:

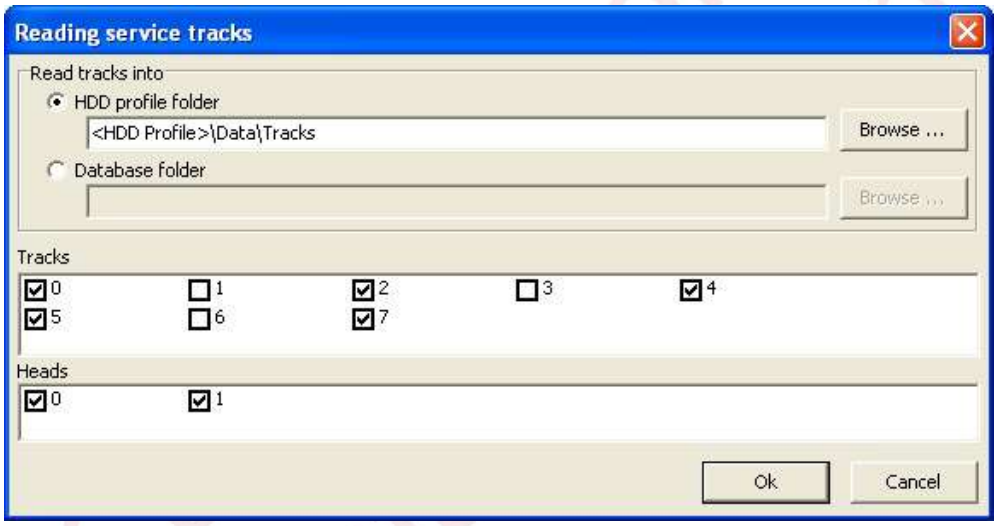

Fig. 8.7. Reading service tracks.

In the «Reading service tracks» dialog you should select the track and head number and the location for saving: HDD profile folder or database. You can select tracks manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination.

Selection of that item from menu allows reading of service area tracks as a whole. If the utility encounters errors during the process, then if fills sectors containing the errors with the «DE AD» signature in the resulting file. You can skip reading the current track by pressing the «Skip» button (Ctrl+B).

Selection of that menu item opens a dialog window, where you can specify the HDD profile files or database as the destination for the tracks to be read from the drive.

8.3.8. Writing service tracks

Recording allows the operator to overwrite all or some service area tracks using the HDD profile folder or database as source.

Having launched the test, you will see a sequence of dialogs understandable from the context. First, you will be offered to select the data source: a HDD profile folder or your database.

If you select the «Writing tracks from HDD profile files» option, the following dialog will be displayed:

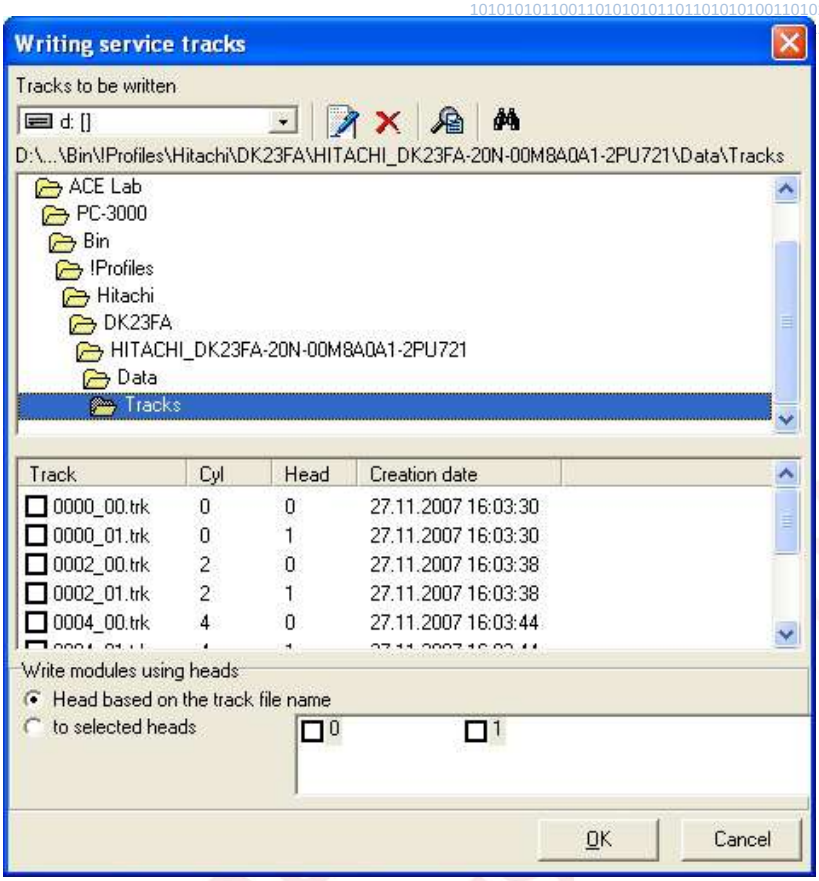

Fig. 8.8. Writing service tracks.

If you select the «Writing tracks from database» option, the following dialog will be displayed:

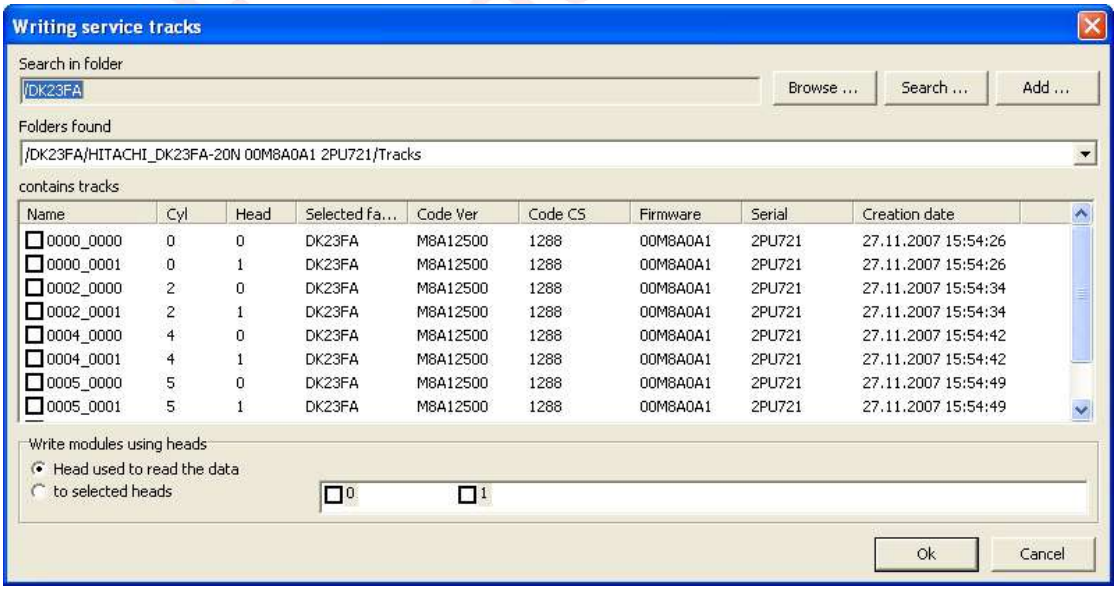

Fig. 8.9. Writing service tracks.

Use the dialog to select the necessary tracks from the list of available ones. You can select them manually or using the group operations menu, which appears after right-clicking the area, or use a hot key combination. Here you can also select the number of the head to be used for recording. If you choose «Head used to read the data», the utility will

perform writing using the heads indicated in file names. If you choose «To selected heads», the utility will record data using the heads specified in the head selection field.

8.3.9. Read HDD microcode

Atentions! Correct functioning of that feature requires connection via COM port.

Selection of that mode allows the operator to read the microcode from HDD microprocessor ROM and save it to a file in format necessary for subsequent loading.

At the start of that mode, you should specify in the initial dialog the HDD profile or database as the destination for the copied microcode.

The reading procedure takes 30-40 minutes. It can be interrupted at any time, but the data will be lost in that case. Upon completion of the reading procedure the utility generates two files: «Original.bin» and «Microcode.bin». The first file contains a binary ROM image. The second is used to store compiled microcode required for the «Write HDD microcode» command.

8.3.10. Write HDD microcode

Selection of that mode allows the operator to write microcode to Flash ROM inside HDD microprocessor.

Microcode loading takes 1-2 minutes. It is not recommended to interrupt the procedure, because the HDD may cease to function as a result.

At the start of that mode, you should specify in the initial dialog the original microcode file from the HDD profile or database. Correct application of that command requires an available microcode file in special format. The file can be produced using the «Read HDD microcode» or «Microcode compilation» commands. The default name assigned to the file generated by those commands is «Microcode.bin». After file selection the utility starts the loading procedure characterized by a spindle stop before the actual loading and spindle motor spin-up following after successful completion. In case of an error the utility displays a diagnostic message informing about the step during which the failure took place.

8.3.11. Microcode compilation

Selection of that command allows conversion of a binary ROM image to special file format required for the «Write HDD microcode» command.

Selection of the «Microcode compilation» command brings up the following dialog:

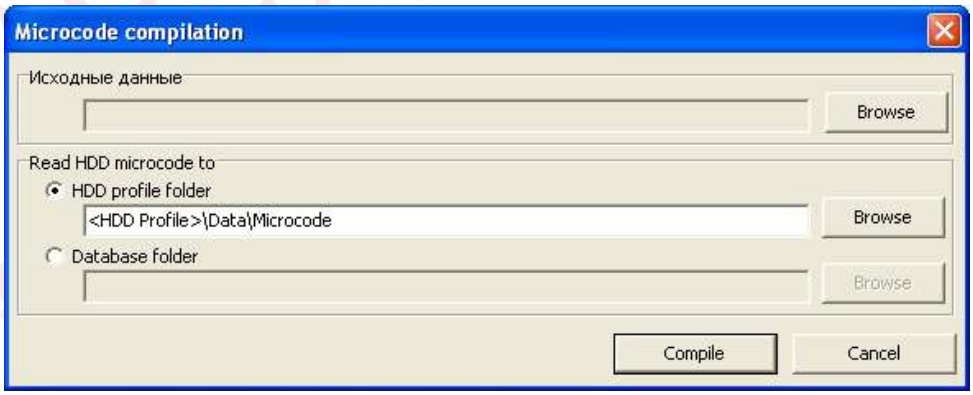

Fig. 8.10. Microcode compilation.

In the dialog you should select the source file and the target location where converted file will be saved: HDD profile folder or database.

The microcode file will be generated as soon as you choose the file and destination and press the «Convert» button.

8.3.12. Security subsystem

Attention! Correct functioning of that feature requires connection via COM port.

That menu item provides access to reading Master and User passwords. In 5-10 seconds after selection of «Security subsystem» the utility outputs to log both Master and User passwords in ASCII and hex notation. Having thus obtained the passwords, you can launch the universal utility and run «Tools → HDD → Security subsystem» to reset the password using standard means.

8.3.13. Clear S.M.A.R.T.

The «Clear S.M.A.R.T.» command returns S.M.A.R.T. attributes to their initial values. In certain cases when S.M.A.R.T. attribute thresholds are exceeded a HDD may cease to function; in such cases the option allows to restore HDD operation.

Attention! Interaction of this feature with drives of BA and AA families is studied incompletely yet, the «Clear S.M.A.R.T» command may function incorrectly. Save copies of the S.M.A.R.T. modules before using it to allow their subsequent restoration, if necessary.

8.3.14. Clear S.M.A.R.T. Error Log

The «Clear S.M.A.R.T. Error Log» command clears the error log. The errors are displayed during SMART viewing in the «Summary Error Log» tab. Hitachi HDD log errors detected in the process of reading or verification and append them to GLIST. In some cases it may cause GLIST overflow resulting in drive's inability to operate properly. The «Clear S.M.A.R.T. Error Log» feature can fix the problem. However, the errors are not always registered in GList.

8.4. Logical test

The menu allows the operator to perform reading/writing based on logical parameters.

Selection of that item brings up the following dialog window:

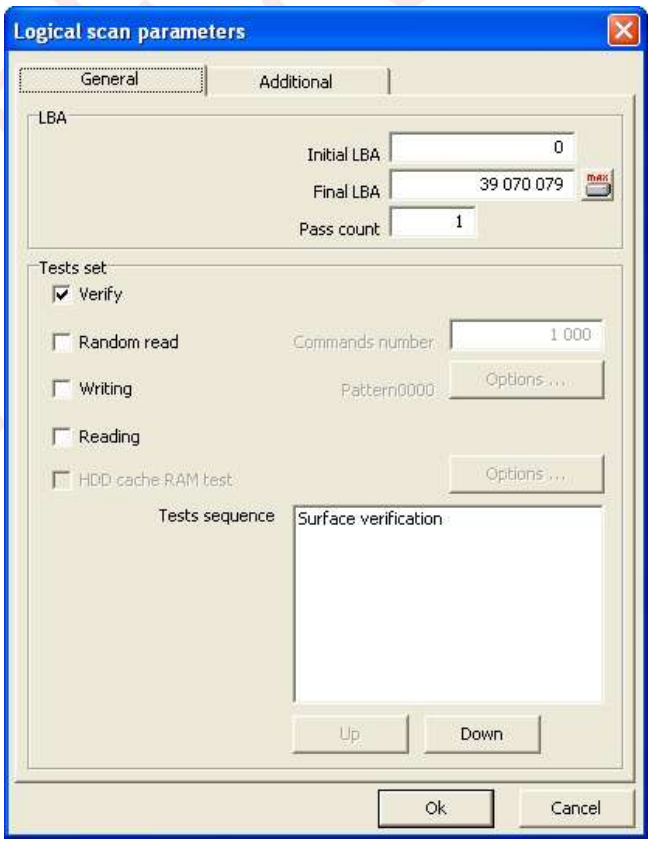

Fig. 8.11. Logical scan parameters.

In the «General» tab of the «Logical test parameters» dialog you can specify the following test parameters:

- Initial and final LBA, the number of test passes.
- A list of procedures, which will be performed, precedes actual test execution: verification, random reading, writing, reading, HDD cache RAM test.

Selected tests are added to the «Tests sequence» list. You can use the «Up» and «Down» button to reorder the tests.

The «Additional» tab of the «Logical scan parameters» dialog allows selection of various scan settings; you can use the tab to select a destination file for recording of defects revealed while scanning, define the data transfer mode (PIO, UDMA33, UDMA66) and the method used to display the performance graph.

8.5. Defect list

8.5.1. Defect list editing

This command allows viewing and editing of the PList list of defects.

Selection of that item brings up the following dialog window:

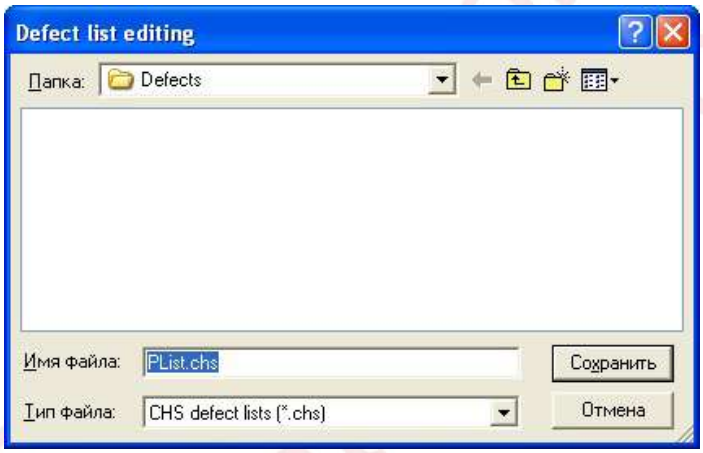

Fig. 8.12. Defect list editing.

The utility offers to select the PList file name in the dialog. The default name is «PList.bin». As soon as the file name is selected and the «Saving» button is pressed, the utility reads PList from HDD, records it to the corresponding profile folder and opens the retrieved PList in the defects editor window:

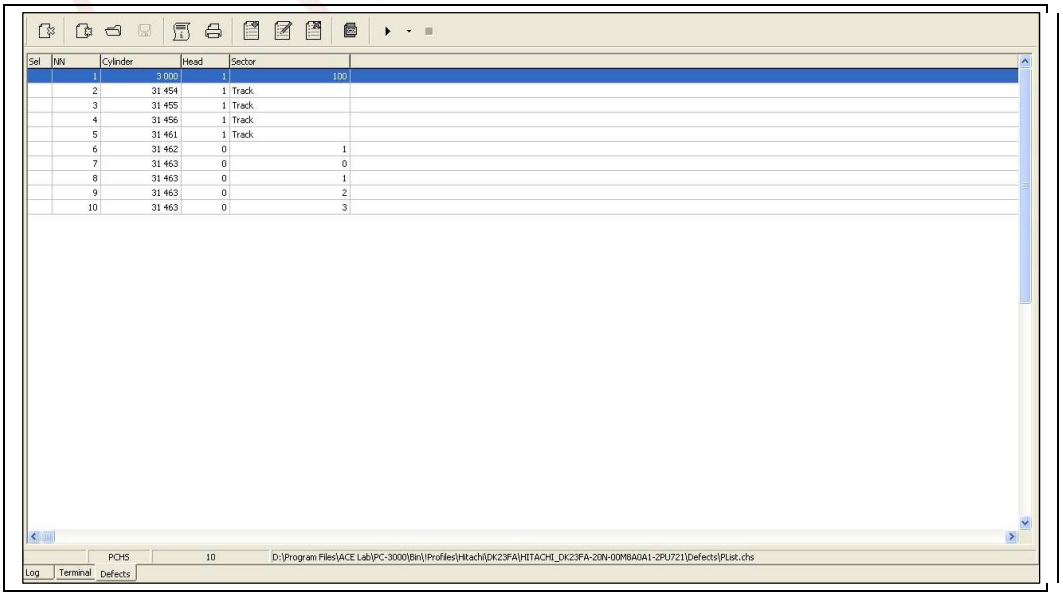

Fig. 8.13. Defects editor window.

The number of defects in PList is displayed in the status line in the lower part of the defects editor window; in this example there are 10 of them.

The defects editor can be used to delete, add or modify the defect records. Pressing the  button displays the following dropdown menu:

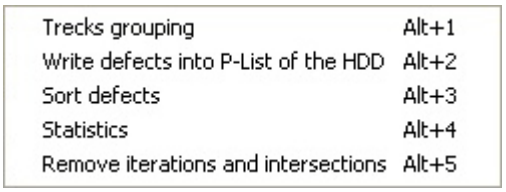

Fig. 8.14.

8.5.1.1. Tracks grouping

The command allows the operator to select the heads to be used for arrangement of track defects from defects located within the same track and accessible for the same head.

8.5.1.2. Write defects into P-List

Selection of that command will record the defects list into HDD. It is necessary to remove duplicate defects selecting the «Remove iterations and intersections» menu item before recording.

8.5.1.3. Sort defects

Selection of that menu item sorts defects in the table in the ascending order by the cylinder numbers.

8.5.1.4. Statistics

Selection of the item displays a diagram reflecting the distribution of defects among heads and zones indicating the number of defects per each head and zone.

8.5.1.5. Remove iterations and intersecions

Selection of that command deletes from the table records containing links to the same defective locations. That command must be performed before you begin to «Write defects into P-List».

8.5.2. Clearing P-LIST

The feature allows the operator to clear P-List. Before its selection you will have to backup the PD module to have an opportunity for its restoration later.

8.5.3. Clearing G-LIST

The «Clearing G-List» command allows the operator to partially clear the GList. Hitachi HDD log errors detected in the process of reading or verification and append them to GLIST. In some cases it may cause GLIST overflow resulting in drive's inability to operate properly. The «Clearing G-List» feature can fix the problem. However, it clears only some (not all) errors.

The «Clearing G-List» procedure also verifies P-List integrity. Therefore, if a critical P-List corruption exists, «Clearing G-List» will be applied with an error and access to user data will be blocked in such cases.

8.5.4. LBA to CHS conversion

Indication of LBA-CHS conversion results.

Selection of that item brings up the following dialog window:

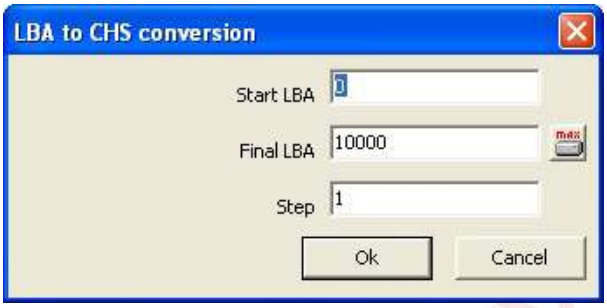

Fig. 8.15. Conversion LBA->CHS.

Here you can select the initial and final LBA for conversion and the increment that indicates the number of LBA to add to the current LBA for the next conversion operation. E.g., if the initial, final LBA and conversion step values are 0, 10 and 3 respectively, then the conversion will be performed for the LBA 0, 3, 6, and 9.

9. Opportunities for data recovery from Hitachi HDD

9.1. Problems related to microcode corruption

Malfunctions pertaining to microcode corruption or damage to its integrity are characterized by the following HDD behaviour:

- HDD reports on readiness immediately after power-up
- the spindle motor does not spin up and a very quiet sound is heard at power-up
- an attempt to send any command causes an 04h (ABRT) error.

The same symptoms appear after a failed attempt to write microcode to drive.

However, if the electronics of the HDD is not damaged, you can restore drive functionality by writing to it microcode copied from another HDD (the family and models of both drives must be identical).

Hitachi HDD use lots of various microcode versions. Still, according to our observations, the microcode versions are compatible between HDD belonging to the same drive family and model. They are ***incompatible*** between HDD of the same family characterized by different capacities.

9.2. Problems resulting from damaged modules

As we have noted above, Hitachi HDD use only a few models and not all of them are essential for drive functionality. If at least one sound copy of each module is available, the HDD continues to work.

If a HDD responds to read commands with ABORT, that may be caused by reading errors or mismatch of checksums of all copies available for one of its modules.

9.2.1. Module DR

When all copies of that module are damaged, HDD responds to all data access commands with ERR=04h (ABORT). An attempt to read the service data modules also results in ABORT by the HDD. The situation with a damaged DR module can be corrected only by rewriting all service tracks (not just the DR module). The tracks used for overwriting must be copied from the same HDD model. If you switch power off and on after that, the HDD becomes functional but it will be impossible to access its data. If you perform recording in normal mode all over the disk surface, then the HDD will be ready for operation but the original data will be lost.

9.2.2. Module PD

When all copies of that module are damaged, HDD responds to all data access commands with ERR=04h (ABORT). An example of a defect-free module instance for FB, EB, EA, DA, CA, C4K40, and C4K60 drive families:

```
00000000h: 50 44 00 24 00 1E 00 1E 00 1E 00 1E 00 1E 00 1E ; PD.$..........
00000010h: 00 1E 00 1E 00 1E 00 1E 00 1E 00 1E 00 1E FF FF ; ..............ÿÿ
00000020h: FF FF 06 3A 00 00 00 00 00 00 00 00 00 00 00 00 ; ÿÿ.:............
```

The remaining portion of the module contains recorded zeros. If all copies are damaged, you may attempt overwriting one of them with the above sample model or zeros provided that there are no surface defects in the service area. Doing so will provide an opportunity to access disk surface. To access the data, you will have to send the «Techno Off» then «Techno On» command sequence in the «Tools» → «Utility extensions» menu. However, you should keep in mind that if there were surface defects hidden in native PLIST, those defects would re-appear during reading or verification. Since the PLIST module is involved in calculation of the translation table, read data may turn out to be incorrect because of that new shift not yet taken into account while calculating their actual position.

9.2.3. Module GD

When all copies of that module are damaged, HDD responds to all data access commands with ERR=04h (ABORT). The structure of that module has not been decrypted completely yet. Unfortunately, it is the only module with unidentified algorithm of checksum calculation. An example of a defect-free module instance for FB, EB, EA, DA, CA, C4K40, and C4K60 drive families:

```
00000000h: 47 44 00 1E 00 00 00 01 00 00 00 00 00 00 00 00 ; GD..............
00000010h: 00 00 00 00 0F FF FF FF 00 00 00 00 09 F0 00 00 ; .....ÿÿÿ.....ð..
```

The remaining portion of the module contains recorded zeros. If all copies are damaged, you may attempt overwriting one of them with the above sample model or zeros provided that there are no surface defects in the service area. Doing so will provide an opportunity to access disk surface. To access the data, you will have to send the «Techno Off» then «Techno On» command sequence in the «Tools» → «Utility extensions» menu. However, you should keep in mind that if there were surface defects hidden in native GLIST, those defects would re-appear during reading or verification. Since the GLIST module is involved in calculation of the translation table, read data may turn out to be incorrect because of that new shift not yet taken into account while calculating their actual position.

9.2.4. Module SD

When all copies of that module are damaged, HDD responds to all data access commands with ERR=04h (ABORT). In FB, EB, EA, DA, CA, C4K40, and C4K60 drive families HDD also respond with ERR=04h (ABORT) to the Techno ON command when the module is damaged, i.e., in those families corruption of that module will definitely prevent access to user data. Currently no methods for its recovery are known.

However, in AA and BA drive families it is possible to access data. You will have to send the «Techno Off» then «Techno On» command sequence in the «Tools» → «Utility extensions» menu. After that data on disk can be accessed using Data Extractor.

9.2.5. Module ID

Corruption of all copies of that module does not affect HDD functioning and user data integrity. Still, its recovery is recommended. To accomplish that, copy an identical module from the same HDD model, modify the 6-character serial number in hex editor to make it match the label on HDA case (taking the last 6 figures of the serial number from HDA case) and recalculate its checksum. After that the modified module can be recorded instead of the damaged one.

Module recovery means taking the following steps. Select in «Tools» menu the «Database» or «Explore profile folder» command and specify any existing ID module (with an .rpm extension). Then the program will open a hex editor window; use it to correct the serial number, then Select All by pressing [Ctrl+A], right-click the selection to produce the context menu and use it to invoke Plug-ins → Hitachi 16 bit check sum (recalculation). The program will recalculate the checksum and after that the module will be ready for saving in the required directory and recording to the HDD service area using the «Writing modules» function.

9.2.6. Modules ~SAT и ~STH

Corruption of all copies of those modules does not affect HDD functioning. However, it will disable S.M.A.R.T. and the universal utility will display the «HDD does not support S.M.A.R.T.» warning in the start-up screen. Therefore it is recommended to restore them from any copy of any functional HDD of the same model.

9.3. If HDD is password-protected

Password protection on HDD blocks access to information. The procedure of password removal in described in the «Security subsystem» and «Launching the utility» sections. Please see also the «Problems resulting from damaged modules» section for details about the SD module.

9.4. Opportunities for PSB replacement

In AA, BA, CA and DA drive families you can swap the electronics boards using another HDD of the same family and model as the donor drive. Drive microcode has to be rewritten when you are replacing the PCB with another one borrowed from a different HDD model of the same family.

In EA, EB, FB, C4K40, and C4K60 drive families PCB replacement is also possible, but it additionally requires resoldering of the control microprocessor (containing Flash ROM with adaptive data), see «Constructional peculiarities of Hitachi HDD» and schemes of HDD PCBs in the appendix hereto. Resoldering is a problematic task for C4K60 drives, because their microprocessors are installed in BGA cases.

9.5. Extended diagnostics

After any error, the utility displays an extensive diagnostic message informing about error causes. The feature is not available in the universal utility. It allows the operator to estimate the opportunities for data recovery and HDD repair. See also the «Reading» section.

9.6. Hiding defects in P-List

The utility supports hiding defects in HDD P-List through the «Defect list editing» menu.

Attention! After any manipulations with P-List recording over the whole disk surface should be performed to ensure correct translator functioning.

To hide defects, you should read the defects list from HDD, create a new one or open for editing a list saved earlier. After modification of the list select the «Write defects into P-List» command, which will write the defects list into HDD. It is necessary to remove duplicate defects selecting the «Remove iterations and intersections» menu item before recording.

However, there is a problem with the defects in P-List. An attempt to hide sector defects in P-LIST, results in defect assignment; but the HDD actually hides a different sector for the specified cylinder and head instead of the specified one. E.g., if you attempt to hide defect on cylinder 10, head 1, sector 100, the drive hides sector 75 on cylinder 10, head 1, i.e. the sector is reassigned with an offset and that offset varies for different cylinders. So far the algorithm for detection of that offset has not been found. Still, you can manually pick the number of the sector, which you can select for hiding to assign the necessary one. But that is a rather tedious process.

The opportunity for generation and reassignment of sector defects is left for experiments required to find the necessary offset.

The proper method of reassignment is their grouping to tracks. You can convert sector defects to track ones by selecting the «Tracks grouping» menu item. However, internal HDD means allow hiding of just a limited number of track defects, usually 100-200 (the number can be found experimentally only). If you hide more, a HDD will respond to all command with «ABORT» after that. You may need to use the «Clearing G-List» command after reassignment of defects. Therefore you should back up all modules before reassignment to be able to restore their original condition and decrease the number of tracks to hide. P-LIST is stored in the PD module.

10. Advanced features

The «Tools»→«Utility extensions» provides access to features specific for the Hitachi utility only.

10.1. Modules table

Selection of that menu item opens the «Modules table» window. The mode can be used for operations over modules copied from disk surface. Right-clicking within the window opens a context menu containing the following items:

- View module
- Start SA structure test
- Check one module
- Rewrite module from DB
- Rewrite modules group from DB
- Rewrite modules group from files
- Show log

The same menu items can be accessed by clicking the respective button in the upper window part.

10.1.1. View module

Selection of that menu item opens the hex editor window containing the selected module. You can view, edit, save the module back to the service area on disk surface or to a file, you can also recalculate its checksum.

Checksum recalculation for DR, DP, PD, GD, SD, and ID modules is performed using «Hitachi 16 bit check sum» algorithm while for ~SAT and ~STH modules «Hitachi 8 bit check sum» algorithm is employed.

The editor also allows loading of a module copied earlier and its subsequent editing and recording to disk surface or to a file.

10.1.2. Start SA structure test

That menu item opens the «Modules selection» window where you can select all modules or one required module to check. The selected modules will be verified, and the utility will display the result in its log in the lower window part.

Modules will be tested for readability and match between header and checksum.

10.1.3. Check one module

The utility just checks the module highlighted by the cursor.

10.1.4. Rewrite module from DB

This menu item allows rewriting a module with a copy from the database. The utility performs actions described in the «Writing modules» section.

10.1.5. Rewrite modules group from DB

This menu item allows rewriting a group of modules from the database. The utility performs actions described in the «Writing modules» section.

10.1.6. Rewrite modules group from files

This menu item allows rewriting a group of modules from HDD profile. The utility performs actions described in the «Writing modules» section.

10.1.7. Show log

If you enable this option in the menu, the utility will display its log in the lower part of the «Modules table» tab. It helps simultaneously test modules and monitor occurring errors through the log.

10.2. «Techno ON», «Techno+ON», «Techno Off»

Work with service information in Hitachi HDD becomes possible after 2 factory mode keys have been sent to the drive: Techno On and Techno+ On. Those keys are sent automatically at utility start. However, in some cases it may be necessary to send them manually.

- ***«Techno Off»*** – switches HDD to standard (user) mode.
- ***«Techno On»*** – in case when some modules are damaged the key helps restore access to data. The reading function starts working, see the «Reading» section; you can recover data using Data Extractor.

Prior to sending Techno On you should send Techno Off first. Keep in mind the following: if PD or GD modules are damaged, previously hidden errors may re-appear. Since the modules are involved in calculation of the translation table, read data may turn out to be incorrect because of that new shift not yet taken into account while calculating their actual position.

11. Using HexEdit

HexEdit is bundled with the PC-3000 UDMA suite. The editor will open every time, when you need to view or edit any hexadecimal data (modules, data read from disk surface, etc.).

The editor has a built-in help system describing all its features.

The editor uses a plug-in architecture, which allows connection of external modules implementing the functionality necessary for a specific situation.

For Hitachi HDD the functionality includes the mechanism for module checksum calculation. To invoke the checksum calculation feature, you should select the necessary data, right-click it and use the context menu to select Plug-ins. You will be offered a choice of four options:

- Hitachi 16 bit check sum (checking);
- Hitachi 8 bit check sum (checking);
- Hitachi 16 bit check sum (recalculation);
- Hitachi 8 bit check sum (recalculation).

Selection of the first two variants forces recalculation of the selected data fragment; if the checksums match the utility outputs «Check sum: OK», otherwise you will see «Check sum: Error».

Selection of «Hitachi 16 bit check sum (recalculation)» recalculates the checksum for the selected data fragment and writes the result to the last two bytes of that fragment.

Selection of «Hitachi 8 bit check sum (recalculation)» recalculates the checksum for the selected data fragment and writes the result to the last byte of that fragment.

Checksum recalculation for DR, DP, PD, GD, SD, and ID modules is performed using «Hitachi 16 bit check sum» algorithm while for ~SAT and ~STH modules «Hitachi 8 bit check sum» algorithm is employed.

12. Appendix 1. Layouts of controller boards in 2.5” Hitachi drives

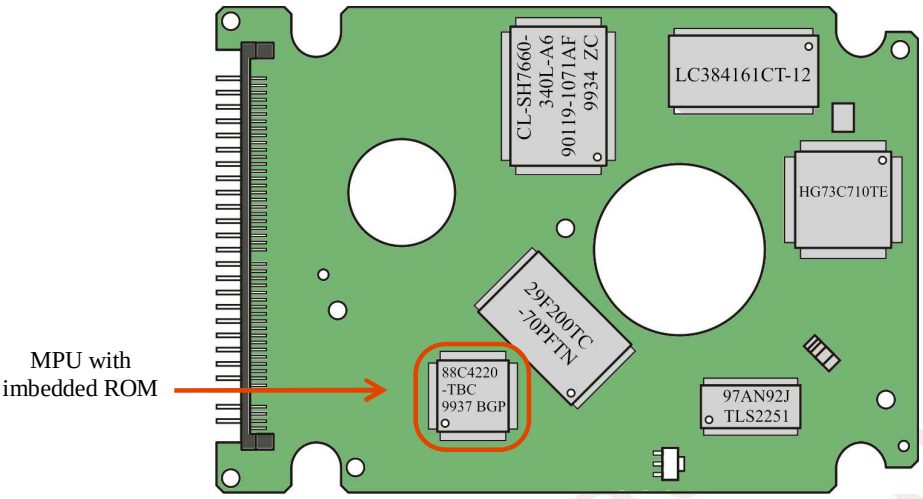

Fig. 12.1. DK23AA-60.

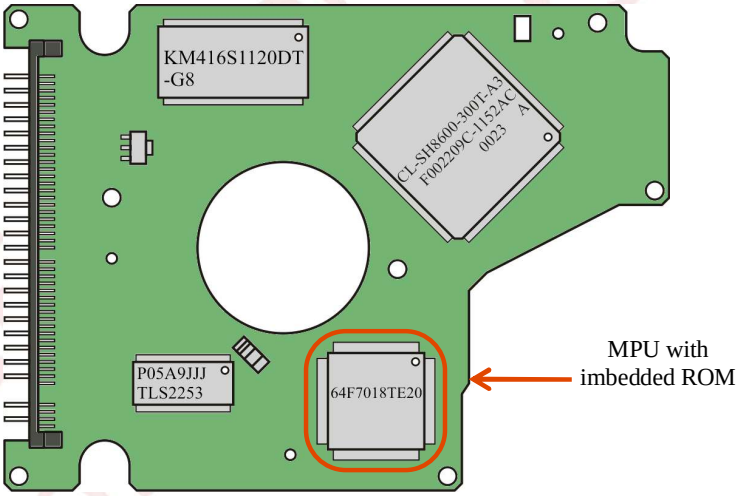

Fig. 12.2. DK23BA-20.

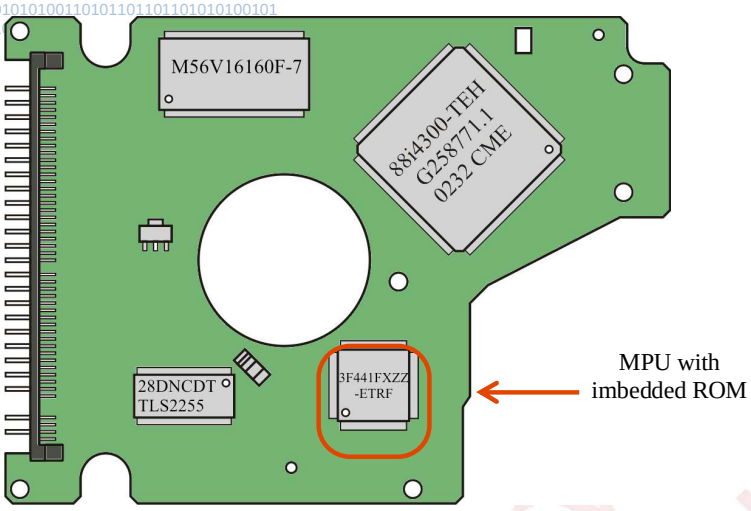

Fig. 12.3. DK23DA-20F.

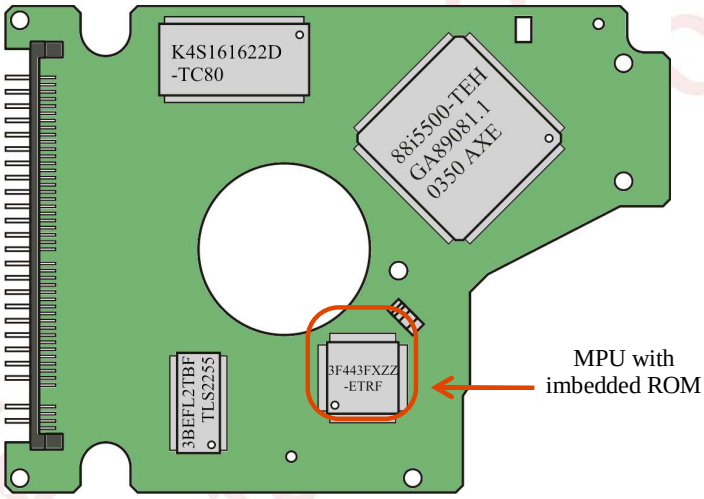

Fig. 12.4. DK23EA-40.

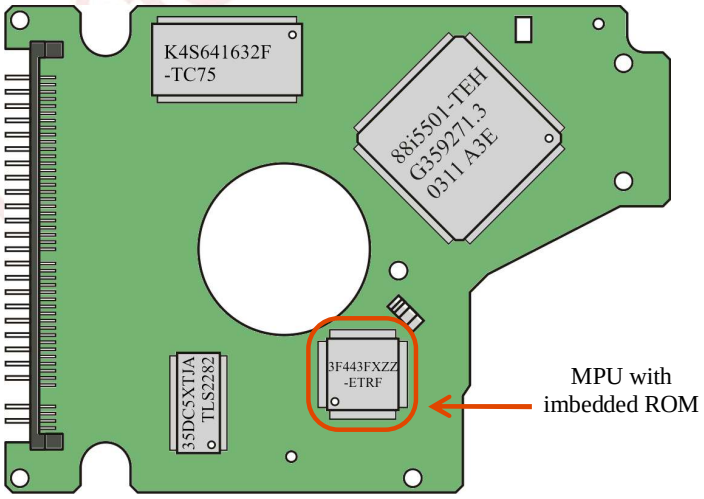

Fig. 12.5. DK23FB-40.

13. Appendix 2. Plugging a C4K60 Slim HDD with ZIF-connector to PC-3000 USB

1.8" models of HTC426060G8CE00, HTC426040G8CE00, HTC426030G5CE00, and HTC426020G5CE00 HDD belonging to the C4K60 Slim drive family are intended for use in portable devices (video cameras, audio players, etc.). Such drives use parallel ATA interface but they are equipped with a miniature ZIF plug, therefore connection to PC-3000 USB requires a 1.8" ZIF – 3.5" IDE adapter. The adapter is not included into the product package, but it is available for purchase over the Internet, for example, at one of the following web sites:

http://www.addonics.com/products/io/aaedt18ide25.asp

http://www.trademe.co.nz/Computers/Other/auction-197277974.htm

http://www.darkwire.com.au/html/zif_to_3_5__ide_adapter.html

Figure 13.1 demonstrates HDD connection to one of such adapters

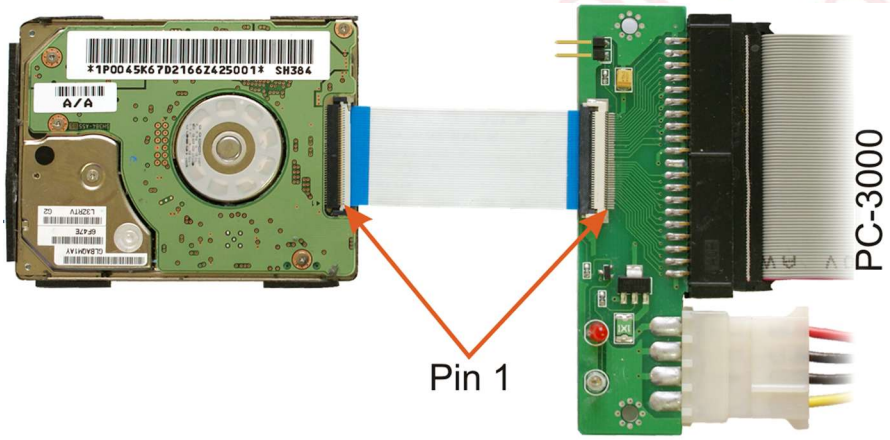

Fig. 13.1.

Some features of the utility require connection to the COM port established via the PC USB Terminal. Terminal connection is arranged by soldering wires between contacts 1 and 2 of the ZIF connector on the adapter and the 10-pin connector on the PC USB Terminal. The scheme for terminal connection is shown in the Figure 13.2.

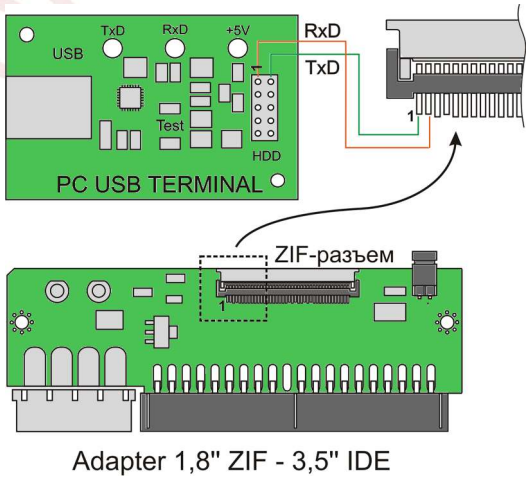

Fig. 13.2.